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ATCCIS WORKING PAPER 25

TECHNICAL STANDARDS FOR THE  
ATCCIS ARCHITECTURE

EDITION 2.0

L. B. Scheiber, *Project Leader*

August 1990

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Office of the Assistant Secretary of Defense (C<sup>3</sup>I)  
(Theater and Tactical Command, Control and Communications)  
*and*  
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| <b>13. ABSTRACT (Maximum 200 words)</b><br><br>This Paper is a reprint of a document prepared by IDA in support of the SHAPE-sponsored Army Tactical Command and Control Information System (ATCCIS) Phase II study effort. ATCCIS is a common army command and control system concept for the year 2000 and beyond. This report describes a methodology, using interoperability parameters, for identifying the technical standards that will be required to support implementation of the ATCCIS architecture and for assessing the degree to which existing and emerging international standards support ATCCIS requirements. Overviews are given of standards that have been recommended for NATO's Quadrilateral Interoperability Program, STAMINA, NATO's Air Command and Control System, UK GOSIP, US GOSIP, and several applications portability profiles. The methodology described in this report is intended to be a framework for addressing interoperability questions such as: is there adequate standards coverage, are there significant overlaps among standards, and how can standards be used to ensure interoperability. |   |   |   |  |
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October 19, 1990

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MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Technical Standards for the ATCCIS (Working Paper 25)

The Institute for Defense Analyses (IDA) has completed a review of technical standards applicable to future theater and tactical command and control systems. While scope of the IDA effort was on tactical command and control for the Year 2000 and beyond, this work appears to have potential interest for current and emerging information systems as well. The IDA paper provides an in-depth review of international and national, civil and military data communications standards that could be used to achieve interoperability and portability of systems. The methodology of the paper is based on interoperability parameters and is used to analyze the contents and relationships of open systems and other standards. This work supports OSD efforts to promote the use of civil standards, including GOSIP, to achieve open systems interconnection.

Attached is a copy of the standards analysis that has been completed under the Army Tactical Command and Control Information System (ATCCIS) Phase II program coordinated by my office in conjunction with the U.S. Army. ATCCIS is a SHAPE-sponsored study. The U.S. Army (ODISC4) provides the U.S. Delegate to ATCCIS and supports U.S. participation, including the IDA technical effort. Questions and requests for additional information can be directed to Dr. Robert P. Walker at IDA, 703-845-2462.

A handwritten signature in cursive script, reading "Richard G. Howe".

Richard G. Howe  
Director, Theater & Tactical C3

Attachment



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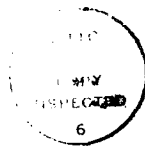
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L. B. Scheiber, *Project Leader*

R. P. Walker  
K. J. Saeger

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## FOREWORD

(U) This paper (IDA P-2459) is a major revision of Edition 1, ATCCIS Working Paper 25 (IDA M-519). In September 1988, SHAPE distributed Edition 1 for comment to the NATO nations and other interested agencies. IDA Paper P-2459 is a reprint of Edition 2 prepared by the Institute for Defense Analyses (IDA) in support<sup>1</sup> of the SHAPE-sponsored Army Tactical Command and Control Information System (ATCCIS) Phase II study effort. IDA P-2459 is being used to disseminate the Working Paper to US National Commands and Agencies. Additional data and analyses will be required to complete the assessments of options and standards coverage and to extend the interoperability parameter methodology.

(U) A draft of this paper (Version 1.2A, July 1989) was submitted to the US Military Communications Electronics Board (MCEB) for review and comment by DoD Services and Agencies. Comments and suggestions received from this review have been incorporated.

(U) Background information relating to the overall ATCCIS effort is contained in the Preface of this Working Paper. It should be noted that Oxford English spelling conventions are used throughout the paper in accordance with standing NATO guidelines.

(U) The Office of the Director of Information Systems for Command, Control, Communications, and Computers (ODISC4), Headquarters, Department of the Army, provides the US delegate to the ATCCIS PWG, which consists of military, technical, and analytical representatives from France, Germany, the United Kingdom, the United States, SHAPE, and observers from the Allied Forces Central Europe (AFCENT). The ATCCIS Steering Group provides overall direction and approval of the ATCCIS PWG work effort and includes representatives from the PWG nations and commands, plus Belgium, Canada, and the Netherlands, with additional representation (observers) from the Allied Data Systems Interoperability Agency (ADSIA), the NATO Communications and Information Systems Agency (NACISA), and the Tri-Service Group for Communications Electronic Equipment (TSGCEE). The Command and Control Division, US Army Combined Arms

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<sup>1</sup> (U) Working Paper 25 is being prepared in response to a request from the Office of the Assistant Secretary of Defense (C3I), Theater and Tactical Command, Control, and Communications under Contract MDA 903 84-C-0031, Task Order T-J1-246, UNCLASSIFIED.

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Combat Development Activity, provides military expertise; the US Army Communications-Electronics Command and IDA provide technical expertise, with additional support provided by the National Institute for Science and Technology (NIST); and IDA provides analytical expertise in support of the US contributions to the overall ATCCIS effort. Further details concerning the ATCCIS Phase II study can be found in the ATCCIS Work Plan.<sup>2</sup>

(U) This paper should be of primary interest to those Commands and Agencies whose focus is on the technical aspects of longer-term command and control requirements. Edition 2 of ATCCIS Working Paper 25 was reviewed by a panel of field-grade officers and senior scientists representing SHAPE, AFCENT, France, Germany, the United Kingdom, and the United States prior to its distribution by SHAPE.

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<sup>2</sup> (U) *ATCCIS Phase II Work Plan*, Edition 2, IDA Memorandum Report M-263, September 1986, UNCLASSIFIED.

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## PREFACE

1. (U) In 1978, NATO's Long-Term Defense Plan (LTDP) Task Force on Command and Control (C2) recommended that an analysis be undertaken to determine if the future tactical Automatic Data Processing (ADP) requirements of the nations, including that of interoperability, could be obtained at a significantly reduced cost when compared with the approach that had been adopted in the past. The Task Force also recommended that the analysis should determine whether tactical ADP systems could be developed according to technical standards prescribed by NATO and agreed upon by the nations.

2. (U) In early 1980 the then Deputy Supreme Allied Commander Europe initiated a study to investigate the possibilities of implementing the Task Force's recommendations. Three nations, those with experience in fielding automated tactical command and control information systems, participated in Phase I of the study, with Supreme Headquarters Allied Powers Europe (SHAPE) as leader and coordinator. The study group reported, at the end of Phase I, that the nations could increase interoperability and potentially reduce costs by using a common development approach. It was also recommended that Phase II, the definition of an operational and technical concept and an analysis of the likely impact of a common Central Region (CR) (tactical) command and control information system, should be initiated.

3. (U) The ATCCIS study, under the direction of a steering group chaired by SHAPE and consisting of representatives from the CR nations and Allied Forces Central Europe (AFCENT), was established in 1984. Concurrently, a permanent working group (PWG) was formed which consists of military, technical, and analytical representatives from France, Germany, the United Kingdom, the United States, SHAPE and AFCENT, and technical support from SHAPE Technical Centre (STC) to progress the Phase II effort. The Phase II study effort commenced in January 1985 and terminates in October 1990.

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**CONTENTS**

|  |    |
|--|----|
| 1. INTRODUCTION .....  | 1  |
| 1.1 Derivation .....   | 1  |
| 1.2 Purpose.....   | 1  |
| 1.3 Scope .....  | 1  |
| 1.4 Information Sources .....  | 2  |
| 1.5 Structure of the Paper.....  | 2  |
| 2. METHODOLOGY .....   | 5  |
| 2.1 Background for ATCCIS.....   | 5  |
| 2.1.1 Basic Facilities.....  | 6  |
| 2.1.2 Basic Interoperability .....   | 6  |
| 2.1.3 Features of the Architecture .....   | 6  |
| 2.2 Identification of Base Standards.....  | 7  |
| 2.3 Assurance of Coverage.....   | 7  |
| 3. OVERVIEW OF THE ASSESSMENT.....   | 9  |
| 3.1 Introduction .....   | 9  |
| 3.2 Relationship of ATCCIS Facilities to OSI Layers.....   | 11 |
| 3.2.1 Basic Options in OSI Standards.....  | 11 |
| 3.2.2 Application Options Applicable to the Basic Facilities and<br>to Enhanced Interoperability ..... | 13 |
| 3.2.3 Connection-Oriented and Connectionless-Oriented<br>Transmission Modes.....                       | 16 |
| 4. THE TRANSFER FACILITY (TF).....   | 21 |
| 4.1 Description of the TF .....  | 21 |
| 4.2 OSI Reference Model, Interworking, and Application Layer<br>Structure .....                        | 22 |
| 4.2.1 Status of OSI Reference Model, ISO 7498.....   | 22 |
| 4.2.2 Interworking of Layers in OSI.....   | 23 |
| 4.2.3 Application Layer Structure .....  | 24 |
| 4.2.4 Distributed Applications .....   | 27 |

**UNCLASSIFIED**

|       |   |    |
|-------|---|----|
| 4.3   | Standards Activities and Emerging Standards .....   | 28 |
| 4.3.1 | Base Standards and Stacks of Base Standards.....  | 30 |
| 4.3.2 | MHS and MOTIS .....   | 34 |
| 4.3.3 | File Transfer and Management (FTAM).....  | 36 |
| 4.3.4 | Directory.....  | 39 |
| 4.3.5 | Application Service Elements .....  | 43 |
| 4.3.6 | Abstract Syntax and Basic Encoding Rules .....  | 48 |
| 4.3.7 | Other Standards.....  | 49 |
| 4.4   | Assessment of Coverage by Standards .....   | 53 |
| 5.    | THE SERVICE CONTROL FACILITY (SCF).....   | 55 |
| 5.1   | Description of the SCF .....  | 55 |
| 5.2   | Standards to Support the SCF .....  | 55 |
| 5.2.1 | Portable Operating System Interface for Computer<br>Environments (POSIX).....                         | 55 |
| 5.3   | Standards Activities and Emerging Standards .....   | 58 |
| 5.4   | Options Within the Standards.....   | 60 |
| 5.5   | Assessment of Coverage by Standards .....   | 60 |
| 6.    | THE DATA MANAGEMENT FACILITY (DMF).....   | 61 |
| 6.1   | Description of the DMF .....  | 61 |
| 6.1.1 | Partitioned, Partially Replicated Database System.....  | 62 |
| 6.1.2 | Conceptual Schema .....   | 62 |
| 6.1.3 | Domains .....   | 62 |
| 6.1.4 | Required Services .....   | 63 |
| 6.2   | Standards to Support the DMF .....  | 64 |
| 6.2.1 | ISO Reference Model for Data Management .....   | 65 |
| 6.2.2 | Data Definition and Manipulation Language Standards .....   | 65 |
| 6.2.3 | Standards for Interfacing Data Definition and Manipulation<br>Languages to OSI Service Elements ..... | 67 |
| 6.2.4 | Information Resource Dictionary System (IRDS) Standards .....   | 70 |
| 6.2.5 | Conceptual Data Modelling Facility Standards.....   | 74 |
| 6.2.6 | Distributed Transaction Processing (TP) Standards.....  | 77 |
| 6.2.7 | Open Distributed Processing (ODP) Standards.....  | 80 |
| 6.3   | Other Standards Activities and Emerging Standards .....   | 81 |
| 6.4   | Options Within the Standards .....  | 82 |
| 6.5   | Data Element Standardization .....  | 82 |

**UNCLASSIFIED**

|       |  |     |
|-------|--|-----|
| 6.6   | Policy and Issues for Data Management.....         | 83  |
| 6.6.1 | Data Management Policy in NATO.....                | 83  |
| 6.6.2 | Data Management Issues in EDI.....                 | 88  |
| 6.6.3 | Data Management for Distributed Applications ..... | 88  |
| 6.7   | Assessment of Coverage by Standards .....          | 88  |
| 7.    | THE SYSTEM MANAGEMENT FACILITY (SMF).....          | 91  |
| 7.1   | Description of the SMF.....                        | 91  |
| 7.2   | Standards to Support the SMF .....                 | 91  |
| 8.    | STANDARDS FOR ALL BASIC FACILITIES .....           | 93  |
| 8.1   | Status of Standards for Security.....              | 93  |
| 8.1.1 | Overview of Civil and NATO Security Standards..... | 93  |
| 8.1.2 | Security Standards Work in ISO .....               | 94  |
| 8.1.3 | Security Standards Work in NATO.....               | 99  |
| 8.1.4 | Other Security Standards Work.....                 | 100 |
| 8.2   | Status of Standards for OSI Management .....       | 105 |
| 8.2.1 | Development of OSI Management Standards.....       | 106 |
| 8.2.2 | ISO Approach to OSI Management .....               | 106 |
| 8.2.3 | ISO Standards for OSI Management.....              | 110 |
| 8.2.4 | Telecommunication Management Network (TMN) .....   | 117 |
| 8.2.5 | Military Concerns in Network Management .....      | 118 |
| 8.2.6 | Quality of Service (QoS) .....                     | 118 |
| 8.2.7 | Special Interest Groups for OSI Management .....   | 121 |
| 8.3   | Standards for Registration Authorities.....        | 121 |
| 8.4   | Status of Standards for Conformance Testing .....  | 122 |
| 8.5   | Format Description Techniques (FDTs) .....         | 126 |
| 8.5.1 | Estelle.....                                       | 126 |
| 8.5.2 | LOTOS .....  | 127 |
| 8.5.3 | SDL.....   | 128 |
| 8.5.4 | G-LOTOS.....                                       | 128 |
| 9.    | STANDARDS FOR ENHANCED INTEROPERABILITY .....      | 129 |
| 9.1   | Enhanced Interoperability .....                    | 129 |
| 9.2   | Standards for Enhanced Interoperability.....       | 129 |



**UNCLASSIFIED**

9.2.1 Operating System Standards ..... 130

9.2.2 Terminal and Human-Computer Interface (HCI) Standards ..... 131

9.2.3 Graphics Interchange Standards..... 138

9.2.4 Geographic Information Exchange and Data Compression Standards..... 141

9.2.5 Standards for Document Interchange Formats..... 144

9.2.6 Open Distributed Processing (ODP) ..... 148

9.2.7 Programming Service Standards ..... 148

9.2.8 Software Environment..... 153

9.2.9 Document and File Transfer Standards ..... 155

9.2.10 Job Transfer and Manipulation (JTM) ..... 157

9.3 Profiles of OSI Standards ..... 158

9.3.1 NATO Functional Profiles ..... 158

9.3.2 International Standardized Profiles (ISPs) ..... 158

9.3.3 U.K. and U.S. GOSIP..... 163

9.3.4 European Procurement Handbook for Open Systems (EPHOS) .... 166

9.3.5 International Versions of GOSIP..... 167

9.3.6 Workshops Promoting OSI ..... 167

9.4 Standards for Application Portability ..... 167

9.4.1 Example Model for the Open Systems Environment..... 167

9.4.2 Interfaces for Applications Portability (IAP)..... 167

9.4.3 X/Open Common Applications Environment (CAE)..... 170

9.4.4 NIST Applications Portability Profile..... 173

9.4.5 Open Software Foundation (OSF) Profiles ..... 177

9.4.6 Technical and Office Protocol (TOP) ..... 177

9.5 Other Profiles and Transition Strategies ..... 179

10. STATUS OF NATO OSI DATA COMMUNICATIONS STANDARDS ..... 181

10.1 Introduction ..... 181

10.2 Military Requirements for NATO OSI..... 181

10.3 Organizational Responsibilities--TSGCEE Subgroup 9 ..... 184

10.3.1 NTIS Transition Strategy ..... 187

10.3.2 Status of Activities and Plans for Developing Lower Layer OSI STANAGs ..... 188

10.3.3 Status of Activities and Plans for Developing Upper Layer OSI STANAGs ..... 192

**UNCLASSIFIED**

|        |  |     |
|--------|--|-----|
| 10.3.4 | Nunn Initiatives and Work Plan of WG3 .....  | 194 |
| 10.3.5 | Status of Activities and Plans for Developing Network Management Standards .....                         | 199 |
| 10.3.6 | AHWG on ISDN .....   | 201 |
| 10.3.7 | AHWG on Security .....   | 204 |
| 10.3.8 | Status of Activities and Plans for Developing the Military Message Handling System (MMHS) for NATO ..... | 206 |
| 10.4   | Status of NATO OSI STANAGs .....   | 210 |
| 10.4.1 | Physical Layer STANAGs .....   | 212 |
| 10.4.2 | Data Link Layer STANAGs .....  | 213 |
| 10.4.3 | Network Layer STANAGs .....  | 214 |
| 10.4.4 | Transport Layer STANAGs .....  | 218 |
| 10.4.5 | Session Layer STANAGs .....  | 220 |
| 10.4.6 | Presentation Layer STANAGs .....   | 221 |
| 10.4.7 | Application Layer STANAGs .....  | 222 |
| 10.5   | Development of Other Technical STANAGs .....   | 223 |
| 10.5.1 | Network Independent Interface (NIIF) .....   | 223 |
| 10.5.2 | Lightweight Protocols .....  | 226 |
| 10.5.3 | EUROCOM and US/EURCOM .....  | 226 |
| 10.5.4 | Other Efforts .....  | 228 |
| 10.6   | Findngs .....  | 228 |
| 11.    | NEAR-TERM APPROACHES FOR ACHIEVING INTEROPERABILITY IN NATO .....  | 229 |
| 11.1   | NATO C3 Master Plan and Architecture .....   | 230 |
| 11.2   | ACE ACCIS .....  | 230 |
| 11.3   | Air Command and Control System (ACCS) .....  | 231 |
| 11.4   | Battlefield Information Collection and Exploitation Systems (BICES) .....                                | 234 |
| 11.5   | NATO Maritime Operational Intelligence Support (NMOS) .....  | 235 |
| 11.6   | Quadrilateral Interoperability Programme .....   | 235 |
| 11.7   | Standard Automated Message Interface for NATO's ACCISs (STAMINA) .....                                   | 237 |
| 11.7.1 | STAMINA Application Profile .....  | 238 |
| 11.7.2 | STAMINA Transport Profiles .....   | 240 |
| 11.7.3 | STAMINA Development Activities .....   | 241 |

**UNCLASSIFIED**

12. CONCLUSIONS AND RECOMMENDATIONS ..... 245

    12.1 OSI Technical Standards ..... 246

    12.2 Other Technical Standards..... 247

    12.3 Recommendations..... 248

Appendix A The Use of Interoperability Parameters to Ensure Standards Coverage..... A-1

Appendix B Functional Profiles Identified in the NTIS Transition Strategy..... B-1

Appendix C National Initiatives for Military Use of OSI Standards..... C-1

Appendix D International Standards Relevant to ATCCIS..... D-1

Appendix E Numerical Listing of ISO Standards Relevant to ATCCIS ..... E-1

Appendix F Organizations for Standardization..... F-1

Appendix G Status of Open Systems Standards Development in ISO/IEC ..... G-1

Appendix H International Military and Other Standards for Open Systems..... H-1

Appendix I Background, Objective, and Statement of Work..... I-1

Appendix J Distribution List ..... J-1

References .....References-1

Glossary .....Glossary-1

Index .....Index-1

**UNCLASSIFIED**

**LIST OF FIGURES**

|  |     |
|--|-----|
| 1. Organization of Working Paper 25 .....  | 3   |
| 2. Overview of the Methodology .....   | 5   |
| 3. Classes of Standards and Their Relation to ATCCIS Facilities.....                                 | 10  |
| 4. The Seven-Layer Model for Open Systems Interconnection.....                                       | 11  |
| 5. Composition of an OSI System .....  | 12  |
| 6. The Role of a Relay .....   | 12  |
| 7. Standards Applicable to the Basic Facilities and to Applicable<br>Enhanced Interoperability ..... | 15  |
| 8. Facilities of the ATCCIS Architecture .....   | 21  |
| 9. Stacks of Standards for Application and Transport Options .....                                   | 29  |
| 10. Application Functional Profiles.....   | 107 |
| 11. Taxonomy for International Standard Transport Profiles .....                                     | 161 |
| 12. Stacks of Standards Recommended for U.K. GOSIP.....  | 164 |
| 13. Stacks of Standards Recommended for U.S. GOSIP .....   | 165 |
| 14. A Model for the Open Systems Environment.....  | 169 |
| 15. An Example View of the Architecture for the Applications Portability Profile..                   | 174 |
| 16. Overview of Standards Applicable to the ATCCIS Architecture .....                                | 245 |

**UNCLASSIFIED**

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**UNCLASSIFIED**

**UNCLASSIFIED**

**LIST OF TABLES**

|     |   |     |
|-----|---|-----|
| 1.  | Application, Transport, and Relay Options Offered by OSI Standards.....   | 14  |
| 2.  | Upper-Layer Stacks of Base Standards for Application Options.....   | 31  |
| 3.  | Lower-Layer Stacks of Base Standards for Transport Options.....   | 32  |
| 4.  | Stacks of Base Standards for Relay Options.....   | 33  |
| 5.  | Base Standards for Message Management .....   | 35  |
| 6.  | POSIX Standards Being Developed by the IEEE Computer Society,<br>Technical Committee on Operating Systems for Submission to ISO<br>Through ANSI ..... | 56  |
| 7.  | New Work Items Proposed in ISO for TP.....  | 78  |
| 8.  | Excerpts from the 1990 Draft Statement by NACISA<br>on the Requirement for Data Management .....  | 85  |
| 9.  | Data Management Requirements Identified in ISO Relating to<br>Data Structures and Data Models.....  | 89  |
| 10. | OSI Security Framework--DP 10181.....   | 95  |
| 11. | Security Protocols Developed in SDNS.....   | 101 |
| 12. | Definitions of OSI Management Functions from DIS 10164.....   | 116 |
| 13. | Overview of Taxonomy for International Standardized Profiles .....  | 159 |
| 14. | Standards for the Applications Portability Profile.....   | 175 |
| 15. | Applications Portability Standards Being Developed by IEEE for<br>Submission to ISO Through ANSI .....  | 176 |
| 16. | Standards for TOP Version 1.0 .....   | 178 |
| 17. | Standards for TOP Version 3.0 .....   | 179 |
| 18. | Standards for COSINE Profiles.....  | 180 |
| 19. | Eight Military Features for Enhancing OSI in NATO.....  | 182 |
| 20. | Impact of Military Features on Layers of OSI Reference Model .....  | 183 |

**UNCLASSIFIED**

|     |  |     |
|-----|--|-----|
| 21. | Proposed Revised Military Features .....                               | 184 |
| 22. | Proposed Revised Special Tasking Instructions for TSGCEE SG9 .....     | 186 |
| 23. | Proposed New Emphases for TSGCEE SG9 Work on Military Features .....   | 190 |
| 24. | Work Plan and Activities on Lower Layer STANAGs by WG1 .....           | 192 |
| 25. | Work Plan and Activities on Upper Layer STANAGs by WG2 .....           | 195 |
| 26. | Proposed Work Areas for CSNI in WG3.....                               | 198 |
| 27. | Initial Approach to Military Features for ISDN.....                    | 201 |
| 28. | Military Features for ISDN .....                                       | 202 |
| 29. | Initial Draft Proposed Work Plan and Activities on ISDN .....          | 204 |
| 30. | Work Plan for AHWG on Security .....                                   | 206 |
| 31. | Work Plan and Activities on MMHS .....                                 | 209 |
| 32. | NATO OSI Standards .....   | 211 |
| 33. | Areas of Deficiencies for STANAG 4253.....                             | 215 |
| 34. | Military Enhancements Identified for Annex C of STANAG 4263 .....      | 217 |
| 35. | Deficiencies and Enhancements Identified for STANAG 4254.....          | 219 |
| 36. | Deficiencies and Enhancements Identified for STANAG 4264.....          | 220 |
| 37. | Status of X.400(MHS)-1988 Relative to the Eight Military Features..... | 224 |
| 38. | Standards for Quadrilateral Interoperability Programme .....           | 237 |
| 39. | Military Features Added to the STAMINA Specification.....              | 239 |
| 40. | Standards for STAMINA Transport Profiles .....                         | 241 |

**ATCCIS Working Paper 25**

**TECHNICAL STANDARDS FOR THE  
ATCCIS ARCHITECTURE**

**1. INTRODUCTION**

**1.1 Derivation**

(U) This paper derives from Working Papers (WPs) 22, 23, and 24 [Ref. 1-3]. WP 22 defines the basic concepts necessary for the definition of the architecture for the Army Tactical Command and Control Information System (ATCCIS), a common army command and control system concept for the year 2000 and beyond. WP 23 defines the ATCCIS services needed to meet the imposed military requirements. WP 24 specifies an architecture designed to satisfy the ATCCIS operational requirements.

**1.2 Purpose**

(U) The purpose of this working paper is to identify the technical standards that will be required to support implementations of the ATCCIS architecture. In this working paper, existing and planned standards appropriate to the ATCCIS facilities are surveyed to the level of detail necessary to confirm a reasonable basis for the future support of the ATCCIS requirements. Relevant standards are identified, but no recommendations for selecting standards are considered. Gaps in current and planned standards coverage, which may require some developmental effort, are identified and will be passed to the appropriate standards defining body within NATO. WP 25 also offers guidance in ensuring adequate coverage by the set of standards employed at the time of implementation.

**1.3 Scope**

(U) This working paper presents information and analyses that are intended to support implementation of the ATCCIS architecture, especially of that minimum part of ATCCIS functionality called basic interoperability (defined in WP 23). WP 25 provides a broad overview of the existing and developing technical standards applicable to ATCCIS.

(U) The scope of the analysis of standards, which is the focal point of this paper, is broad, extending to international and national, commercial and military standards.



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However, the emphasis is on international commercial standards with military enhancements.

### 1.4 Information Sources

(U) This assessment is based primarily on a review of standards for open systems developed by the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Telegraph and Telephone Consultative Committee (CCITT). Since ISO/IEC has decided to use the profiles of standards being developed by regional standards workshops, the primary sources for profiles are those workshops. Use of open systems standards in NATO is the responsibility of the Tri-Service Group on Communications and Electronic Equipment (TSGCEE) Subgroup 9 (SG9) on Data Processing and Distribution; thus, TSGCEE SG9 draft STANAGs, *NATO Technical Interface Standards (NTIS) Transition Strategy* [Ref. 4], and working documents form the basis of the assessment of military use of open systems standards.

(U) The cut off date for information contained in Edition 2 of WP 25 is July 1990. The primary impact of early publication is that the progression of some standards to committee draft (CD), draft international standard (DIS), and international standard (IS or ISO) status may not be fully reflected herein.<sup>1</sup>

### 1.5 Structure of the Paper

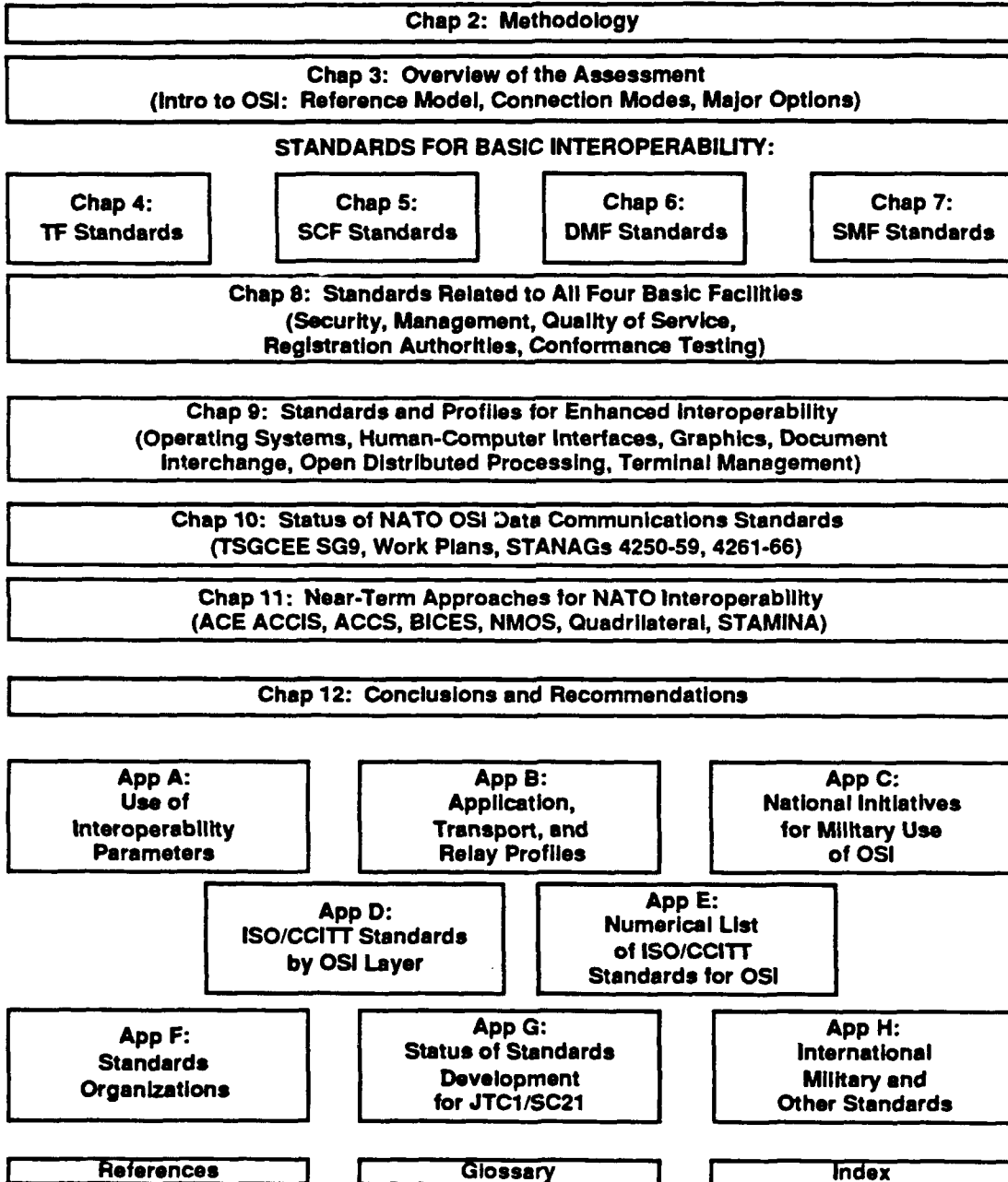
(U) Chapter 2 describes the methodology employed in WP 25 to identify and analyse standards relevant to ATCCIS. This methodology includes the use of interoperability parameters to specify options and choices within the standards. Chapter 3 provides an overview of the assessment and includes a description of the reference model for open systems interconnection (OSI) that is the basis for most of the current international commercial data communications standards activities. Chapter 3 also identifies the key elements of the ATCCIS architecture, namely the four facilities that make up the Basic Ensemble for ATCCIS: Transfer Facility (TF), Service Control Facility (SCF), Data Management Facility (DMF), and System Management Facility (SMF). Analyses of the applicable standards for these four facilities are presented in Chapters 4-7, respectively. Technical standards that potentially apply to all four facilities are reviewed in Chapter 8. Such standards include security and OSI management.

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<sup>1</sup> (U) Significant contributions have been received from representatives to TSGCEE, the British Standards Institute (BSI), the American National Standards Institute (ANSI), the National Institute of Standards and Technology (NIST), OMNICON, and Technology Appraisals.

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(U) Figure 1 identifies the roles of each of the chapters. Chapters 4-8 address basic interoperability. Chapters 2 and 3 are essential to understanding the assessment, but the remaining chapters are generally independent and can be read in any order.



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*Figure 1. (U) Organization of Working Paper 25*

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(U) Chapter 9 discusses technical standards that would appear to go beyond those required to achieve basic interoperability and would therefore be applicable to enhanced interoperability. Specifically, Chapter 9 discusses standards that could be considered for operating systems, human-computer interfaces (HCIs), graphics, document interchange, distributed transaction processing (TP), open distributed processing (ODP), and terminal management (TM). Standards for some of these areas go beyond the OSI Reference Model. Further, Chapter 9 identifies some of the profiles recommended by international and national standards bodies for applications portability and interoperability of similar products by different vendors.

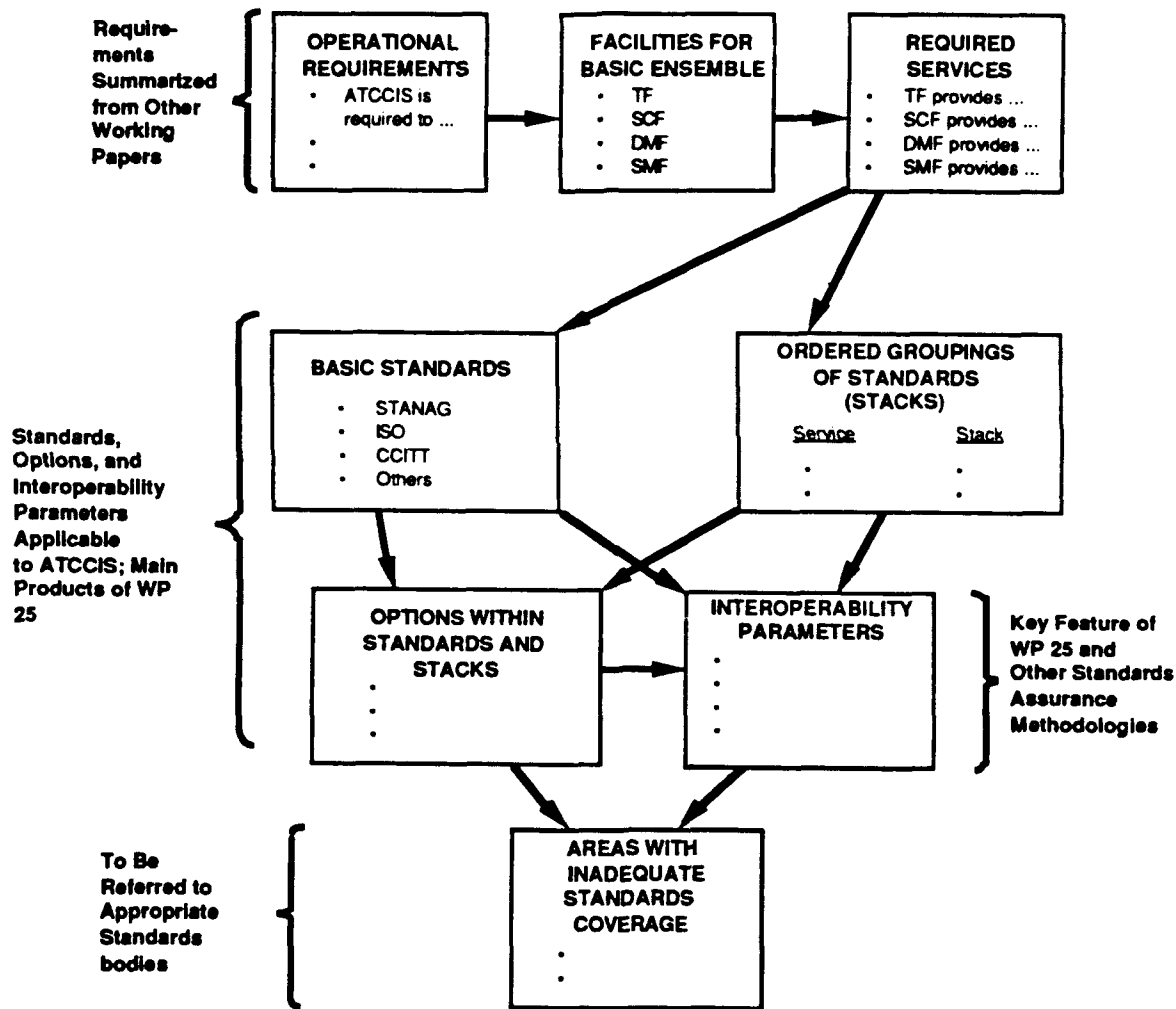
(U) Chapter 10 provides a review of the plans by NATO bodies to specify standards and military enhancements to international commercial technical standards for OSI. A detailed review of the NATO OSI data communication Standardization Agreements (STANAGs) being developed by TSGCEE is included in Chapter 10. A review of six NATO projects is provided in Chapter 11, which identifies the standards to be used for interoperability. Conclusions and recommendations of this study are given in Chapter 12.

(U) Several appendixes, some lengthy, are provided as reference material. Appendix A expands the discussion of the interoperability parameter methodology and applies the approach to some commonly used standards (RS-232, RS-423, STANAG 4202, and CCITT X.25). Appendix B summarizes the application, transport, and relay functional profiles identified for use in NATO. Appendix C provides examples of TSGCEE SG9 and national initiatives to address the military use of OSI standards. A compilation of technical standards being developed by ISO and CCITT is given in Appendixes D and E, the former listed by layer of the OSI Reference Model and the latter listed numerically. Appendix F identifies the role and (in some cases) the standards responsibility of international and national, both civil and military, standards bodies. Appendix G provides some detailed information on the work plans for one of the major subcommittees (SC21) of the Joint Technical Committee Number 1 (JTC1) of ISO and IEC. Finally, Appendix H identifies STANAGs and other military and commercial standards being developed for use in open systems.

2. METHODOLOGY

2.1 Background for ATCCIS

(U) This chapter describes the methodology employed to identify the group of existing and planned standards required to support ATCCIS functionality and to assess the completeness of standards coverage for the time period of ATCCIS implementation. The methodology is illustrated in Figure 2.



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Figure 2. (U) Overview of the Methodology

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### 2.1.1 Basic Facilities

(U) WP 24 identifies the ATCCIS architecture in terms of facilities whose combined functionality fulfills the ATCCIS operational requirements. The Basic Ensemble, which provides the minimum required operational capability (called basic interoperability), is composed of four facilities, each analysed individually in subsequent chapters:

- (1) Transfer Facility (TF). The TF provides functionality to allow different parts of an ATCCIS system, or two ATCCIS systems, to invoke services one from another. TF includes data transfer protocols, services of the communications infrastructure, and services to manage data transfer and communications (see Chapter 4).
- (2) Service Control Facility (SCF). The SCF provides functionality to control interactions among all other ATCCIS facilities (see Chapter 5).
- (3) Data Management Facility (DMF). The DMF provides functionality to ensure the proper management of data, and to ensure that there is a consistent representation of data and data relationships across all ATCCIS-conformant systems (see Chapter 6).
- (4) System Management Facility (SMF). The SMF provides functionality supplementary to the management services of the TF and DMF for control of part or all of an ATCCIS system (see Chapter 7).

The Basic Facilities provide the three mechanisms necessary for basic interoperability: providing end-to-end transfer of data; managing the storage, retrieval, and interpretation of data; and managing these mechanisms as the minimum capability to support basic interoperability.

### 2.1.2 Basic Interoperability

(U) Basic interoperability is the capability to allow two systems to exchange data and to preserve the meaning and relationships of the data exchanged. Capabilities, such as portability of applications software, that support a more general concept of interoperability constitute enhanced interoperability. The focus of this working paper is on basic interoperability and, therefore, on the technical standards applicable to the four Basic Facilities.

### 2.1.3 Features of the Architecture

(U) ATCCIS technical analyses have concluded that an ATCCIS-conformant system must be a transaction processing system with a partitioned, partially replicated database capable of supporting applications and maintaining the capability for consistent interpretation of the data across organizational boundaries (see Section 6.1.1).

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(U) The ATCCIS architecture will be defined by adopting existing or emerging standards wherever and whenever possible. Further, when such a standard cannot be found ATCCIS will identify the requirement for a standard to be developed and will pass such a requirement to the appropriate standards defining body within NATO. Each facility in the ATCCIS architecture is a logical entity that provides a set of related services; implementation of a facility is not defined by the architecture and is a national responsibility for each system. This paper identifies standards (and options within standards) that are applicable to each facility, but the paper does not recommend any specific standard or groups of standards. Selection of appropriate standards, as well as the basic design choices implicit in the standards and options within standards, will be made by agreement prior to implementation decisions.

### 2.2 Identification of Base Standards

(U) Following a review of the required services for each facility, the next step is to identify the base standards appropriate for that facility. These standards may come from international, NATO, national military, or national non-military standards bodies, and they may be existing or planned. High-level options within standards applicable to ATCCIS are identified.

(U) For many functions, there are several interrelated standards that must be used together to provide the required services. In most cases there is an order or hierarchy among these standards in which the lower levels are closer to physical means, and higher levels are associated with applications that are independent of the physical means. An ordered grouping of standards is called a stack. A profile is a stack of standards for which the interoperability parameters are partially or fully specified (profiles usually represent agreements among implementors). Where applicable to services required by ATCCIS, stacks will be constructed and illustrated in tables or figures.

### 2.3 Assurance of Coverage

(U) Assurance of adequate standards coverage is addressed in three ways. First, WP 25 checks for the existence of standards that generally support each specific ATCCIS function. Requirements for which no existing or planned standard seems to exist, or for which existing standards do not seem to be adequate, are identified so that these needs may be referred to the appropriate NATO standards defining body.

(U) On a more specific level, a methodology for assuring adequate standards coverage through detailed analysis has been developed. An interoperability parameter approach is defined that begins with the identification of the system design parameters

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whose control is required to achieve interoperability. The assembled parameters act as a checklist for interoperability since each interoperability parameter must be controlled by a suitable standard. The purpose of an analysis using interoperability parameters is to recognize and examine all relevant quantities and characteristics in a direct manner, instead of assuming that existing or draft standards will provide adequate coverage of the quantities. Appendix A discusses this approach in more detail. NATO's TSGCEE Subgroup 9 (SG9) has developed a format, called a functional profile, for specifying stacks and interoperability parameters. Functional profiles are discussed in Section 9.3, and examples are provided in Appendix B.

(U) In the third step of the coverage analysis, the array of standards identified that could support ATCCIS is compared with plans for near-term efforts to check for completeness. Near-term efforts include: developing NATO C2 systems, such as the Air Command and Control System (ACCS); conducting multilateral interoperability demonstrations, such as the Quadrilateral Interoperability Programme (QIP); and harmonizing the standards and stacks recommended by several national agencies, such as government open systems interconnection profiles (GOSIPs) and applications portability profiles recommended by international consortia such as X/Open. National initiatives for military use of OSI standards are reviewed in Appendix C. In addition to providing a check on completeness of ATCCIS applicable standards, some of these near-term efforts are of interest because they represent transition strategies for moving to open environments for information processing and exchange.

### 3. OVERVIEW OF THE ASSESSMENT

#### 3.1 Introduction

(U) One of the underlying principles for the ATCCIS concept is that specifying standards is essential to ensuring interoperability. However, it cannot be emphasized too strongly that specifying standards alone will not guarantee interoperability. Indeed, every standard has a number of system and design parameters or interoperability parameters whose values may need to be fixed in the design phase of implementation. To ensure interoperability, each of these interoperability parameters must also be specified and controlled. Some interoperability parameters are very general and may be used to specify a class of options or mode of operation. Other interoperability parameters may be very detailed, such as restrictions on timing, format size, or bandwidth.

(U) Because each standard is a reflection of the degree to which agreement can be reached in a service area, many important attributes (i.e., interoperability parameters) are often left unspecified or unaddressed. As agreements are reached over time, the standards will improve by addressing more functionality and harmonizing conflicting approaches. In cases where standards identify extensions and other types of options, great care must be taken in standards specification and interoperability parameter control to ensure that whenever an extension or option is permitted, every implementation of the related service also supports this extension or option. This principle is especially important in achieving not only interoperability but also portability of applications from one environment or implementation to another, such as is needed when operating systems, data management systems, interface packages, and hardware are upgraded.

(U) There are three major classes of standards applicable to ATCCIS:

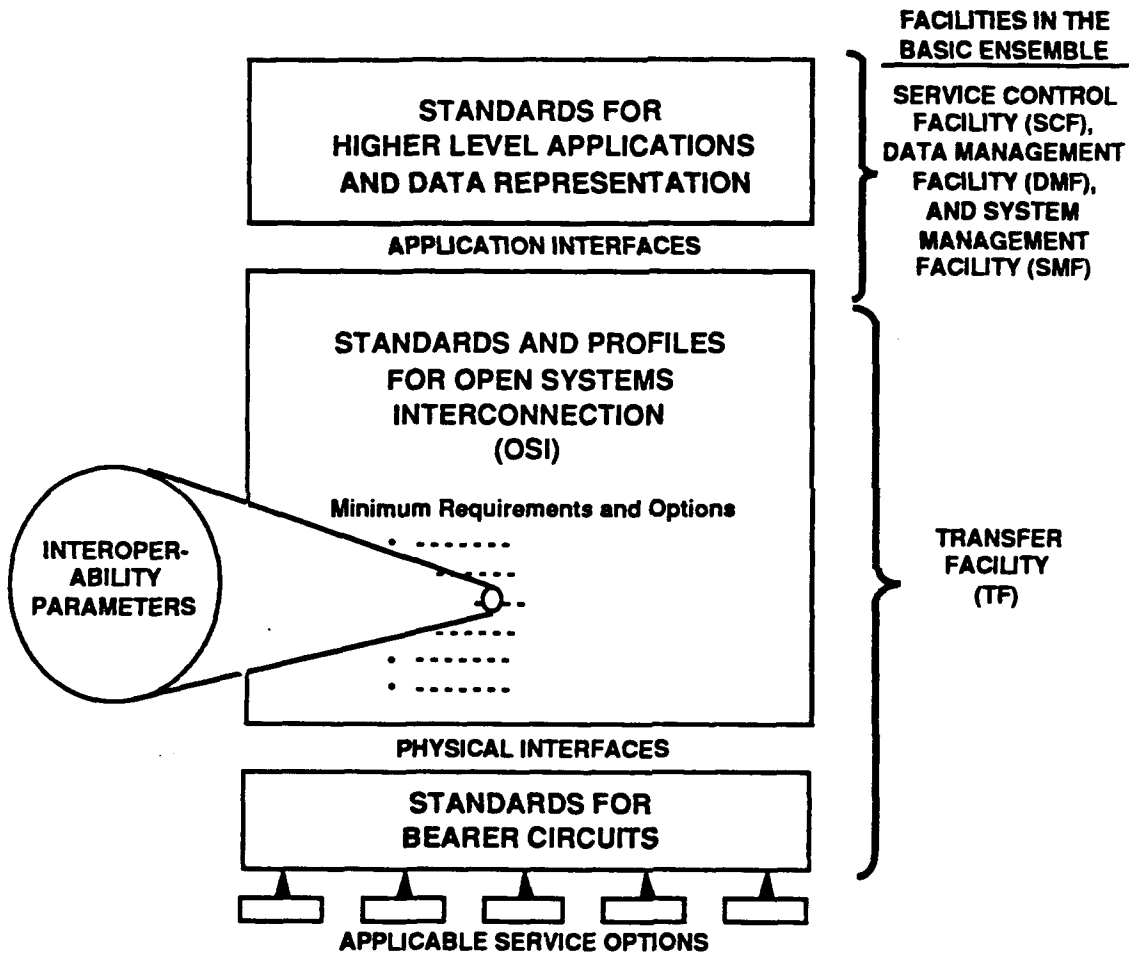
- Standards for bearer circuits
- Standards and profiles for OSI
- Standards for higher level applications and data representation.

The classes are shown in Figure 3. Interoperability parameters will be drawn from all three classes of standards, both from the minimum requirements and from the options within the standards. As will be shown in subsequent chapters, the TF requires standards in the first two classes, whereas the other three facilities in the Basic Ensemble (SCF, DMF, and SMF) are addressed primarily by standards for higher level applications and data representation. One of the layers of OSI standards (the application or highest layer) has standards not only for the TF but also for the other three facilities. Although not indicated in Figure 3, there is a potential overlap among the standards applicable for the TF and those



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for the other facilities. Further, Figure 3 does not explicitly identify higher-level functional or military applications that go beyond basic interoperability and may be implemented by some or all of the ATCCIS components. Whenever possible, diagrams such as the one in Figure 3 will be provided to show which standards are required for each of the applicable service options and profiles; in some cases, the service options will be identified at the bottom of the diagram. Ordered groupings or stacks of standards for a particular service will also be shown by connecting blocks of standards with solid vertical lines.



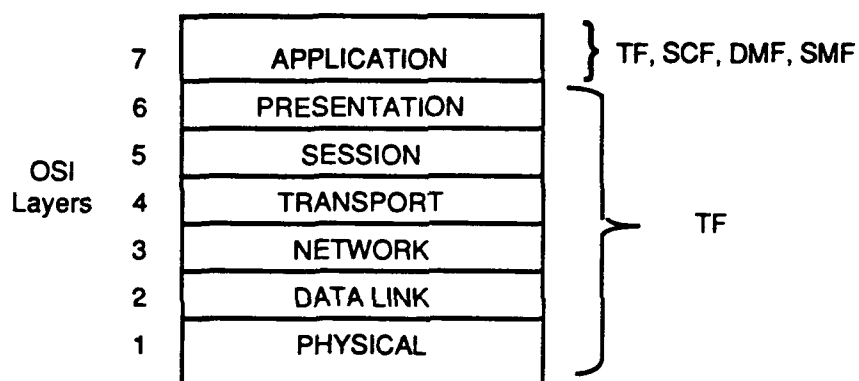
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*Figure 3. (U) Classes of Standards and Their Relation to ATCCIS Facilities*

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**3.2 Relationship of ATCCIS Facilities to OSI Layers**

(U) The first step of the analysis consists of the classification of the facility of interest in terms of the OSI Reference Model developed by ISO. In this model, the functions required for interoperation between data processing systems are divided into seven layers [Fig. 4]. Layers 1-4 are called the lower layers and are primarily concerned with control of the data transmitted between data processing systems. The Physical Layer (Layer 1) controls data transmission over physical media (e.g., wire). The Data Link Layer (Layer 2) augments the Physical Layer function by providing transmission error control along segments of the transmission network. The Network Layer (Layer 3) controls the data transmission route. The Transport Layer (Layer 4) provides protocols for moving data between end systems on the network.



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*Figure 4. (U) The Seven-Layer Model for Open Systems Interconnection*

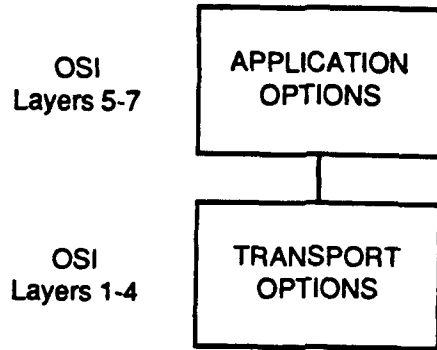
(U) Layers 5-7 are called the upper layers and are concerned with the network's interface to the end systems. The Session Layer (Layer 5) establishes a logical connection between communicating end systems. The Presentation Layer (Layer 6) ensures that data from the network is presented to the user in an intelligible form. The Application Layer (Layer 7) provides services to the application programs that may request support from other systems on the network in order to complete their user-dictated tasks.

**3.2.1 Basic Options in OSI Standards**

(U) Options for international standards that support the OSI model are often designated by grouping the OSI layers into two classes: application options and transport options [Fig. 5]. Using the definitions of Reference 4, the combined Layers 5-7

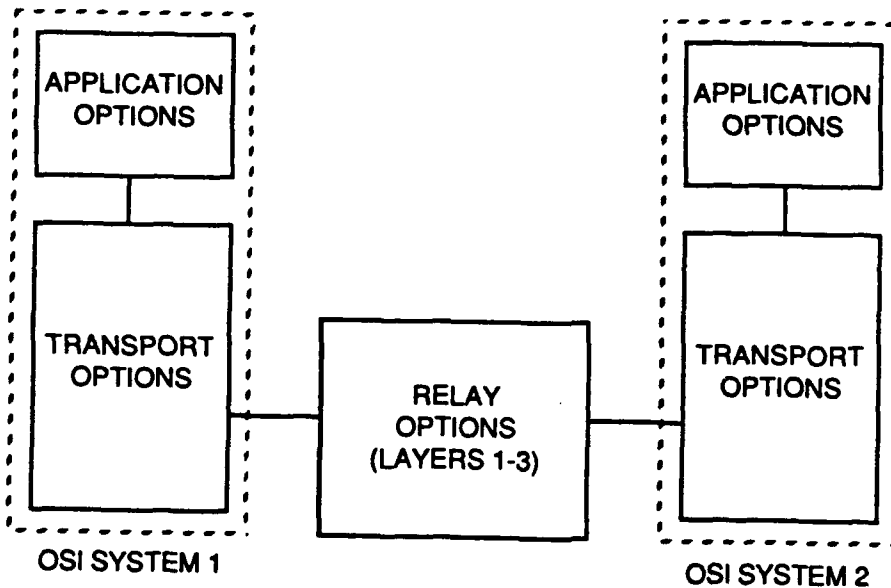
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will be considered to offer application options, while Layers 1-4 offer transport options. A separate category of relay options that provides interfaces between subnetworks will also be considered. Relay options normally are provided by Layers 1-3 [Fig. 6]. Examples of these options are illustrated in Appendix B.



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*Figure 5. (U) Composition of an OSI System*



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*Figure 6. (U) The Role of a Relay*

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(U) OSI standards are being developed through ISO and CCITT. ISO/IEC JTC1 was formed to progress international standards on information processing.<sup>2</sup> Study Committee 21 (SC21), Standardization on Information Retrieval, Transfer, and Management for Open Systems Interconnection, is responsible for OSI upper layer standards. There are three stages for development of ISO standards. Results of a working group are issued as a Committee Draft (CD), formerly a Draft Proposal (DP). When approved by the cognizant subcommittee (e.g., SC21), the standard is issued as a Draft International Standard (DIS). When approved (unanimously, if possible) by a technical committee (e.g., JTC1), it is issued as an International Standard (IS or ISO). The CCITT has ongoing study groups that issue new and revised standards every 4 years. CCITT standards issued in 1984 are known as the "red" books; the 1988 standards have blue covers (the "blue" books).

(U) The major application, transport, and relay options in OSI being developed by ISO, IEC, and CCITT are listed in Table 1. The transport and relay options are addressed in Chapter 4 on the Data Management Facility. The application options are briefly addressed below and discussed more fully in Chapters 4-9.

### 3.2.2 Application Options Applicable to the Basic Facilities and to Enhanced Interoperability

(U) The top portion of Figure 7 identifies the application options applicable to the Basic Facilities and the chapters that discuss each of these options.

(U) Each of the following standards appears to be applicable to the Transfer Facility: Message Handling System (MHS), File Transfer and Management (FTAM); Directory; Application Service Elements (ASEs) such as the Reliable Transfer Service Element (RTSE), the Association Control Service Element (ACSE), and the Remote Operations Service Element (ROSE); and all the OSI standards at Layers 1 to Layer 6. The only standard applicable to the Service Control Facility is the Portable Operating System Interface for Computer Environments (POSIX). Standards applicable to the Data Management Facility are the Database Languages NDL and SQL; Remote Data Access (RDA); ASEs such as ROSE and Commitment, Concurrency, and Recovery Control (CCR); Information Resource Dictionary System (IRDS); distributed Transaction Processing (TP), and Open Distributed Processing (ODP). Standards applicable to the System Management Facility are still to be determined (TBD).

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<sup>2</sup> (U) JTC1 replaced ISO Technical Committee 97, Information Processing Systems.

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*Table 1. (U) Application, Transport, and Relay Options  
Offered by OSI Standards*

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**BASIC APPLICATION OPTIONS**

**Primary Services:**

**Message Handling:**

Message Handling Service (MHS) [CCITT]

Message-Oriented Text Interchange System (MOTIS) [ISO]

File Transfer Access and Management (FTAM)

Telematic Services (Teletex, Telefax, Textfax)

Virtual Terminal (VT)

Job Transfer and Manipulation (JTM)

**Other Services:**

Directory

Transaction Processing (TP)

Open Distributed Processing (ODP)

Remote Data Access (RDA)

OSI Management

Application Service Elements (ACSE, RTSE, ROSE, CCR)

Information Resource Dictionary System (IRDS)

Office Document Architecture (ODA)

Computer Graphics Metafile (CGM) and Interface (CGI)

**Transmission Mode:**

Connection Oriented (CO)

Connectionless (CL)

**BASIC TRANSPORT OPTIONS**

**Subnetwork Types:**

Circuit Switched Data Network (CSDN)

Packet Switched Data Network (PSDN)

Dedicated Line (Point-to-Point Subnetwork)

Switched Telephone Network (STN)

Integrated Services Digital Network (ISDN)

Local Area Network (LAN)

**Transmission Modes:**

Connection Oriented

Connectionless

**Transmission Media Interfaces:**

Wire

Radio

Fiber Optic Cable

Microwave

Infrared

**BASIC RELAY OPTIONS**

LAN to LAN

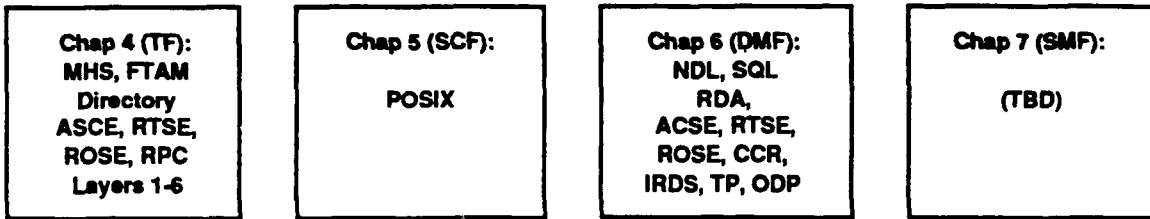
LAN to Wide Area Network (WAN)

WAN to WAN

LAN to WAN to LAN

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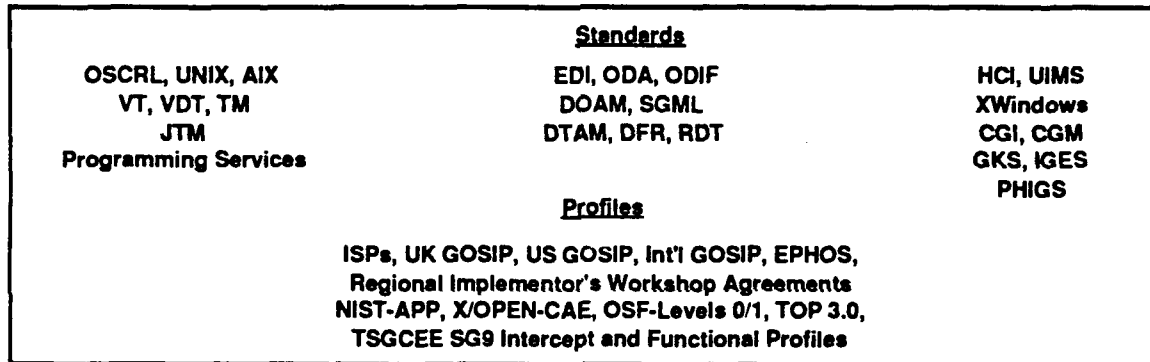
**CHAP 4-8: STANDARDS FOR BASIC INTEROPERABILITY**



**CHAP 8: STANDARDS FOR ALL FOUR BASIC FACILITIES**



**CHAP 9: STANDARDS AND PROFILES FOR ENHANCED INTEROPERABILITY**



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*Figure 7. (U) Standards Applicable to the Basic Facilities and Applicable to Enhanced Interoperability*

(U) The remaining applications in Table 1, together with additional standards that fall outside the OSI Reference Model, are shown in the bottom portion of Figure 7 as applicable to enhanced interoperability and therefore are discussed in Chapter 9. Two of these are controversial. The ATCCIS PWG is evaluating whether Virtual Terminal (VT) and Job Transfer and Manipulation (JTM) are to be considered relevant to basic interoperability for ATCCIS. (VT would provide a capability to simultaneously perform batch and interactive processing. JTM would permit one component to task another component to perform data processing normally conducted only at the first component.) It is possible that these two services could be determined inappropriate for the required data communications standards for use between national corps headquarters; instead, the

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services could be implemented as a national prerogative in support of enhanced interoperability. Other application options that are considered applicable to enhanced interoperability are:

- Operating system standards, such as Operating System Command and Response Language (OSCRL), UNIX™, and AIX™
- Display terminal standards, such as Visual Display Terminal (VDT) and Terminal Management (TM)
- Programming service standards, including Ada, Pascal, C, and FORTRAN language bindings for other standards and system definition and design support tools
- Document interchange standards, such as Electronic Data Interchange (EDI), Office Document Architecture (ODA), Office Document Interchange Format (ODIF), Distributed Office Applications Model (DOAM), and Standard Generalized Markup Language (SGML)
- File transfer standards that provide capabilities similar to FTAM, such as the Document Transfer and Manipulation (DTAM), Document Filing and Retrieval (DFR), and Referenced Data Transfer (RDT)
- Human-computer interface (HCI) standards, including X-Windows and the User Interface Management System (UIMS)
- Graphics standards, such as Computer Graphics Interface (CGI), Computer Graphics Metafile (CGM), Graphical Kernel System (GKS), Initial Graphics Exchange Specification (IGES), and Programmer's Hierarchical Interactive Graphical System (PHIGS).

### 3.2.3 Connection-Oriented and Connectionless-Oriented Transmission Modes

(U) One of the important issues that must be considered when reviewing OSI standards is the choice between connection-oriented (CO) services (also called "virtual circuit" services) and connectionless-oriented (CL) services (also called "datagram" services). Each of the seven OSI layers, except the Physical Layer, may be CO or CL. (The Physical Layer has no connection orientation.) The OSI Reference Model recommends that the upper four layers be either all CO or all CL. The following paragraphs, based on References 5-8, address some prominent distinctions between these two classes of services.

(U) The basic difference between CO and CL service is that CO service requires that an explicit relationship be established between the interacting peer entities, while in CL service no such explicit relationship occurs. A connection preserves the state of peer-to-peer communications from one data transfer to the next, storing and

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distributing information regarding the connection within the service provider, while the CL transmission does not. In CO service the relationship may be real--such as a dedicated circuit--or virtual, such as a particular path from node to node between peer entities in a CO packet-switched service. In the latter case the path would be agreed upon before data transfer begins and would remain unchanged during the transfer. A heuristic example of CO service is any national public telephone service; the regular delivery postal service is a heuristic example of a CL service. In CO service, there is the possibility of error checking and retransmission of data packets known to be in error, at the cost of some amount of overhead for each packet.

(U) CO service has three phases: connection establishment (set up), data transfer, and connection release (call termination). The route of each data packet is determined by the state of the network during the call set up and remains static for the duration of the connection. Since the state information is maintained for each established connection and the route of data packets is static, the data units are freed from the requirement to carry the full address of the required destination. The CO explicit relationship is established during the negotiation portion of the set-up phase and before the transfer phase. CO service provides for negotiation of the form of transmitted data and may maintain sequence and flow control. Error handling may also be supported. The overhead invested in setting up and maintaining a CO connection pays off when the data transfer phase is relatively long. The CCITT Recommendation X.25 for packet switching for wide area networks (WANs) is an example of a connection-oriented protocol.

(U) In contrast, CL service has only one phase--namely, data transfer. The form of the data transferred must be pre-arranged between peer entities. Sequencing, flow control, and error handling are not supported by the CL service, but are instead the responsibility of the interacting peer entities. Sometimes referred to as a "datagram" service, CL service requires each data unit to be self-contained; there is no relationship between individual data unit transfers.

(U) While the service mode at each of the six highest OSI layers may be CO or CL, crossover between the two types of service usually occurs only at the Network Layer (Layer 3). In these cases, the connection orientation of the Application Layer (Layer 7) agrees with the connection orientation of Layers 4, 5, and 6; further, the connection orientation of Layers 2 and 3 also agrees, but this orientation may differ from that of the higher layers. The rationale for maintaining the service mode (CL or CO) throughout Layers 4-7 is based on the recommendation of the ISO Reference Model for simplifying system and protocol complexity, specifically that the features at one layer should not be negated by the unavailability of similar services at another layer. The goal of



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the OSI Reference Model is to limit the amount of *a priori* information exchanged between end systems regarding services used to communicate, which is best met by limiting the mixing of service modes. The ISO/IEC standards for the four cases of connection orientation of the transport and network services are:

- ISO 8602 for CL transport and CL network
- ISO 8602 for CL transport and CO network
- ISO 8073 for CO transport and CO network
- ISO 8073 DAD 2 for CO transport and CL network.

(U) The many resulting combinations of service are useful in different circumstances. In general, CO service is beneficial when long-lived connections with extensive data transfer are anticipated. File Transfer, Access, and Management (FTAM) is an example of an application that would likely benefit from a CO connection. However, CL service may be appropriate for military applications that require robust networks capable of continuing data transfer even as some nodes are taken out of service, especially for the lower layers (network and data link). References 5 and 7 give some additional examples of cases for which CL service is appropriate, even for the upper layers. Included are: inward data collection from the sampling of data sources, broadcast messages, some distributed transactions, some real-time transmission applications, and cases in which one or more communicating peers are mobile.

(U) The cases in which Layers 2 through 7 are all either CO or CL are more straightforward than cases with upper and lower layers of different orientation. If CL upper layers operate over CO lower layers, the full functionality of the lower layers is not employed; the application in this case does not enjoy the amenities of CO service.

(U) The OSI standards supporting CO service were the first to be developed and are nearly complete. Until recently, standards supporting the lower layer CL service were more advanced than those supporting upper layer CL services. CL protocols for the Transport Layer (ISO 8602), Session Layer (ISO 9548), and Presentation Layer (ISO 9576) are complete.

(U) Choice of connection orientation affects the structure of the Network Layer and to some degree the performance of services in the network and Transport Layers. The Network Layer is divided into three sublayers (ISO 8648, *Internal Organization of the Network Layer*). From top to bottom they are the Subnetwork Independent Convergence Protocol (SICP), the Subnetwork Dependent Convergence Protocol (SDCP), and the Subnetwork Access Protocol (SAP). This structure is preferred by many European members of NATO. In a CL network, the Network Layer is divided

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into two sublayers: Internetwork Protocol (IP) and Subnetwork Specific Protocol (SSP), where the IP focuses on unreliable internetwork transfer of information while the SSP focuses on the reliable transfer of individual data units across the supporting networks. The CL approach is favored by the US [compare the OSI profiles recommended by the UK and the US given in Section 9.3.3, noting that ISO Class 4 Transport Protocol (TP4, discussed below) provides services for CL networks]. In the CL model, end-to-end responsibilities are placed in the network sublayers, whereas in the CO approach the end-to-end requirements are placed in the Transport Layer. One drawback of using TP4 over a CO network is the size and complexity of the implementing code. For this and other reasons, many implementors of CO stacks do not support TP4. Section 6 of Reference 8 provides an analysis of the impact of the choice of CL or CO mode on the interconnection of heterogeneous military networks.

(U) As in the Network Layer, there are significant differences in the protocols for the Transport Layer in connectionless and connection-oriented modes. The CL transport protocol (TP) makes use of only a subset of the CO network services, while the CO TP makes use of all the CO network services. The CL transport service is not expected to provide ordered delivery, flow control, or error control. Hence, the CL TP is very simple and requires only a single type of transport protocol data unit (TPDU). There are, however, five classes of the CO TP [Ref. 9]:

- Class 0: Simple class, oriented for Teletex (upgrade to CCITT T.70)--connection flow control is based on network flow control, and connection release is based on release of the network connection
- Class 1: Basic error recovery class, designed to run on a CCITT X.25 network and provide minimal error recovery for network-signalled errors--TPDUs are numbered so that they can be resequenced
- Class 2: Multiplexing class, an enhancement of Class 0 that still assumes a highly reliable network service--has the ability to multiplex multiple transport connections onto a single network connection
- Class 3: Error recovery and multiplexing class, provides the union of the capabilities of Class 1 and Class 2.
- Class 4: Error detection and recovery class--assumes that the underlying network service is unreliable, in particular that the TPDUs may be lost or arrive out of sequence--provides for TPDU retransmission, duplicate detection, flow control, connection establishment and termination, and crash recovery.

Of the five CO TP classes, only Class 4 can make use of a CL network service. Ten types of TPDUs are used to provide CO transport services.

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4. THE TRANSFER FACILITY (TF)

4.1 Description of the TF

(U) As defined in WP 24, the TF is the logical entity in the Basic Ensemble that binds together all ensembles<sup>3</sup> in ATCCIS. As such, it supports the transmission of service requests between ensembles.

(U) A simplified block diagram of the ATCCIS architecture is shown in Figure 8. It shows the relationship between the TF and the other facilities in a Basic Ensemble. The Basic Ensemble is highlighted with bold lines. Application-level facilities (ALFs), which provide functional support to the users beyond basic interoperability, are included with Other Facilities. Figure 8 shows that the DMF, SMF, and SCF each appear in all the ensembles, whereas the TF is considered to be a facility that extends across all the ensembles. Ensembles A and B can be thought of as the facilities at two physical locations in two ATCCIS components. The TF includes the services for the bearer circuits (i.e., communications media) as well as for OSI. The services of the bearer circuits are depicted in Figure 8 as the portion of the TF that connects Ensembles A and B.

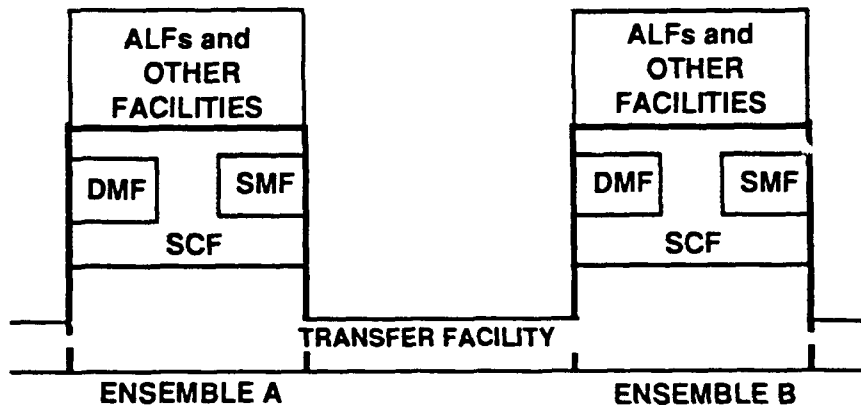


Figure 8. (U) Facilities of the ATCCIS Architecture

<sup>3</sup> (U) An ensemble is [WP 24] a set of standard facilities that includes, as a minimum, the four basic facilities (TF, SCF, DMF, and SMF). An ensemble is a logical entity that will be implemented on an ATCCIS component and thus has the intrinsic property of being associated with a location. Only one ensemble can be implemented on any one ATCCIS component.

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(U) The TF provides a variety of services for transferring data from one component to another. Some of these services are necessarily defined [WP 24, Annex D] by reference to international standards, such as the standards for MHS. In these cases, the specification of the TF does not indicate the services to be provided, but will point to the appropriate standard.

### 4.2 OSI Reference Model, Interworking, and Application Layer Structure

(U) This section summarizes the elements of the OSI Reference Model, interworking of layers, and the structure of the Application Layer. It also addresses the characteristics of distributed applications and architectural standards work being performed for distributed aspects of applications.

#### 4.2.1 Status of OSI Reference Model, ISO 7498

(U) The OSI Reference Model has four elements: *Basic Reference Model* (ISO 7498), *Security Architecture* (ISO 7498-2), *Naming and Addressing* (ISO 7498-3), and *Management Framework* (ISO 7498-4). Connectionless-mode aspects were originally addressed as Addendum 1 to ISO 7498. Multipoint Data Transmission (MPDT) is addressed as Addendum 2 and Upper Layer Architecture (ULA) as Addendum 3.

(U) Balloting for SC21 N 3287,<sup>4</sup> *Proposed Draft Addendum 2 on MPDT* (ISO 7498-1/PDAD2), ended 15 July 1989. Work in ISO on MPDT has been suspended in SC21/WG1, since the nations did not demonstrate specific interest in continuing this work. The completed work is planned to be released as a technical report. New work in ISO on MPDT may come in the form of standards for multi-party communications (MPC), defined as information distribution within groups of end open systems. A May 1990 Canadian contribution to SC21 identified the basic driving forces for MPC as the coordinated interworking of more than two application processes in a single activity and use of inherently shared resources of certain subnetwork types. "Group" processing was identified as one of the next "hot topics" for standardization and was expected to include such activities as conferencing, co-authoring, sensor-based data collection, and process control--all of which involve MPC [Ref. 10].

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<sup>4</sup> (U) SC21 N xxxx denotes an ISO working draft standard or technical paper distributed throughout SC21. Such drafts applicable to ATCCIS are listed at the end of the first section of Appendix E.

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(U) ISO 7498 is being revised to incorporate the connectionless-mode text (AD1) into ISO 7498-1, *Basic Reference Model, General Aspects*. A working draft of the revised text [SC21 N 5092] was distributed in June 1990 [Ref. 11]. The ULA is still at the proposed draft stage in ISO.

(U) ISO 7498-1 is also being revised to permit routing and relaying between individual local networks to be performed in the Data Link layer. This work is being coordinated with CCITT [Ref. 12]. Other work includes clarifying the distinction between connectionless and connection-mode operation, aligning the service definitions for the lower layers and also for the upper layers, improving consistency of layer descriptions, adding Reset as a facility to the Data Link Layer, adding Suspend and Resume as functions in the Transport Layer, and aligning this work with CCITT. The first draft of the revised text for ISO 7498-1 is expected to proceed to CD ballot late in 1990 [Refs. 13, 14].

(U) The OSI Reference Model is being supplemented by a number of other models and frameworks within the context of OSI. These include Application Layer Structure, Internal Organization of the Network Layer, and the Transaction Processing Model [Ref. 15]. Conventions for specifying OSI service definitions are also being developed. CD text has been distributed in ISO [SC21 N 5101, June 1990] for a new standard, *Conventions for Service Definitions*, CD xxxx [Ref. 16]. The three parts are *General Model and Conventions*, *Application Layer*, and *Layers 1-6*.

### 4.2.2 Interworking of Layers in OSI

(U) The basic interworking standards used for specifying relays are the following (examples of relay profiles using these standards are given in Appendix B):

- DP 10028.2, *Definition of the Relaying Functions of a Network Layer Intermediate System*, Second Draft, June 1989
- TR 10029, *Operation of an X.25 Interworking Unit*, March 1989
- DP 10038, *Media Access Control (MAC) Sublayer Interconnection (MAC Bridging)*, October 1988.

(U) DTR 10172, *Network/Transport Protocol Interworking Specification* [SC6 N 5906, March 1990], addresses the inability of end systems operating in the CO network protocol (ISO 8208/8878 X.25) and CL network protocol (ISO 8473) to interwork with each other. A mediating device, called the Interworking Functional Unit (IFU), is defined to perform relaying and/or conversion of protocol data units (PDUs) from

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one network protocol type to another. Three modes of operation are considered in DTR 10172:

- Network Layer Relay (NLR). In the NLR mode the IFU operation functions as a regular intermediate system. CL NLR operation is in accordance with ISO 8473 and CO NLR with ISO 10177 and ISO 10028.
- Passive Transport Layer Relay (PTLR). PTLR does not itself operate on the PDUs of transport connections, but passes transport PDUs received in network service data units from each end system transparently to the other end system.
- Active Transport Layer Relay (ATLR). ATLR provides an end-to-end transport service by operating a separate transport connection to each of the connected end systems and relaying data from one connection to the other.

Since the PTLR and ATLR modes of operation lie outside the scope of the OSI architecture, the technical report is not planned to be converted to an ISO standard.

(U) The following comment on CL-mode and CO-mode interworking was provided to SC21 following a February 1990 meeting of CCITT SG VII regarding the proposed update to the OSI Reference Model (ISO 7498-1) [Ref. 17]:

The connectionless/connection-mode crossover rules currently proposed by ISO appeared, to many of the Q23/VII attendees at this meeting to be unacceptable for use in fully supporting connectionless-mode CCITT applications, due mainly to interconnectivity problems. Many of the attendees felt that, for "across-the-board" support of connectionless CCITT applications, within the lower layers, there is a need to have common (mandatorily provided) support required that would assure interconnectivity among all connectionless-mode OSI CCITT applications. It was unanimously agreed that the concept of attempting to solve such interconnection problems exclusively through introduction of any "transport relay" concept in CCITT Recommendations is totally unacceptable.

### 4.2.3 Application Layer Structure

(U) The Application Layer differs from the other layers of OSI in several respects. Entities in the Application Layer are made up of a collection of application service elements (ASEs), each of which is defined by a set of service and protocol standards. These ASEs are combined in various ways to form various types of Application Elements (AEs). The Application Layer, as the highest layer of OSI, does not provide connections within the Application Layer. As a result, relationships formed by the transfer of information between AE invocations in the Application Layer have special significance.

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(U) Standards in the Application Layer define procedures for the support of distributed information processing. The Presentation Layer supports the Application Layer by providing facilities for representing information exchanged between AEs. The Session Layer provides the mechanisms that may be used for controlling interactions between AEs.

**4.2.3.1 ISO Studies on Application Layer.** (U) In its November 1989 Strategic Plan, JTC1 directed five initial major technical studies in order to address new or expanding areas to provide a basis for planning the JTC1 long-range programme. The studies of required standards are all applicable to the Applications Layer:

- (1) Defining interfaces for application portability
- (2) Defining interfaces required for distributed systems and applications
- (3) Integrating voice, data, text, graphics, and image information at the user application level
- (4) Addressing the area of artificial intelligence
- (5) Supporting modelling of user requirements.

**4.2.3.2 Application Layer Structure (ALS).** (U) ISO 9545, *Application Layer Structure*, was published by ISO in December 1989. This was based on work done by SC21/WG6. ISO 9545 defines the nature of standards in the Application Layer and the relationships among them, the architectural framework in which individual OSI Application Layer protocols shall be developed, and the categories of identifiable objects that are necessary for the specification and operation of protocols. It also relates distributed information processing activities to the standards in the Applications Layer. Key concepts from the ALS are the following:

- Association (application association)--a cooperative relationship between two AE invocations for the purpose of communicating information and coordinating their joint operation. This relationship is formed by the exchange of application protocol control information using the Presentation Service.
- Application context--a set of rules shared in common by two SE invocations in order to enable their cooperative operation. The application context is an example of a shared conceptual schema.
- Single association object (SAO)--the collection of things in an AE invocation related to a single application association.



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- **Single association control function (SACF)**--the component of a single association object that represents the use of those rules in the application context concerning interactions among ASEs within a single application association.
- **Multiple association control function (MACF)**--a component of the AE invocation that coordinates the interactions among multiple associations within an AE invocation in order to provide a coordinated service.

(U) SC21 N 4118, PDTR xxxx, *Methodology and Guidelines for the Development of Application Layer Protocols*, November 1989, is being developed by SC21/WG6 to provide a discipline into the development of application protocol standards in order to generate precise specifications. It describes a step-by-step procedure for generating ASE definitions and protocol specifications.

**4.2.3.3 Extended ALS.** (U) Work on an extended ALS (XALS) model has begun. The purpose of XALS is to supplement ISO 9595 (*Application Layer Structure*) by providing a more complete framework for development of Application Layer protocol standards that use other Application Layer protocol standards. A central focus of XALS is extension of the architecture for use of multiple associations [Ref. 18].

(U) XALS is planned to provide a revised ALS model that is significantly richer in scope and descriptive capability than is provided in ISO 9545. As a result, it will provide more options for the specification of Application Layer standards. Examples of new features being proposed for the XALS are:

- **Defining application service elements (ASEs), application service objects (ASOs), and control functions.** An ASO is made up of one or more ASEs and/or ASOs, and a control function. A control function is the component of an ASO that controls the interactions among ASEs and/or ASOs within the containing ASO [Ref. 19].
- **Providing guidance for ASE specifications in the areas of the reference model the ASE supports, the service definition, the abstract protocol definition, and the ASE environment requirements specification.**
- **Addressing peer-to-peer (application level) relationships as well as the established concept of application association, such as are used on MHS, TP, EDI, and Directory.**
- **Accommodating both peer-to-peer and client-server interaction styles.** (ROSE supports both styles of interaction. X-Windows and DOAM use client-server styles, for which the terminal in the X-Window environment is the server, whereas the terminal in the DOAM model is the client.)

(U) An approach being considered for XALS for defining ASEs is that each ASE is a complete specification of a function, together with the application protocol

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data units (APDUs) that support it. The APDUs are defined in one or more abstract syntax specifications within the ASE standard. The name of the specification is a parameter used when establishing a presentation connection, with each resulting transfer syntax assigned its own presentation context. Concurrent use of multiple ASEs would be accomplished by either APDU concatenation or embedding one APDU in another as user data. FTAM, CCR, VT, and ACSE fit this proposed model, but not Directory, ROSE, or RTSE. The Directory protocol, for example, is used in conjunction with ROSE to completely specify an abstract syntax--the relationship between Directory and ROSE is not one of APDU concatenation or user data embedding. Use of XALS would benefit work in RPC and other ASE areas [Ref. 20].

(U) Future work on XALS is expected to include the following:

- Peer-to-peer relationship (in addition to application associations) [Ref. 21]
- Recovery model, new work item (JTC1 N 764) approved June 1990 [Refs. 22, 23]
- Multi-level structures, new work item (JTC1 N 846) approved June 1990 [Ref. 24].

#### 4.2.4 Distributed Applications

(U) Application Layer standards often define, at least partially, distributed applications. Examples are MHS, Directory, and FTAM; specifically, Directory contains a specification of a directory information tree (DIT) and its associated navigation rules. The nodes of the DIT for CCITT are envisioned to be distributed worldwide. Such standards contain elements that relate to features (and models) of distributed applications, in addition to features related to communications transfer. In this regard, these standards relate both to the ODP model and the ALS model.

(U) The following are examples of tasks being proposed in generic work on distributed applications [Refs. 25, 26]:

- Model information held by distributed applications and address issues of distribution and local transparency (the ODP work has chosen to recognize five different viewpoints from which various features of a distributed application can be modelled); *Modelling for Communications Aspects of Distributed Applications* has been accepted by JTC1 and assigned to SC21/WG6 [Ref. 27].
- Formalize management interactions between application processes in specific protocols in such functions as establishing relationships, distributing data, and replicating data.

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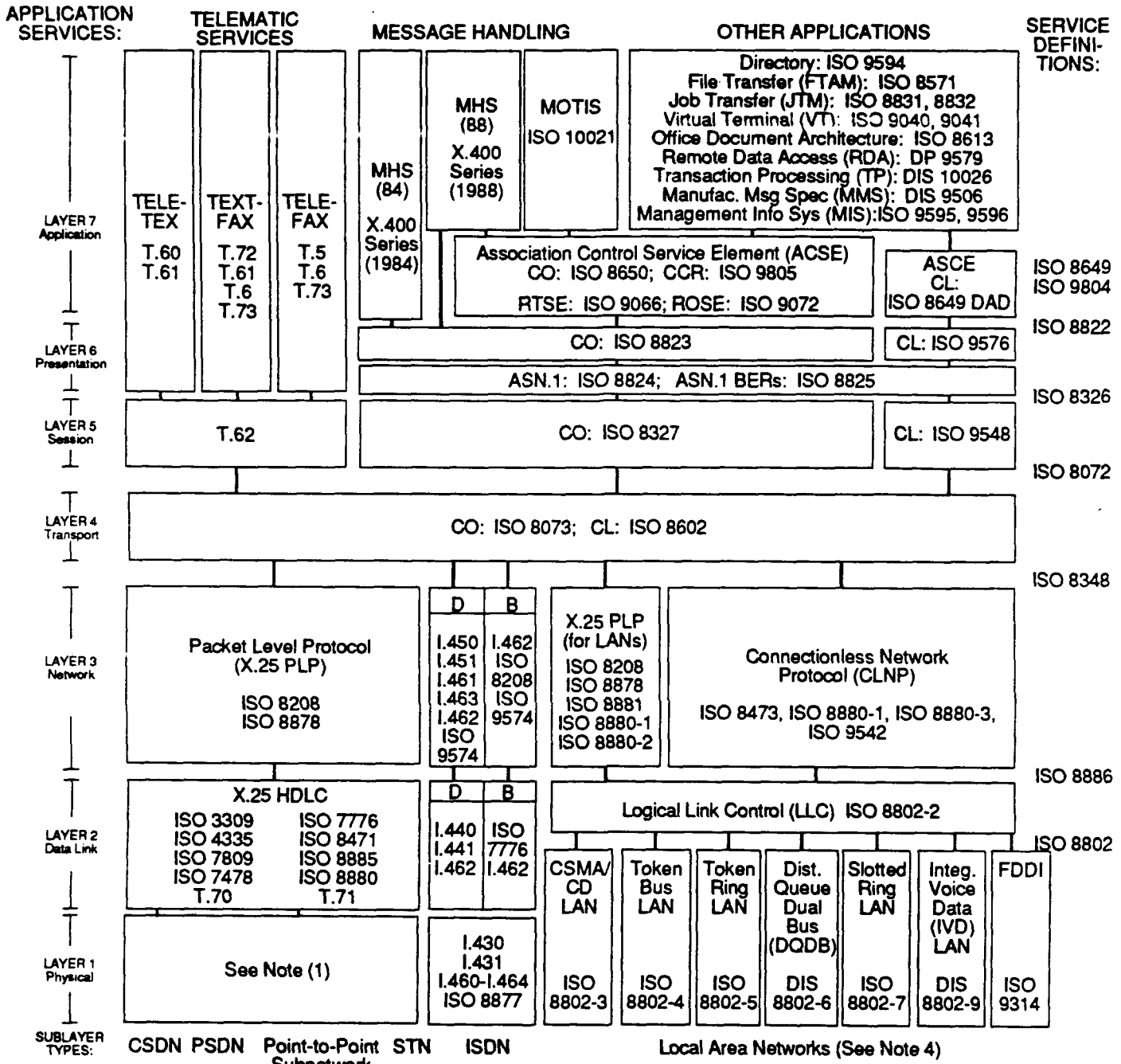
- Devise global security mechanisms for use throughout the entire domain of the distributed application.
- Enable the schema for information held at an applications process to be distributed among cooperating systems.
- Address database issues such as data integrity and consistency, together with replication of data.
- Identify constraints on process decomposition and interaction types (communication among subprocesses).
- Specify support for configuration management, reconfiguration, and routing.
- Define application features to allow migration for future extensions.
- Address real-time effects associated with distribution.
- Provide for time synchronization of application processes.

(U) A key aspect of distributed applications that is essential to automated CCISs is that different components may have a different user view of the information held by the distributed application. Presentation Layer facilities generally require that there be full agreement between communicating systems at both the concrete (transfer syntax and data) level and the abstract syntax (close to information) level, thus requiring the components to have identical views of the information. The standards permit some capability for multiple user views, but such use of the standards could result in poor control of agreement and consistency between the components [Ref. 28].

### 4.3 Standards Activities and Emerging Standards

(U) This section begins with a description of the base standards that have been defined for the OSI seven-layer model. Stacks of base standards are described separately for application options, transport options, and relay options. This is followed by a description of two related sets of standards that are emerging--one for OSI management and one for directory services. Figure 9 provides an overview of the standards applicable to the TF. The layer OSI standards are connected by vertical lines to depict a wide range of stacks for application and transport options. OSI management, security, registration authorities, conformance testing, and other standards applicable to all the Basic Facilities are identified and discussed in Chapter 8. These are not included in Figure 9.

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Notes: (1) Layer 1 Standards are:  
 (a) CSDN/PSDN: ISO 2110, 2593, 4902, 4903; V.24, V.28, V.35, V.36; X.21, X.21bis, X.22, X.24, X.26, X.27,  
 (b) Point-to-Point Subnetwork: Predefined  
 (c) STN: ISO 2110, 2593, 4902, V.10 or V.11, V.20, V.24, V.27, V.31bis, V.35, V.36, V.37, V....

- (2) Standards are CCITT unless designated ISO, DIS, or DP.
- (3) Stacks are based on 1989 NTIS Transition Strategy.
- (4) Each LAN standard addresses both Layer 1 and Layer 2 (Media Access Control).

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*Figure 9. (U) Stacks of Standards for Application and Transport Options*

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(U) Examples of possible application and transport options are depicted in Figure 9. The types of transport services are identified along the bottom of the figure. Standards and options in a layer common to several stacks are shown in blocks. For example, the Logical Link Control (LLC) in Layer 2 is common to stacks for all types of LANs shown in Figure 9. Above the LLC, the CO-mode X.25 Packet Level Protocol (PLP, ISO 8208, 8878, 8880-1, 8880-2, and 8881), and the connectionless network protocol (CLNP) apply to each of the four LAN options. The X.25 PLP (ISO 8208 and 8878) in Layer 3 and the High-Level Data Link Control (HDLC) in Layer 2 are common to stacks for four types of circuits: Circuit Switched Data Network (CSDN), Packet Switched Data Network (PSDN), Point-to-Point Subnetwork, and Switched Telephone Network (STN).

### 4.3.1 Base Standards and Stacks of Base Standards

(U) This section identifies the OSI standards that are relevant to the TF. Table 1 (above) identified OSI options applicable to ATCCIS, which are, with the possible exception of VT and JTM, all relevant to the TF. The most useful form in which to present the specific standards that support OSI options is ordered groupings (called stacks) to show their application to specific interfaces and services. Tables 2, 3, and 4 identify stacks for application options, transport options, and relay options, respectively. The relationship among these three classes of options was described earlier in Figure 6. The stacks are taken primarily from the 1988 recommendations of TSGCEE SG9 for the *NTIS Transition Strategy* [Ref. 4]. (Appendix B provides figures that depict in more detail 4 application, 20 transport, and 11 relay functional profiles from the 1989 *NTIS Transition Strategy*.) The NATO profile reference used in the *NTIS Transition Strategy* is given in the first column of Tables 2, 3, and 4 (the symbol "ICT" identifies intercept recommendations that have no profile number). The standards include CCITT recommendations (e.g., T.60, X.402, V.24) and ISO standards.

(U) Of the possible sets of transport standards for LANs providing combinations of CO-mode and CL-mode transport and network services, CL transport with CO network service has not yet been included in Table 3. Standards for the case of asynchronous devices (start-stop transmission) are listed under Options in the second part of Table 3, although the relevant standards (X.28 and X.29) also control OSI layers above Layer 4.

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*Table 2. (U) Upper-Layer Stacks of Base Standards for Application Options*

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| <b>NATO Profile</b> | <b>Application Option</b>                   | <b>Layer 5</b>       | <b>Layer 6</b>                      | <b>Layer 7</b>   |
|---------------------|---|----------------------|-------------------------------------|--|
| A.1                 | File Transfer, Access and Management (FTAM) | ISO 8327<br>ISO 9548 | ISO 8823<br>ISO 9576<br>ISO 8824-25 | ISO 8571<br>ISO 8649<br>ISO 8650   |
| A.2                 | Teletex                                     | T.62                 | T.60<br>T.61                        | T.60<br>T.61   |
| A.2                 | Textfax                                     | T.62                 | T.72, T.61<br>T.6, T.73             | T.72, T.61<br>T.6, T.73  |
| A.2                 | Telefax                                     | T.62                 | T.5, T.6<br>T.73                    | T.5, T.6<br>T.73   |
| A.3[*]              | Message Handling Service (MHS-88); MOTIS    | ISO 8327<br>ISO 9548 | ISO 8823<br>ISO 9576<br>ISO 8824-25 | ISO 10021<br>ISO 9066<br>ISO 9072<br>ISO 8649<br>ISO 8650<br>X.403, X.408<br>T.330 |
| A.4                 | Virtual Terminal (VT)                       | ISO 8327<br>ISO 9548 | ISO 8823<br>ISO 9576<br>ISO 8824-25 | ISO 9040<br>ISO 9041   |
| A.5                 | Transaction Processing                      | ISO 8327<br>ISO 9548 | ISO 8823<br>ISO 9576<br>ISO 8824-25 | DIS 10026-1,2,3  |
| A.6                 | Job Transfer and Manipulation (JTM)         | ISO 8327<br>ISO 9548 | ISO 8823<br>ISO 9576<br>ISO 8824-25 | ISO 8831<br>ISO 8832   |
| A.7                 | Remote Data Access                          | ISO 8327<br>ISO 9548 | ISO 8823<br>ISO 9576<br>ISO 8824-25 | DP 9579  |
| A.8                 | Management Information System (MIS)         | ISO 8327<br>ISO 9548 | ISO 8823<br>ISO 9576<br>ISO 8824-25 | ISO 9595<br>ISO 9596   |
| A.9                 | Directory                                   | ISO 8327<br>ISO 9548 | ISO 8823<br>ISO 9576<br>ISO 8824-25 | ISO 9594<br>X.500, X.501<br>X.509, X.511<br>X.518, X.519                           |

Source: NTIS Transition Strategy, TSGCEE SG9, 20 June 1988, NATO UNCLASSIFIED.

\*Note: Transition Strategy cites MMHS for NATO Profile A.3; most currently defined MMHS requirements appear to be in MHS-1988 (analysis by TSGCEE SG9 is not yet complete).

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*Table 3. (U) Lower-Layer Stacks of Base Standards for Transport Options*

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| NATO Profile | Transport Option   | Layer 1  | Layer 2  | Layer 3                                    | Layer 4                                  |
|--------------|--|--|--|--|--|
| T.21         | Permanent Analogue Circuit   | V.24<br>V.35<br>V.36<br>ISO 2110.2<br>ISO 2593<br>ISO 4902.2                   | ISO 3309<br>ISO 4335<br>ISO 7478<br>ISO 7776<br>ISO 7809<br>ISO 8471<br>ISO 8885                 | ISO 8208<br>ISO 8878                       | ISO 8073<br>(Classes 1 & 2)              |
| T.31         | Permanent Access to PSDN:<br>End System<br><br>PSDN  | X.21<br>ISO 4903.2   | ISO 3309<br>ISO 4335<br>ISO 7478<br>ISO 7776<br>ISO 7809<br>ISO 8471<br>ISO 8885<br>X.25<br>X.25 | ISO 8208<br>ISO 8878<br>X.25<br><br>X.25   | ISO 8073<br><br><br><br><br><br><br>X.25 |
| T.32         | Permanent Digital Circuit  | X.21, DIS 4903.2   | ISO 7776   | ISO 8208                                   | ISO 8073                                 |
| ?            | Switched Telephone Network (STN)   | X.28   | ISO 7776   | ISO 8208                                   | ISO 8073                                 |
| T.41         | Switched Digital Circuit (CSDN):<br>(CCITT T.70 Type)  | X.21   | T.70<br>X.21   | T.70<br>X.21                               | ISO 8073<br>(Class 0)                    |
| T.42         | Switched Digital Circuit (CSDN):<br>Call Control and Clearing Phase<br>Data Transfer Phase             | X.21<br>X.21, ISO 4903.2   | X.21<br>ISO 7776   | X.21<br>ISO 8208                           | N/A<br>ISO 8073                          |
| T.61         | LAN Providing CO Network Service<br>and CO Transport Service   | ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7                              | ISO 8802/2<br>ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7                                  | ISO 8881<br>ISO 8878<br>ISO 8208           | ISO 8073                                 |
| T.62         | LAN Providing CL Network Service<br>and CO Transport Service   | ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7                              | ISO 8802/2<br>ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7                                  | ISO 8473                                   | ISO 8073<br>(Class 4)                    |
| T.63         | LAN Providing CL Network Service<br>and CL Transport Service   | ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7                              | ISO 8802/2<br>ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7                                  | ISO 8473                                   | ISO 8602                                 |
| ICT          | Asynchronous Devices (Start-Stop<br>Transmission)  | X.20   | X.28, X.29   | X.28, X.29                                 | X.28, X.29                               |
| ICT          | Integrated Services Digital Network<br>(ISDN):<br>D Service (16,000 b/s)<br><br>B Service (64,000 b/s) | I.430, I.431<br>I.460-463<br>ISO 8877<br>I.430, I.431<br>I.460-463<br>ISO 8877 | I.440, I.441<br>I.462<br><br>I.462   | I.450, I.451<br>I.460<br><br>I.462<br>T.70 | ISO 8073<br><br><br>ISO 8073             |

Source: NTIS Transition Strategy, TSGCEE SG9, 20 June 1988, NATO UNCLASSIFIED.

Note: ICT identifies a TSSGCEE SG9 intercept recommendation that is not part of the NATO profile taxonomy.

Note: ISDN standards have been changed in the 1988 CCITT recommendations; new numbers need to be identified and incorporated here and elsewhere. See Annex D and Annex E (Part II).

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*Table 4. (U) Stacks of Base Standards for Relay Options*

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| <b>NATO Profile</b> | <b>Relay Option</b>     | <b>Layer 1</b>                                    | <b>Layer 2</b>  | <b>Layer 3</b>       |
|---------------------|-------------------------|---|---|----------------------|
| R.12                | LAN to WAN/PSDN to LAN: |   |   |                      |
|                     | LAN                     | ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7 | ISO 8802/2<br>ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7 | ISO 8473             |
|                     | WAN/PSDN                | X.21<br>ISO 4903                                  | X.25<br>ISO 7776  | X.25<br>ISO 8208     |
|                     | Internetworking Service |   |   | ISO 8648             |
| R.13                | WAN/PSDN to WAN/PSDN    | X.75  | X.75  | X.75                 |
| R.21                | LAN to LAN:             |   |   |                      |
|                     | LAN                     | ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7 | ISO 8802/2<br>ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7 | ISO 8473<br>ISO 8208 |
|                     | Internetworking Service |   |   | ISO 8648             |
| R.22                | LAN to WAN/PSDN:        |   |   |                      |
|                     | LAN                     | ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7 | ISO 8802/2<br>ISO 8802/3<br>or 8802/4<br>or 8802/5<br>or 8802/7 | ISO 8881             |
|                     | WAN/PSDN                | X.21<br>ISO 4903                                  | X.25<br>ISO 7776  | X.25<br>ISO 8208     |
|                     | Internetworking Service |   |   | ISO 8648             |

Source: NTIS Transition Strategy, TSGCEE SG9, 10 June 1988, NATO UNCLASSIFIED.



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### 4.3.2 MHS and MOTIS

**4.3.2.1 Message Handling Standards.** (U) Table 5 summarizes the set of standards that define MHS (CCITT X.400) and the Message-Oriented Text Interchange System (MOTIS ISO 10021) services. Efforts have been made by CCITT and ISO to converge MHS and MOTIS. The result, defined by standards released in 1988, is a substantially but not completely compatible set of new standards. [Balloting for the previous MOTIS standards (DIS 8505, DIS 8883, and DIS 9065) was suspended, and the scope of these standards has been incorporated in ISO 10021.] The relationship of the X.400-1984 (MHS-84), X.400-1988 (MHS-88), and MOTIS-1988 standards is provided in Table 5. Notice that MOTIS still has no parallel to the X.408 standards for algorithms used when converting between different types of encoded information, no parallel for the X.430 (now T.430) Teletex access protocols, and none for X.403.

(U) MHS-88 provides new (relative to MHS-84) capabilities for message store (listing, summary, fetching, and deletion of stored messages); security services (origin authentication, secure access management, data confidentiality, data integrity, nonrepudiation, and security management); distribution lists (members, submit permission, expansion point, and owner); directory services (authentication, name resolution, data list expansion, and capability assessment); physical delivery service (basic physical rendition, ordinary mail, physical forwarding, and return of undeliverable mail); and conformance testing (methods, criteria, and notation). In addition, MHS-88 revises MHS-84 standards for naming, addressing, routing, and special access.

#### 4.3.2.2 Manufacturing Message Specification (MMS).

(U) A Manufacturing Message Specification (MMS) has been defined. MMS is the key component of the Manufacturing Automation Protocol (MAP), the OSI protocol promoted worldwide by General Motors. The MMS work in ISO is under TC184/SC5/WG1, which is responsible for communications systems in the area of industrial automation [Ref. 29]. The MMS standard has two parts: DIS 9506-1 (*Service Definition*) and DIS 9506-2 (*Protocol Specification*).

**4.3.2.3 MHS-1984 and MHS-1988 Profiles.** (U) The standards for MHS-84 include delivery notification, disclosure of other recipients, explicit conversion (Message Transfer Service), grade of delivery selection, hold for delivery, prevention of non-delivery notification, probe, stored message alert, and stored message automatic forward.

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*Table 5. (U) Base Standards for Message Management*

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| CCITT X.400-LAYER | MHS<br>CCITT X.400-<br>1984 | MHS<br>MOTIS<br>1988 | ISO-1988                  |
|-------------------|-----------------------------|----------------------|---------------------------|
| 7                 | X.400                       | X.400 <sup>a</sup>   | ISO 10021-1               |
| 7                 | X.401                       |                      |                           |
| 7                 | X.400                       | X.402                | ISO 10021-2               |
| 7                 | N/A                         | X.403 <sup>b</sup>   | None                      |
| 7                 | N/A                         | X.407                | ISO 10021-3               |
| 7                 | X.408                       | X.408                | None                      |
| 7                 | X.409                       | X.208                | ISO 8824<br>ISO 8824 DAD1 |
|                   |                             | X.209                | ISO 8825<br>ISO 8825 DAD1 |
| 7                 | X.410                       | X.218                | ISO 9066-1                |
|                   |                             | X.219                | ISO 9072-1                |
|                   |                             | X.228                | ISO 9066-2                |
|                   |                             | X.229                | ISO 9072-2                |
| 7                 | X.411                       | X.411                | ISO 10021-4               |
|                   |                             | X.419 <sup>c</sup>   | ISO 10021-6               |
| 7                 | N/A                         | X.413                | ISO 10021-5               |
| 7                 | X.420                       | X.420                | ISO 10021-7               |
| 7                 | X.430                       | T.330                | None                      |
| 7 (ACSE)          | N/A                         | X.217                | ISO 8649                  |
|                   |                             | X.227                | ISO 8650                  |
| 6                 | N/A                         | X.216                | ISO 8822                  |
|                   |                             | X.226                | ISO 8823                  |

<sup>a</sup>1988 X.400 is double-numbered with 1988 F.400.

<sup>b</sup>Citation for 1988 X.403 includes three manuals.

<sup>c</sup>1988 X.419 and ISO 10021-6 have a wider scope than the part of 1984 X.411 and DIS 8883 that they replace.

Source: Provided by OMNICON on 8 September 1988.

(U) The 1988 CCITT X.400 recommendations are supplemented by a new series of standards on the service aspects of MHS. These standards are:

- F.400 System and Service Overview
- F.401 Naming and Addressing for Public Message Handling Services
- F.410 The Public Messaging Transfer Service
- F.415 Intercommunication with Public Physical Delivery Services
- F.420 The Public Interpersonal Messaging Service

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- F.421 Intercommunication Between the IPM Service and the Telex Service
- F.422 Intercommunication Between the IPM Service and the Teletex Service.

(U) According to analyses conducted by WG2 of TSGCEE SG9, MHS-88 is not backward compatible with MHS-84 (due to changes in data type formats in the P1 protocol) and, even with a gateway between systems using different versions of MHS, there are several differences [Ref. 30] that could cause interoperability problems. For example, MHS-84 is unable to use the physical delivery capability of MHS-88. In addition, MHS-88 users may not be able to communicate with Telex terminals on an MHS-84 system. Finally, MHS-84 systems will reject some addresses that may be valid for MHS-88 systems. Addressing these problems without service request rejection will require a complex gateway. The incompatibilities of the MHS-84 and MHS-88 standards could present serious interoperability issues since ATCCIS or other ADP-supported CCISs might adopt the newer standard, but a variant of the older standard [*Standard Automated Message Interface for NATO ACCIS (STAMINA)*], described in Section 11.7] has been mandated for the ACE Automated Command and Control Information System (ACCIS) that supports battlefield command and control entities at echelons above corps. Note that while the 1989 *NTIS Transition Strategy* [Ref. 4] identifies the MMHS(84) as an intercept interoperability functional profile, the following caveat is included:

It must be clearly stated that the MMHS-STANAG will be based on CCITT X.400 series version 1988, which offers a considerably enhanced functionality, including security services. Problems with backward compatibility can not be precluded.

(U) However, backwards compatibility of MHS-88 with MHS-84 is being claimed by many technical experts [Ref. 31-35]. According to Jim White [Ref. 35], CCITT Special Rapporteur for X.400, "backwards compatibility between 1984 and 1988 P1 has been achieved." P1 is the relay protocol from one Message Transfer Agent (MTA) to another. 1988 and 1984 products implementing P1 would be able to interwork because the 1988 P1 is a superset of the 1984 P1. However, the same is not true of the P3 protocol used for submission and delivery access for a remote User Agent. Specifically, it is not possible for a 1988 UA to use the P3 protocol to communicate with a 1984 messaging system. The rules that a 1988 system shall obey when interworking with 1984 systems are defined in Annex B, *Interworking with 1984 Systems*, of CCITT X.419.

### 4.3.3 File Transfer and Management (FTAM)

4.3.3.1 FTAM Standards. (U) FTAM defines a file service and specifies a file protocol within the Application Layer (Layer 7). The standard is concerned

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with identifiable bodies of information that can be treated as files, which may be stored within open systems or passed between application processes. ISO 8571 defines the basic file service for FTAM. It provides sufficient facilities to support file transfer and establishes a framework for file access and file management. This standard does not specify the interfaces to a file transfer or access facility within the local system. An addenda may be added that reflects quality of service developments and integration. The FTAM standard currently has five parts and two addenda. An additional standard describes a performance test suite. The pertinent FTAM standards are:

- ISO 8571-1, Part 1: *General Introduction*
  - DAM1 Addendum 1: *Filestore Management*
  - PDAM2 Addendum 2: *Overlapped Access*
- ISO 8571-2, Part 2: *Virtual Filestore Definition*
  - DAM1 Addendum 1: *Filestore Management*
  - PDAM2 Addendum 2: *Overlapped Access*
- ISO 8571-3, Part 3: *File Service Definition*
  - DAM1 Addendum 1: *Filestore Management*
  - PDAM2 Addendum 2: *Overlapped Access*
- ISO 8571-4, Part 4: *File Protocol Specification*
  - DAM1 Addendum 1: *Filestore Management*
  - PDAM2 Addendum 2: *Overlapped Access*
- ISO 8571-5, Part 5: *PICS Proforma*
  - WDAM1 Addendum 1: *Filestore Management*
  - WDAM2 Addendum 2: *Overlapped Access*
- *Conformance Test Suite for the FTAM Protocol*
  - DIS 10170-1, Part 1: *Test Suite Structure and Test Purposes*, July 1990
  - WD 10170-2, Part 2: *FTAM Abstract Test Suite* (CD expected June 1991)
  - WD 10170-3, Part 3: *ACSE Abstract Test Suite Embedded Under FTAM* (CD expected June 1992)
  - WD 10170-4, Part 4: *Presentation Abstract Test Suite Embedded Under FTAM* (CD expected June 1992)
  - WD 10170-5, Part 5: *Session Abstract Test Suite Embedded Under FTAM* (CD expected June 1992)
- *Enhancement to FTAM Services to Satisfy Use Requirements*, January 1990 (CDAM expected June 1991)
- *Enhancements to FTAM Security Services*, July 1990 (CDAM expected January 1992).

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(U) The current FTAM standard treats a filestore as an unstructured collection of files. Addendum 1 defines a structured filestore to allow the organization and manipulation of individual groups of files. Addendum 2 on Overlapped Access allows more efficient access to contents of a structured file. The Overlapped Access working draft specification uses the formal description language LOTOS. These extensions will support needs of the Network File Store, but harmonization with DTAM (CCITT) and DFR (SC18) will be needed. PICS proformas such as ISO 8571-5 are discussed in Section 8.4.

(U) A new work item on FTAM will provide for higher-level services using FTAM with other application services. Currently FTAM is not easily exportable to other application services. The new work will attempt to improve efficiency by reducing the number of confirmed requests (e.g., needed for file transfer over long-haul communications), extend and simplify FTAM services to allow other applications services (e.g, TP) to easily use FTAM services (e.g., for data transfer) with minimum overhead by providing high-level services, and to provide file services for other user services, such as CCITT telematic services.

(U) SC21/WG5 is developing a document type to enable FTAM to transfer CGM files as a structured file rather than (with current FTAM) as a transparent sequence of octets. The new work would provide access to the whole metafile, to the metafile descriptor, or to the individual pictures with an associated metafile descriptor. All three CGM encoding techniques would be supported: binary, clear text, and character text [Ref. 36].

(U) EWOS is developing a Remote Actions (RA) service and protocol for use with FTAM to support the ability to perform a remote action upon completion of a file operation. Examples of a remote action would be execution of a batch job that is transferred to another system via FTAM and to spool a print file to a printer after being transferred using FTAM. Both RPC and JTM could provide this support, but JTM is viewed in EWOS as too complex for simple remote actions. RA would not compete with JTM and specifically would not support such JTM services as gathering information for input to a job, spawning jobs to several systems, manipulating entries in job queues (e.g., kill a job), monitoring progress of jobs, or preparing progress reports [Ref. 37].

(U) The Joint European Standards Institution (CEN/CENELEC) has issued a draft European Prestandard (prENV), prENV 41 205, *Information Systems Interconnection - File Transfer Access and Management (FTAM) - File Management*, March 1989, for balloting.

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**4.3.3.2 Options and Profiles for FTAM.** (U) Protocols and services for FTAM are specified in ISO 8571. The ISO standard (ISO 8571-2, Annex B) provides for three document types: unstructured text, sequential text, and unstructured binary. Stable Implementor's Workshop agreements have been published by the US National Institute of Standards and Technology (NIST) for four others: sequential file, random access file, indexed file, and file directory file. Six implementation profiles have been defined by the European Standards Promotion and Application Group (SPAG), which have the following corresponding profiles from the NIST OSI Implementor's Workshops:

- *Simple file transfer* (SPAG A/111, NIST T1)
- *Positional file transfer* (SPAG A/112, NIST T2)
- *Full file transfer* (SPAG A/113, NIST T3)
- *Simple file access* (SPAG A/122, NIST A1)
- *Full file access* (SPAG A/123, NIST A2)
- *Management* (SPAG A/13, NIST M1).

(U) An International Standardized Profile (ISP) is being developed by the JTC1 Special Group on Functional Standardization (SGFS) for FTAM [SGFS N 131, August 1989]. There are currently three parts:

- (1) *AFT nn - File Transfer, Access, and Management - Part 1: Specification of ACSE, Presentation, and Session Protocols for the Use by FTAM*
- (2) *AFT nn - File Transfer, Access, and Management - Part 2: Definition of Document Types, Constraint Sets, and Syntaxes*
- (3) *AFT nn - File Transfer, Access, and Management - Part 3: AFT 11 - Simple File Transfer (Unstructured).*

### 4.3.4 Directory

(U) CCITT is developing a database application standard for logically storing directory information. The directory is a distributed database on users, processes, and other objects, used to provide access to information that people or processes require prior to communicating. The standards are in the following X.500 Series recommendations: X.500, X.501, X.509, X.511, X.518, X.519, X.520, and X.521.

**4.3.4.1 Directory Services and Models.** (U) The Directory services provide a specialized hierarchical database, called the Directory Information Tree, for OSI applications. The Directory contains information about objects and provides structured mechanisms for accessing that information. These services are intended to provide user friendly naming to permit a user to specify an object's name and then retrieve

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additional addressing information. The two key aspects of the OSI Directory, which distinguish it from other database and name-server work, are [Ref. 38]:

- The Directory can be read, modified, and searched remotely via OSI protocols.
- A highly distributed database is provided by Directory System Agents (DSAs).

The following four models define the Directory services:

- (1) The informational model describes the Directory Information Base (DIB). The DIB contains all the information to which the Directory provides access. This model is concerned only with the logical structuring of the information.
- (2) The functional model describes interactions that take place between the various DSAs that comprise the Dictionary.
- (3) The organizational model describes how portions of the Directory tree map onto the DSAs. This includes issues of replication and access control.
- (4) The security model of Directory services describes the service in terms of authentication and authorization. ISO 9594-8, *OSI Directory Authentication Framework*, has now been transferred to SC21/WG1 (Security).

**4.3.4.2 Directory Standards.** (U) SC21/WG4 is working on OSI directories. ISO standards for the Directory are:

- ISO 9594-1, *Overview of Concepts, Models, and Service*, December 1988 [SC21 N 2751]
- ISO 9594-2, *Models*, December 1988 [SC21 N 2752]
- ISO 9594-3, *Abstract Service Definition*, December 1988 [SC21 N 2753]
- ISO 9594-4, *Procedures for Distributed Operations*, December 1988 [SC21 N 2754]
- ISO 9594-5, *Protocol Specifications*, December 1988 [SC21 N 2755]
- ISO 9594-6, *Selected Attribute Types*, December 1988 [SC21 N 2756]
- ISO 9594-7, *Selected Object Classes*, December 1988 [SC21 N 2757]
- ISO 9594-8, *Authentication Framework*, December 1988 [SC21 N 2758]
- Amendments to Parts 2-5, *Access Control*, PDAMs, December 1989 [SC21 N 4041] (DIS text for June 1991, and IS status in June 1992)
- Amendments to Parts 2-5, *Replication and Knowledge Management*, PCDAMs, July 1990 [SC21 N 4913] (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- Amendments to Parts 1-7, *Support of Nameform2* (WD text planned for June 1991, CD text planned for November 1991, DIS text for November 1992, and IS status in November 1993)

## UNCLASSIFIED

- Amendments to Parts 1-7, *Schema*, PCDAMs, July 1990 [SC21 N 4914] (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- Amendments to Parts 3,4, *Enhanced Search*, PCDAMs, July 1990 [SC21 N 4924] (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- WD 9594-9: *Directory Information Tree (DIT) Structure and Naming*, July 1990 (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- WD 9594-10: *Replication and Knowledge Management*, July 1990 [SC21 N 4913] (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- WD 9594-11: *Directory PICS Proforma*, July 1989 [SC21 N 4039] (new work item accepted by JTC1; a revised WD text is planned for June 1991, CD text for November 1991, DIS text for November 1992, and IS status in October 1993)
- *Test Suite for OSI Directory*, July 1990 [SC21 N 4951] (text recommended to JTC1 as a new work item)
- *Question on Standardization of Directory API*, July 1990 [SC21 N 4918] (recommended by SC21/WG4 for balloting within SC21).

**4.3.4.3 Enhancement to Directory Standards.** (U) CCITT SG VIII and SC21/WG4 are collaborating on enhancements to the Directory. Two areas being addressed are the Extended Information Model and Extended Search. The Extended Information Model work covers the generic way in which information is viewed in the Directory, from the viewpoint of both users and system administrators. The Extended Search work covers how extensions to the current searching mechanisms might be provided to offer a better service to the users of the Directory [Ref. 39].

(U) Extensions have been proposed to the DIT Structure Rule used to control the positioning of entries in the DIT based on the values of the Object Class attributes. The extensions would allow the subschema administrator to specify, within the portions of the DIB to which the subschema is applicable, criteria that allow the existence of entries based not only on the Object Class attributes of child entries and their parent entries, but also on the Object Class attributes of their other ancestor entries [Ref. 40].

(U) The concept of extensible matching rules is being developed in CCITT SG VII and SC21/WG4 for use in Directory and Enhanced Search. Capabilities such as approximate matching, diacritics-ignore matching, regular expressions, and word-sensitive searching are supported [Ref. 41].



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(U) Work on a replication abstract service for the Directory is based on MHS abstract service definition conventions (ISO 10021-3). An underlying assumption is that the replication abstract service will be realized by means of ASEs. Data transfer systems, external to the DSA, may be needed to carry shadow updates. Replication operations are Request Shadow, Request Update, Refresh Shadow, and Terminate Shadow [Ref. 42].

(U) EDI users have requirements for use of Directory in which the naming structure would not necessarily be country oriented but would enable the current trading practices that use certain trading partner names [Ref. 43].

(U) CCITT and SC21 are considering the following features and facilities for joint work on Directory [Ref. 44]:

- Inverted directories for Telex and Teletex services
- Additional information with or after the result of a query
- Query cost information
- Information about services, service instructions, tariffs, etc., in standardized formats, taking into account additional attributes
- Additional service controls
- Full functionality of access control mechanisms
- Ability of the user to indicate the desire not to receive partial results when service control maximum parameters are exceeded
- Return of multiple responses in groups of any specified number
- Administrative procedures for authentication
- Standardized error service messages
- Shadowing (controlled replication) of Directory information
- Geographical extension
- Consequences of distributed Directory services.

**4.3.4.4 Options for Directory.** (U) Two international groups are working on functional standards (profiles) for the Directory. The issues being addressed by the NIST OSI Implementor's Workshop Directory Services SIG and the EWOS/ETSI Directory Expert Group indicate options within the Directory standard and areas where baseline standards may be exceeded to address practical implementation problems. Examples of the issues and options are:<sup>5</sup>

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<sup>5</sup> (U) *Functional Standards for the X.500 Directory*, IST/21:1868, IST21/4/DIR, British Standards Institute, 4 October 1989.

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- **Classification of minimum schema capabilities.**
- **Classification of baseline structure rules--mandates the capability to access a standard Directory tree (which may be extended to a wide variety of entries).**
- **Definition of maximum APDU size--eases design of high-performance DSAs (e.g., to ensure the Directory can respond in seconds) and eases network problems in providing quality of service.**
- **Pragmatic constraints on filters--protects the Directory from pathological conditions and potentially simplifies design.**
- **Holes in distributed operation definitions--there are many undefined aspects for distributed operations (e.g., how to handle errors).**
- **Constraints on alphabets--Directory uses T.61 strings. Directory profiles are addressing rejection of strings that contain non-T.61 characters and restrictions on permissible characters (e.g., escape characters).**
- **Constraints on integer values--defines a minimum size integer that must be supported.**
- **Classification of authentication--mandate use of simple uncorroborated authentication that supports external authentication within a closed domain.**
- **Augmentation of attribute syntax rules--augments the standards material with practical rules.**
- **ASN.1 rules--mandates support of ASN.1 identifier tags that are three octets in length (and no longer) and requires constructed string elements not to be nested more than one deep.**
- **Strong authentication algorithms--proposing alternatives to the use of RSA™ (a licensed product) for digital signatures.**

### 4.3.5 Application Service Elements

(U) The services performed in the Application Layer of the OSI model can be thought of as application processes whose communication aspects are represented by application entities. The OSI Application Layer structure permits an application process to have multiple communication aspects and, hence, multiple application entities.

(U) An application entity is a collection of one or more ASEs. Each of the peer application entities have identical ASEs. Additionally, each ASE talks only with its peer in the remote application entity. The remainder of this section discusses the ASEs:

- **Association Control Service Element (ACSE), which provides association control and manages connections between application entities**
- **Commitment, Concurrency, and Recovery (CCR), which provides fault tolerance and manages error indication and recovery**
- **Reliable Transfer Service Element (RTSE), which manages bulk data transfers**

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- Remote Operations Service Element (ROSE), which manages request/reply interactions
- Remote Call Procedure (RPC).

(U) A typical application process might have a user element orchestrating the application entities' actions. This user element could use RTSE services to manage associations via ACSE services and could use the ROSE, which invokes RTSE services, to transfer data through the use of the presentation service.

### 4.3.5.1 Association Control Service Element (ACSE).

(U) The ACSE provides service to both user elements and to specific application service elements. The purpose of this service is to support the establishment, maintenance, and termination of application associations. Because the ACSE manages the association of application entities, all OSI applications contain an ACSE. The services provided by ACSE are:

- ASSOCIATE, which sets up an application association
- RELEASE, which releases an association in an orderly fashion
- ABORT, which terminates application association simultaneously with the underlying presentation and session connections.

(U) The ISO definition of the service is technically aligned with the 1988 CCITT recommendation on the ACSE service. The differences between the ISO definition and the CCITT definition are quite small and are not expected to affect interoperability between implementations written against either document [Ref. 30]. There are four relevant ISO standards:

- ISO 8649, *Service Definition for the Association Control Service Element (ACSE)*
- ISO 8650, *Protocol Specification for the Association Control Service Element (ACSE)*
- ISO 10035, *Connectionless ACSE Protocol Specification*
- DIS 10169-1, *Conformance Test Suite for the ACSE Protocol, Part 1: Test Suite Structure and Test Purposes.*

(U) In addition, ISO 8650 and 8649 have three draft addenda: *Authentication, Connectionless ACSE Service, and A-Context Management Service.* Further, ISO 8650 has a fourth proposed addenda on *Application Entity Titles.* WD 10035-2 is the *PICS Proforma for Connectionless ACSE Protocol.*

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### 4.3.5.2 Commitment, Concurrency, and Recovery (CCR).

(U) The CCR service and protocol standards are used to supply a more fault tolerant association than is possible with ACSE. The ACSE has two basic flaws [Ref. 9]:

- A system crash leaves ambiguous results.
- A lack of coordination of multiple systems could produce inconsistent results.

These flaws are resolved in CCR by adding the concept of commitment. The master asks the subordinate for a commitment to perform a task (request) before the call for the execution of the task (commitment) is made. This allows for a record to be kept by both the master and the subordinate as to the status of the task.

(U) Recovery is the process of determining the status of a task after an application or communication failure. The CCR service provides partial support for recovery; however, the actual recovery process is specific to the application.

(U) Concurrency is a concept that is necessitated by the concept of commitment. Once an application entity has offered to commit, conflicting requests cannot be made against the application until the commitment is fulfilled. Concurrency is the mechanism by which committed resources are "frozen" until the committed application is completed.

(U) There are two standards relating to CCR, and each has three draft addenda: *Enhancements*, *Session Mapping Changes*, and *Restart*. The ISO standards are:

- ISO 9804, *Service Definition for the Commitment, Concurrency, and Recovery Service Element*
- ISO 9805, *Protocol Specification for the Commitment, Concurrency, and Recovery Service Element*.

### 4.3.5.3 Reliable Transfer Service Element (RTSE).

(U) RTSE provides a service of reliably moving arbitrarily large objects from one application entity to another. The RTSE accomplishes this service by dealing with ASN.1 data types rather than a string of octets and by abstracting the complexity of the underlying service session into an easily usable service.

(U) When an application context contains an RTSE, it is the sole user of ACSE services and the presentation service. The RTSE is used to signal to application elements that a transfer has been completed successfully. The ISO standard for RTSE comes in two parts:

- ISO 9066-1, *Reliable Transfer, Part 1: Model and Service Definition*
- ISO 9066-2, *Reliable Transfer, Part 2: Protocol Specification*.

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### 4.3.5.4 Remote Operations Service Element (ROSE).

(U) Remote operations are a popular technique for building distributed applications. The ROSE manages operations for application entities via a mechanism that is analogous to services performed by CCR for data transfer. In its most primitive form, an operation is a simple request/reply interaction. The request, or invocation, consists of:

- An operation number--a unique identifier for the operation to be performed
- An arbitrarily complex argument--the "input" for the operation
- An invocation identifier--a unique identifier for a particular invocation
- A linked invocation identifier--an indication that this operation is being invoked as a part of the processing of another invocation.

(NU) An invocation can have one of three results:

- A result--an invocation identifier corresponding to the operation that succeeded and an arbitrarily complex result
- An error--an invocation identifier corresponding to the operation that failed, an error number uniquely identifying the error that occurred, and an arbitrarily complex parameter that provides clarifying information
- A rejection--an invocation identifier corresponding to the operation that was performed and a reason that describes the rejection that occurred.

(U) The standards that apply to the ROSE are:

- ISO 9072-1, *Remote Operations, Part 1: Model, Notation, and Service Definition*
- ISO 9072-2, *Remote Operations, Part 2: Protocol Specification.*

(U) ROSE is a set of communications facilities to distributed applications. ROSE was derived from the Remote Operations (RO) service defined in CCITT MHS-84. The standard (ISO 9072) also provides a notation for defining them (an extension of ANS.1). Remote operations service is asynchronous, so a client need not wait for a response before invoking another operation. ISO 9072 defines the structure of remote operations and the abstract services and protocol to support them. The services are generic in that their effect on the remote object is defined by their users.

(U) The basic interaction with a remote object is an operation that is similar to a procedure call in a programming language. An operation is invoked on a target object, to which the operation argument is passed. Operations have one of two possible structures, and invocations have two possible outcomes. Some operations return either a Result, when they are executed successfully, or an Error; other operations produce only a response (Error) if the operation fails.

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**4.3.5.5 Remote Calling Procedure (RPC).** (U) The ECMA standard for RPC is ECMA 127. As defined in ECMA 127, an RPC is a communication service to transfer procedure calls to a remote server and return results, errors, or associated call backs. One of the central notions of RPC is that of a stub. A stub builds protocol information for RPCs (marshalling) and translates protocol information to server procedure calls (unmarshalling). ECMA 127 defines an Interface Definition Notation (IDN) to facilitate the transfer of data across an interface. The IDN supports a union of programming language-specific data types such as pointers, arrays, and records, and primitive data types such as integers and bit strings. ECMA 127 limits the number of outstanding procedure calls to one per association, in order to prevent livelock situations and preserve fairness; it is unclear if this is the most efficient solution to the livelock problem. SC21/WG6 proposes to address RPC using an IDN that is based on abstract data types rather than on a union of programming language-specific data types.

(U) Text for DIS 10148, *Basic Remote Procedure Call (RPC) Using OSI Remote Operations* [SC21 N 3463], was based on ECMA 127 and submitted in 1989 on a fast-track ballot, which has failed. DIS 10148 has now been withdrawn, and a September 1989 proposal for a new work item was accepted by JTC1 in May 1990. The planned schedule for RPC is to CD text in January 1991, DIS text in January 1992, and an international standard in January 1993 [Ref. 45].

(U) The aim of the current work in ISO on RPC is to provide a mechanism for writing distributed applications that are both syntactically and semantically similar to a local procedure call. The scope of RPC includes a language-independent IDN for specifying interfaces between components of distributed applications. The RPC protocol for a particular interface definition is derived from the IDN. RPC is closely related to two projects in SC22: Common Language Independent Data Types and Common Language Independent Procedure Call Mechanism. It is not at all clear whether remote operations (ISO 9072) can be used to satisfy RPC requirements or whether collaborative work with CCITT will be conducted for RPC [Ref. 46]. SC21/WG6 has identified requirements for RPC and IDN [Ref. 47] and has begun coordination of these requirements with SC22/WG11 and CCITT SG VII.

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(U) ASN.1 may not be adequate as a basis for the IDN, even if extended for this purpose. Some requirements for the IDN identified in SC21/WG6 are [Ref. 48]:

- Be user friendly in the sense that an applications programmer can translate from the IDN to the programming language of choice in a straightforward, approximately one-to-one manner
- Be useable to automatically generate language-specific interfaces that support procedure calls using the RPC service
- Be useable to automatically generate the programming language-specific procedure declarations that correspond to the procedures in an IDN for use by a server.

(U) There would appear to be some danger of duplication of effort--and possibly even rival standards--unless RPC is brought together, in some manner, with ROSE [Ref. 49]. For example, ROSE has already standardized an IDN, called RO-notation, that uses ASN.1 as a language-independent way of describing the data types of the parameters. ROSE is already used widely, and a program of enhancements to allow it to meet additional needs is underway. However, ROSE is not even mentioned in the new RPC work item proposal.

### 4.3.6 Abstract Syntax and Basic Encoding Rules

4.3.6.1 Abstract Syntax Notation One (ASN.1). (U) At present, ASN.1 is the only abstract syntax language that exists in OSI. Abstract syntax languages describe data types in a machine-independent manner, thus freeing data representation from machine restrictions. For example, a protocol specifying that a data type is an integer need not concern itself with the number of bits required for the internal machine-dependent representation of this data type.

(U) ASN.1 has a rich syntax for describing data types and provides a macro facility for extending its grammar. According to Rose [Ref. 30],

ASN.1 is destined to become the network programming language of the 90's, just as the C programming language is largely seen as having been the systems programming language of the 80's.

(U) The pertinent specifications for ASN.1 are ISO 8824, ISO 8824/DAM1, ISO 8824/WDAM2, and recommendation X.208 from CCITT. The ISO specifications are compatible with those of CCITT, but include a few extensions [Ref. 9].

## UNCLASSIFIED

(U) The Framework for the Support of Distributed Applications (DAF), a new activity established by CCITT SG VII to standardize common aspects of distributed applications, has been working for various enhancements to ASN.1. There are presently five working documents for possible extensions to ASN.1 in the 1992 time frame. The areas covered by these documents are [Ref. 50]:

- Provide a firmer framework for the specification of table types and functions
- Improve current definitions of character strings
- Provide new encoding rules, Packed Encoding Rules (PER), Confidential Encoding Rules (CER), and Distinguished Encoding Rules (DER), to supplement or replace the current Basic Encoding Rules (BER)
- Improve machine processability
- Provide miscellaneous enhancements.

**4.3.6.2 Basic Encoding Rules (BER).** (U) The mechanism that translates the abstract representation of data to its physical characteristics, either for machine storage or for transmittal, is called transfer syntax. The transfer syntax in OSI corresponding to the abstract syntax ASN.1 is contained in *Basic Encoding Rules*, ISO 8825.

(U) The BER use a "TLV" approach to mapping between abstract and physical data: each data type is encoded as a Tag, a Length, and a Value. The tag field corresponds to the label defined by the data type's abstract syntax, the length field normally indicates how many octets are used for the encoding of the value portion of the data type, and, finally, the value of the data type is encoded.

(U) The relevant standards for BER are ISO 8825, ISO 8825/DAD1, ISO 8825/DAD2, and CCITT X.209. Again, the ISO and the CCITT specifications are compatible.

### **4.3.7 Other Standards**

**4.3.7.1 TP and ODP.** (U) The TF may make use of two services that may be seen as outside the OSI Reference Model: distributed TP and ODP. These services are primarily applicable to the DMF. The status of the standards defining them is described in Section 6.2.6 (TP) and Section 6.2.7 (ODP).

**4.3.7.2 VT and JTM.** (U) VT is specified in ISO 9040 (services) and ISO 9041 (protocols). JTM is specified in ISO 8831 (services) and ISO 8832 (protocols). Further analysis is needed to determine whether these features are applicable to the ATCCIS TF. The standards for these services are discussed in Chapter 9.



## UNCLASSIFIED

**4.3.7.3 Time Synchronization.** (U) CCITT SG VII(Q19) has begun work on a time synchronization service (TSS). The work is based on the US DoD RFC-1119, *Network Time Protocol (NTP)*, currently being used by the Internet community (see Section 4.3.7.5). The TSS time standard is based on the Coordinated Universal Time (UTC), determined by the Bureau International de l'Heure (BIH) from astronomical observations provided by the US Naval Observatory and other observatories.<sup>6</sup>

(U) The TSS can be used in distributed systems in several ways: to measure elapsed time, to preserve the order of events, and to coordinate activities of a set of processes. The elements of the TSS model are the following:

- Local clock--an oscillator that, once set with a time value, attempts to maintain a local estimate of global time
- Time user agent (TUA)--the user of the TSS
- Time synchronization agent (TSA)--the provider of the service.

(U) Each TUA interacts with a set of TSAs to obtain information, from this information to determine the best estimate of global time, and to set the local clock to this value. The TUA may adjust the frequency of the local clock to compensate for drift in the hardware. Synchronization of clocks is by continuous distribution of time--TUAs build up information based on samples of a number of servers for the delay characteristics of the communication path between itself and each of the TSAs.

(U) Time is distributed through the system via a hierarchical set of TSAs. Stratum 1 TSAs, at the top of the hierarchy, have local clocks that are set by external means from the most accurate sources available. These means could include radio receivers and such satellite devices as the Global Positioning System. Clocks that have been set by TUAs that have obtained time information directly from Stratum 1 TSAs are said to be at Stratum 2. At each level of the hierarchy, except the top and bottom, each TUA may have an associated TSA that can be used to distribute time information in the local clock to TUAs at the next lower level of the stratum. It is expected that there will be a number of Stratum 1 TSAs, some being provided as public services. Each site using LANs would have two or more Stratum 2 TSAs, and each LAN segment could have two or more Stratum 3 TSAs. Individual end systems might not need to have clocks at much more than Stratum 4 [Ref. 51].

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<sup>6</sup> (U) Discussion on time synchronization was taken from SC21 N 4565, *Liaison Statement to SC21/WG4/WG7 on Time Synchronization*, CCITT SG VII, March 1990.

## UNCLASSIFIED

**4.3.7.4 ECMA Model for Management.** (U) In January 1987 the European Computer Manufacturers Association (ECMA) established [Ref. 52] an abstract model for the management aspects of OSI. The framework provided by ECMA is designed to form the basis for the definition and specification of services and protocols that enable the planning, organizing, supervising, and controlling of the communication service that forms a part of a distributed information processing system. In this context, OSI management is defined as the collection and interchange of information necessary for the management of those aspects of open systems that are relevant to Open Systems Interconnection. The abstract model addresses standardization in two areas:

- Semantics of the management information transferred or extracted from the management information base (where the structure of the information within the management information base is viewed as a local matter and not subject to management standardization)
- Services and associated protocols for the transfer of management information between open systems; this requires that both the syntax and semantics of the information transferred be specified.

ISO standards for OSI network management are being developed by SC21/WG4; they are discussed in Section 8.2.

**4.3.7.5 US DoD Standards for Interneting Networks.** (U) The US military has developed and widely implemented (e.g., in the Defense Data Network) unique protocols for Layers 3 and 4 that are not OSI conformant. These protocols will serve as a costandard for the US DoD until transition to OSI is complete. These protocols are identified since they will be implemented in the transition strategy for tactical data systems to be fielded in the 1990s by the US Army [Ref. 53]. Details are provided in Appendix C (Section 2.7). A connection-oriented transport service (CLNS) is provided by the Transmission Control Protocol (TCP), which provides end-to-end reliability, and a connectionless-mode network service is provided by the Internet Protocol (IP). The IP provides connectivity over diverse network technologies.

(U) Historically, TCP/IP arose to meet the need for reliable transmission of information over media that did not guarantee reliable, error-free delivery of information (e.g. Ethernet, Packet Radio, and Satellite). The Defense Advanced Research Projects Agency (DARPA) sponsored research into survivable multi-media packet networking in order to improve the only existing network, ARPANET. This research resulted in the US DoD sponsored Internet suite of protocols.

(U) TCP/IP corresponds to Layers 3-4 of the OSI model. In terms of network service, the closest comparison is between the connectionless network service

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(CLNS) and the service offered by the IP. The services offered by the the OSI CO-mode TP4 and the TCP are similar, however, three major differences exist:

- (1) The TCP service is stream-oriented, whereas the OSI transport service is packet-oriented.
- (2) The TCP service offers a graceful release, whereas the OSI offers this release in the session service.
- (3) The TCP has an urgent data facility, whereas the OSI has an expedited data service.

(U) The major emphasis of the Internet suite is on the connection of diverse network technologies (Layers 1-4). In addition, several applications for use in the Internet suite are available (see Appendix H; for a more complete listing see Reference 20):

- Simple Mail Transfer Protocol (SMTP)
- File Transfer Protocol (FTP)
- TELNET
- Domain Name System (DNS).

(U) These services are the analogs of MHS, FTAM, VT, and Directory, respectively. All of the Internet application protocols are rather simple. They offer a basic level of service and have a very narrow scope. The OSI applications are, in general, functionally more capable than the corresponding applications in the Internet suit [Ref. 30]. In fact, the US government, as well as manufacturers and users, endorse OSI rules at the upper layers while preserving the established TCP/IP networks for the transport of information [Ref. 54].

(U) The technical body that oversees the development of the Internet suite of protocols is termed the Internet Activity Board (IAB). The IAB is composed of senior researchers, the majority of whom are the designers and original implementors of the Internet suite. Any member of the Internet community can design, document, implement, and test a protocol for use in the Internet suite. The IAB requires that protocols be documented in the Request for Comments (RFCs) series.

(U) There are four RFCs that define the status of documents in the RFC series. The first is the *Assigned Numbers* [Ref. 55], which lists the assigned values used for the parameters in the Internet suite of protocols. The second is *Official Protocols*, which lists all official protocols. The third is *Gateway Requirements*, which lists all protocols and practices that relate to network nodes. And the fourth is *Host Requirements*, which lists all protocols and practices that relate to host nodes. These RFCs are periodically updated, with the most recent document always taking precedence.

## UNCLASSIFIED

**4.3.7.6 ISO Development Environment (ISODE).** (U) ISODE is non-proprietary software, developed as a tool to study OSI. In the current vacuum of OSI implementations, however, ISODE has become a default reference implementation of the OSI upper-layers, a platform for deploying OSI services, and a means for transitioning from TCP/IP to OSI protocols.

(U) The ISODE software supports various OSI protocols and applications. ISODE is aligned with US GOSIP. The current modules include the following [Ref. 30]:

- OSI transport service (TP0 on top of TCP, X.25, and the CO network service; TP4 for SunLink OSI)
- OSI session, presentation, and association control services
- ASN.1 abstract syntax/transfer notation tools
- OSI reliable transfer and remote operations services
- FTAM/FTP gateway
- OSI Directory services
- OSI VT (basic class and TELNET profile).

#### **4.4 Assessment of Coverage by Standards**

(U) MHS-88 provides a number of the military features identified by TSGCEE SG9 WG2 (Upper OSI Layers) for a Military Message Handling System (MMHS). Work on the draft STANAG for MMHS that was based on MHS-84 was completed as an intercept strategy, and analysis is now being performed in TSGCEE SG9/WG2 to identify additional features required for military application of MHS (See Section 10.3.8). Analysis of the relationship of MHS to ACP 129 and Abstract Syntax Notation One (ASN.1) to STANAG 5500 and other message standards is needed. NATO has requirements for media independent data communications protocols (e.g., for Link 1 replacement) that have not yet been developed; these standards could be applicable to the TF, and more work needs to be done in this area (see Section 10.3.4).

(U) Allied Communications Publication (ACP) 127 is a NATO standard for message handling services. In a comparison of the 65 service elements of ACP 127, a recent analysis [Ref. 56] has identified 55 as common to MHS-88. An additional five service elements were shown to be related to, but not the same as, those in ACP 127:

- Precedence levels (MHS-88 provides an Importance Indicator)
- Message identification (MHS-88 provides somewhat different features)
- Prosign C (MHS-88 has an obsoleting indication)

## UNCLASSIFIED

- Bell signal (MHS-88 provides a stored message alert)
- Date-time group (MHS-88 has a submission time stamp).

Five services provided in ACP 127 are not supported in MHS-88: financial accountability, service message, network continuity indication, off-line accountability, and tracer action. Version 4 of STAMINA provides MHS-84 services and ACP 127 functionality (see Section 11.7).

(U) A key feature required for the TF is the Directory service that may be fully addressed by CCITT X.500-1988 standards. Further analysis is needed of the features of, as well as the requirements for, Directory services.

(U) SC21/WG1 is still refining the OSI Reference Model regarding the specification of the boundaries of Layers 1 and 2. Some of the protocols needed for the TF may be determined to lie outside the Reference Model. These might include forward error correction coding (several ISO standards provide for error detection) and other mechanisms such as interleaving of bits from a sequence of octets to reduce the impact of the environment on certain transmission media. Protocols for handling requirements of cryptographic devices (e.g., synchronization) and media access may also lie outside the Reference Model. Standardization of these features within NATO should, wherever possible, be accomplished with media-independent STANAGs.

## **5. THE SERVICE CONTROL FACILITY (SCF)**

### **5.1 Description of the SCF**

(U) The SCF is defined in WP 24 [Ref. 3] as a logical entity that binds together all the facilities in a given ensemble, together with any National facilities that are supported by that ensemble. There is no concept of peer interactions between SCFs.

### **5.2 Standards to Support the SCF**

(U) The selection of standards for the SCF is more difficult than for the TF for two reasons: (1) there are far fewer relevant international standards, and (2) the selection of standards for the SCF, more than for the other basic facilities, is nearly an implementation issue. The SCF appears to be outside the scope of the OSI model.

(U) In WP 24, Annex C, it is pointed out that one option for providing SCF functionality is through the selected operating system (possibly with some modifications). Potential operating system interfaces are described in the subsections that follow. Another option is to define a separate entity for the SCF; however, no standard appears to exist for such an entity, and the required services may be too ATCCIS specific to allow standards to be employed.

(U) Continued analysis of standards relevant to the SCF, including the consideration of options within specific standards, is dependent on the selection of base standards (e.g., a specific operating system). The PWG considers such a selection to be implementation dependent and wishes to leave open the possibility of other implementations that are presently less standardized (e.g., the use of a bare machine with an Ada run-time environment). Further analysis of potential SCF standards would be based on further definition of standard operating system functions and interfaces or refinement of SCF basic service requirements.

#### **5.2.1 Portable Operating System Interface for Computer Environments (POSIX)**

(U) The Portable Operating System Interface for Computer Environments (POSIX) is an interface standard for operating systems that is designed to be vendor independent and to promote application portability. Development of the POSIX standards is through the Institute of Electrical and Electronics Engineers (IEEE) Computer Society's Technical Committee on Operating Systems (TCOS). The TCOS has formed a large number of working groups. These working groups and the POSIX standards being

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developed are identified by the same label, namely P1003 with an appropriate extension. The scope and status of the POSIX work in IEEE is provided in Table 6 [Ref. 57].

Table 6. (U) POSIX Standards Being Developed by the IEEE Computer Society, Technical Committee on Operating Systems for Submission to ISO Through ANSI

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| <p><u>P1003.1, POSIX - System Interface and C Bindings</u>--defines a standard operating system interface and environment to support application portability at the source code level (approved by ANSI in November 1989 and by ISO as ISO 9945-1.)</p> <p><u>P1003.1a</u> Provides editorial corrections that respond to concerns in balloting.</p> <p><u>P1003.1b</u> Adds functions and provides preparatory work for language-independent specifications. (IEEE balloting planned for late 1991.)</p> <p><u>P1003.2, Shell and Utilities</u>--defines a standard source-code-level interface to shell services and common utility programs for applications programs. (Draft #10 was submitted for IEEE ballot and to ISO as DP 9945-2.)</p> <p><u>P1003.2a</u> <i>User Portability Extensions</i>. (IEEE ballot planned for August 1990.)</p> <p><u>P1003.3, Test Methods: General</u>--defines general requirements and test methods for test suites to measure conformance of an implementation to IEEE POSIX and related standards; seeks to define what to test rather than how to test and promotes the development of testable standards. (Draft #11 was submitted to IEEE ballot in February 1990; approval of final text is expected late in 1990.)</p> <p><u>P1003.3.1, Test Methods: System Interfaces</u>--defines test methods and requirements for implementations of test suites to measure conformance of an operating system product to POSIX P1003.1. (IEEE ballot in February 1990; approval of final text expected late in 1990.)</p> <p><u>P1003.3.2, Test Methods: Shell and Utilities</u>--defines test methods and requirements for implementations of test suites to measure conformance of an operating system product to POSIX P1003.2. (IEEE balloting planned for early 1992; approval of final text expected late in 1992.)</p> <p><u>P1003.4, Real-Time Extensions</u>--defines a real-time extension to POSIX environments. (Balloting in May 1990; approval as an IEEE standard expected in the spring of 1991.)</p> <p><u>P1003.4a, Threads</u>--defines interfaces for handling multiple threads of control within a single POSIX P1003.1 process. (IEEE balloting planned for August 1990.)</p> <p><u>P1003.4b, Language-Independent Specifications</u>--rewrites interfaces defined in P1003.4 and P1003.4a into a language-independent binding. (Balloting planned for December 1990, with approval late in 1991.)</p> <p><u>P1003.4c, Extensions to P1003.4</u>--extends interfaces defined in P1003.1 and P1003.4 to include additional real-time facilities. (Balloting planned for 4Q 1991.)</p> <p><u>P1003.5, Ada Language Binding</u>--determines the Ada environment interface and Ada extensions required for POSIX; provides a specification for the Ada environment interfaces and Ada required extensions so that applications programs can be written to operate consistently on all conforming POSIX/Ada environments. (Balloting planned for August 1990 and approval of final text early in 1991.)</p> <p><u>P1003.6, Security Interface for POSIX</u>--develops specifications for standard interfaces to security services and mechanisms for portable applications to include Systems Call Interfaces and System Commands. (Balloting planned for May 1991 and approval in early 1992.)</p> <p><u>P1003.7, System Administration Interface</u>--defines a standard interface to utility programs for administering systems that conform to POSIX. (Balloting planned for 1Q 1992 and approval in 1993.)</p> |
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Table 6. (U) (Continued)

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| <p><b>P1003.8, Transparent File Access (TFA)</b>--develops system interfaces and other mechanisms to permit portability of applications into environments where files, directories, etc., may reside on remote systems. (Balloting planned for 2Q 1992.)</p>   |
| <p><b>P1003.9, FORTRAN Language Binding</b>--defines a FORTRAN-1977 language binding to applicable POSIX interfaces and functionality as specified in P1003.1,2,4, etc., and establishes an interface for FORTRAN to POSIX such that FORTRAN applications using POSIX functionality will be portable at the source code level. (Work based on results of /usr/group; balloting planned for August 1990.)</p>             |
| <p><b>P1003.10, Supercomputing Application Environment Profile (AEP)</b>--develops an AEP for supercomputing environments. (Balloting planned for 4Q 1990.)</p>  |
| <p><b>P1003.11, Transaction Processing AEP</b>--develops an AEP for transaction processing environments. (Balloting planned for Spring 1991.)</p>  |
| <p><b>P1003.12, Protocol Independent Interfaces</b>--defines programmatic interfaces that allow a portable application to communicate with another entity in the network such that the application may be independent of the underlying protocols. (Balloting planned for 1993.)</p>   |
| <p><b>P1003.13, Name Space/Directory Services</b>--provides a standard interface supporting the development of applications that use Directory services. (Status is uncertain; TCOS support withdrawn April 1990.)</p>   |
| <p><b>P1003.14, Real-Time AEP</b>--defines an AEP for real-time applications using the POSIX interfaces; addresses three profiles: full-function real-time system, embedded control system, and intermediate real-time system. (Balloting planned for early 1991.)</p>   |
| <p><b>P1003.15, Traditional Interactive Multiuser System AEP</b>--defines an AEP based on P1003 work and related standards that describes a traditional model of an interactive, multiuser system; establishes a profile to reflect traditionally understood functionality and addresses both application developers and users. (Status uncertain as work not yet approved by TCOS; balloting planned for mid-1991.)</p> |
| <p><b>P1003.16, Multiprocessing Application Support AEP</b>--defines an AEP for multiprocessing applications environments based on relevant POSIX standards. (Balloting planned for mid-1991.)</p>   |
| <p><b>P1003.17, Batch Environment Amendments</b>--define utilities, library routines, system administration interfaces, and a host-to-host protocol to provide a network queueing and batch system in a POSIX environment. (Balloting planned for July 1991.)</p>  |

Source: *Briefing on POSIX*, NIST, 12 June 1990, UNCLASSIFIED.

(U) The POSIX standard recently approved by IEEE was provided to ISO by the American National Standards Institute (ANSI). WG15 of SC22 within the JTC1 was formed in September 1987 and assigned responsibility for POSIX. The IEEE standard P1003.1<sup>7</sup> has been adopted as ISO 9945-1. WG15 eventually intends to remove the focus on UNIX and the C language to create a generic interface specification between any language and a multiuser environment.

<sup>7</sup> (U) P1003.1-1988 has been adopted as a US standard: Federal Information Processing Standard (FIPS) 151-1, March 1990. It is mandated for all US Government departments and agencies: "...shall be used ... where POSIX-like interfaces are required."



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(U) Part 2 of the POSIX standard is for interfaces to shell and utilities (P1003.2). Draft #9 of IEEE P1003.2 has been submitted<sup>8</sup> to ISO through ANSI as DP 9945-2 and is currently undergoing a formal approval process. Part 3 will be *System Administration*. It has also established a project to describe POSIX by use of the Vienna Development Method-Specification Language (VDM-SL) as an FDT. All three regional workshops (AOW, EWOS, and NOIW) have accepted POSIX as part of their recommendations.

(U) ANSI is developing a standard interface for the C language (X3J11) that is compatible with POSIX. As shown in Table 6, IEEE is working on Ada and FORTRAN bindings for POSIX; the Ada binding should be complete in 1991. POSIX is intended to be compatible with both Database Language SQL and information resource dictionary system (IRDS) database management languages, as well as with OSI data communications and interprocess communications. Other aspects of POSIX standards work needed for the SCF are the security interface (1992), file access (1992), real-time extensions (late 1991), and protocol independent interface (1993) [Ref. 58].

### 5.3 Standards Activities and Emerging Standards

(U) Standards activities in areas related to the SCF have been primarily in the area of developing international, nonproprietary standards for interfaces to operating systems. It appears unlikely that an international standard for an operating system will be developed, in part because operating systems are closely tied to the hardware architecture of vendor products. International standards for entities other than operating systems that provide the SCF functionality have not appeared and no work is known in this area.

(U) As indicated earlier, POSIX is becoming a widely accepted approach to standardizing interfaces to operating systems; the initial standard for POSIX (ISO 9945-1) has been completed. Consortia have been formed to develop and promote profiles of standards that could be the basis for open environments and portable systems within these environments. All the consortia have adopted POSIX; however, there are differences in the approaches being taken. Activities of these consortia in the POSIX area are discussed in this section; additional information on portability profiles is provided in Chapter 8.

(U) The international nonprofit consortium X/Open<sup>TM</sup> is developing extensions to UNIX<sup>TM</sup> System V Interface Definition (SVID) to a distributed (two-phase) transaction processing environment that meets OSI standards. A layered functional model for this

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<sup>8</sup> (U) P1003.2 (Draft #9, 1989) is currently undergoing a formal approval process as a FIPS for the US. Approval as a mandatory standard is expected early in 1991.

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processing environment that meets OSI standards. A layered functional model for this environment that consists of resource, commit, and transaction management has been proposed. This model requires certain extensions to the UNIX<sup>TM</sup> kernel (guaranteed output to files and concurrent input from peripherals). The X/Open System V Specification (XVS) is the initial recommended standard for the operating system. The extensions would be part of a Common Applications Environment (CAE), a concept to promote software portability. This would be achieved by adopting and adapting existing industry and "*de facto*" standards, rather than by creating a new standard. Future goals for the CAE are alignment with POSIX P1003.1 (with a large number of extensions) and ANSI X3J11 C together with interfaces for Indexed Sequential Access Method (ISAM) and an embedded standard Relational Database Language (SQL). The X/Open version of ISAM is based on a major (implementation nonspecific) subset of C-ISAM Version 2.10 (January 1985) from the Informix Corporation. The initial X/Open version of SQL is not fully compliant with ANSI X3.135-1986 [Ref. 59-61]. Standards recommended for the CAE are discussed in Section 9.4.3.

(U) Another approach to developing standard interfaces to UNIX-type systems is being taken by the Open Software Foundation (OSF), an international consortium formed in May 1988. The emerging operating system interface standards would initially be based on AIX<sup>TM</sup>, an IBM version of UNIX interfaces. The operating system is planned to be fully compatible with the POSIX standards. In addition to the operating system, the other elements of the OSF architecture are: languages, user interface (e.g., distributed window manager), graphics libraries, networking services, and database management. Each element in the OSF Level Zero application environment specification is defined by existing ISO, FIPS, ANSI, and military standards. OSF is a non-profit, industry-supported research and development organization whose activities are designed to promote an open, portable application environment.

(U) A third approach to developing POSIX-conformant operating systems is underway. This approach is based on providing a version of the Berkeley UNIX with a POSIX interface.

(U) A fourth approach has been announced by the consortium called OPEN88. This consortium is reported to be planning to have a POSIX-conformant version of UNIX in 1990.

(U) The NIST has developed an Applications Portability Profile (APP) as an approach to identifying standards that could be used to achieve an open environment that would ensure a high degree of applications portability. In addition to the operating system, this environment includes data management, data interchange, network services, user

## UNCLASSIFIED

the key, in addition to open systems interconnection, to such an environment. NIST has identified [Ref. 62] a number of areas in which the current POSIX definition must be extended in order to "provide full operating system functionality." These extensions include shell and tools, system administration, and terminal interface extensions. Extended POSIX would be part of an integrated set of non-proprietary standards. Efforts are still required to specify the appropriate standards and "bindings" for the open environment. The complete APP proposed by NIST, together with the status of relevant standards other than POSIX, is discussed in Section 9.4.3.

### 5.4 Options Within the Standards

(U) POSIX standards are still in an early stage of development. Extensions to the draft standards currently available will increase functionality and reduce the options not yet addressed by the standards, specifically in the areas of language bindings, tools, and administration.

### 5.5 Assessment of Coverage by Standards

(U) While an operating system could provide SCF services, such services could potentially be provided in other ways. Standardization of operating systems appears unlikely and not required for ATCCIS. Further, there is no need to select a standard operating system for ATCCIS, since such a selection is viewed as an implementation issue left to the nations. When mature, adopting the POSIX interface standard for ATCCIS appears to be an attractive option, both to achieve some of the SCF functionality and to promote applications portability among the nations during implementation. Adoption of POSIX would probably not fully meet SCF requirements. However, further refinement of the SCF requirements and extension of the POSIX standard are needed to assess additional requirements for ATCCIS.

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### 6. THE DATA MANAGEMENT FACILITY (DMF)

#### 6.1 Description of the DMF

(U) The DMF for ATCCIS is defined in WP 24 as a logical entity in each ensemble that provides services for manipulating data objects to support the transfer of information between systems. The purpose of data management is to represent the meaning and relationships of the information items required to perform key tasks, to ensure meanings and relationships are preserved when information is exchanged with another ATCCIS system, and to ensure changes to data items in ATCCIS systems are applied consistently wherever these items are stored. The DMF provides the services related to transaction processing and database management, whereas the exchange mechanisms are provided by the Transfer Facility (TF).

(U) Peer interactions between two DMFs will be of two forms: either a DMF will be sending an update or it will be requesting data. One or more standard query languages will form the basis of the peer-to-peer protocol for the exchange of data between ATCCIS systems. More than one data model (e.g., relational, hierarchical, image/map oriented) may be required for the DMF. The information transfer services are primarily constrained by finite communications bandwidth and security. Security is discussed in Section 8.1.

(U) The DMF will provide mechanisms to accurately represent the meanings and relationships of the information items to be managed. These mechanisms include the database system, the conceptual schema, and ATCCIS domains. For each ATCCIS data model to be supported, these mechanisms will provide a standard way of representing the data, including support for common data definitions. (The definitions as well as the data would be standardized during the implementation phase of ATCCIS.) An example of one type of support that could be provided is a data dictionary system, which could be used by ATCCIS conformant systems to maintain common data definitions and representations. Another example is the data definition language (DDL) that may be provided with a database system or language. The DDL must be rich enough in its forms of expression to have attributes required of both commercial and military systems. For example, it needs to have the capability to recognize several types of hierarchy for data classification and compartmentalization and be trusted to permit access by users with varying levels of authorization for these classification levels and compartments.

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### 6.1.1 Partitioned, Partially Replicated Database System

(U) As described in WP 24 [Ref. 3], Annex A, data transfer services in ATCCIS will be provided by a partitioned, partially replicated database system. Partitioning means that the entire ATCCIS database is segmented into disjoint parts that are held at geographically separate locations. Some of the parts of the ATCCIS database are copied or replicated at other locations to ensure survivability or to provide more rapid local access. A partitioned, partially replicated database provides sufficient flexibility for efficient exchange of information in a manner that minimizes usage of communication by permitting either "push" access (for updates) or "pull" access (for queries).

### 6.1.2 Conceptual Schema

(U) A common conceptual schema will define all ATCCIS data related to information exchange.<sup>9</sup> The ATCCIS database will be segmented or partitioned into replication domains, each owned and managed by a specified subfunctional area (SFA). Each replication domain has one master copy and may have other copies referred to as slave copies. A single DMF would be able to access some, but not all of the master and replication domains.

### 6.1.3 Domains

(U) Each domain comprises two parts. One part (domain details) provides the characteristics and control information for the domain. Examples of possible domain details are: name, owning SFA, home ATCCIS ensemble for the master domain, list of permitted users, component addresses for the replication domains, and security classification parameters. The other part of a domain (domain data) provides the values of each data item. The representations of some features of a domain, such as data item characteristics, data relationships, and data dictionaries, are implementation dependent and have therefore not been specified.

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<sup>9</sup> (U) The schema may not identify information managed uniquely by a headquarters or a national system.

## UNCLASSIFIED

### 6.1.4 Required Services

(U) The DMF provides these basic services [Ref. 3, Annex A]:

- Data definition--provides a common understanding between systems on the attributes and meaning of data.
- Local queries--queries that can be satisfied by a data item or a set of items as specified in parameters supplied in the query, subject to authentication of the requestor's identity before issuing the data, such that the data resides in either a master or slave copy at the location where the query is made.
- Remote queries--transfers, from a remote master or slave copy, a data item or a set of items as specified in parameters supplied in the query, subject to authentication of the requestor's identity before issuing the data, from a location other than the one where the query originated.
- Consistency control--ensures that any updates to values of data items in a slave copy ultimately become the same as the values in the master copies of the relevant domain; consistency control also ensures that update transactions are applied in the correct order.
- Local updating--provides for changing the values of a data item or set of data items for a domain, where the master copy is held at the same location as the one where the update originated.
- Local slave updating--provides for changing the values of a data item or set of data items for a slave domain, but without replication of the updates.
- Remote updating--provides for changing the values of a data item or set of data items for a domain, where the master copy is at a remote location; these operations are subsequently directed to all slave copies of the relevant domain.
- Integrity of replicas--ensures that each replica, together with deferred updates, can be used to replace the master domain in the event of a system failure.
- Management of distribution--supports the partitioning and partial replication of the databases.
- Recovery from failure--provides mechanisms to decide that there has been a failure, allows recovery from failure, and permit a slave copy to become a master copy.
- Change of command--supports change of location of command (COLOC) and succession of command (SUCOC) by permitting a slave to become the master and by permitting new slave copies to be designated dynamically.
- Database statistics--provides status and usage data for the system manager.
- Database initialization--provides for the creation and loading of initial values of a database and its replicas when the system is initialized.

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(U) In addition, the DMF will provide the following management services:

- Create domain--creates a new, empty domain, either as a master copy or for use as a replication copy of a domain.
- Delete domain--deletes a domain and erases all data in that domain. (When applied to a master copy it will delete all associated replication copies.)
- Transfer domain--causes, when proceeding to normal completion, the master of the domain to become a slave copy and the slave copy at a designated replication component to become the master.
- Assume domain--provides for change of ownership of a domain.
- Unassume domain--provides the capability to resolve the situation in which more than one ATCCIS component has exercised assumption of the same domain by designating another domain as the master.
- Amend domain--provides for changing the characteristics of a domain, such as the list of users or the replication list, by the owner or other authorized user.
- Details domain--provides for query of the details or characteristics of a domain by an authorized user.
- Copy domain--copies the entire contents of a domain, both characteristics and data, to a replication copy. (Space for the copy is first created by "create domain.")
- Restore domain--allows the owner of a domain to recreate the data in the master copy of the domain by copying it from a replication copy, in support of data recovery after failure.
- Advise domain--allows an ATCCIS component to be interrogated to see if it holds a copy of a domain. (This permits components who have lost and then reestablished communications to find out whether the replication list is correct.)

(U) Some options for standardizing the appropriate features of domains are inherent in the discussions in the sections that follow. Some services being evaluated to provide database operations (not yet adopted) imply implementation of a relational database architecture. Examples of database operations are: select, update, delete, insert, project, product, union, intersect, difference, divide, join, and equijoin.

### 6.2 Standards to Support the DMF

(U) This section primarily addresses the technical aspects of data management. The procedural aspects of data management are addressed in Sections 6.5 and 6.6. The Reference Model for Data Management described below applies to both the technical and procedural aspects.

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### 6.2.1 ISO Reference Model for Data Management

(U) The Reference Model for Data Management is CD 10032. Development began in 1988 and a second CD text was distributed in 1990. The Reference Model for Data Management is expected to take 2 more years to complete. Issues to be resolved for this reference model include distributed operation and export-import concepts and requirements. Coordination with ODP is required.

(U) CD 10032 includes in the scope of data management the description, creation, modification, use, and control of data in information systems. The model provides a framework for identifying interfaces; positioning interfaces relative to each other; identifying facilities provided at each interface; identifying the process that supports each interface and, where appropriate, the specific data required for this support; positioning the use of the interfaces in terms of the information system's life cycle; and identifying the binding alternatives associated with each interface. The concepts defined in the model may be used to define the services provided by particular database management systems or data dictionary systems. The data management field of application concerns any user--human or applications program--who wants to request services for management and storage of information in a persistent manner.

(U) SC21/WG3 is preparing a technical report, *Tutorial for Reference Model of Data Management*, that will address the following topics [Ref. 63]:

- Tutorial aspects for the Reference Model of Data Management
- Analysis of current database standards in terms of the Reference Model concepts
- Analysis of data management services using data flow diagrams
- Description of current database standards with respect to the requirements of the Reference Model.

### 6.2.2 Data Definition and Manipulation Language Standards

(U) There are now two data manipulation language standards approved by ISO, ANSI, and FIPS: NDL<sup>10</sup> and SQL.<sup>11</sup>

**6.2.2.1 Database Language NDL.** (U) Database Language NDL (ISO 8907, ANSI X3.133-1986, FIPS 126) is an outgrowth of 1978 CODASYL

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<sup>10</sup> (U) NDL is not an acronym; historically, the term derived from the concept of a network data language.

<sup>11</sup> (U) SQL is also not an acronym; historically, the term derived from the concept of a structured query language, but today represents much more.



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specifications using a network model for a DDL and a data manipulation language (DML). NDL is characterized, in part, by extensive use of logical pointers. These pointers support such facilities as FIND NEXT (push down in a stack) and FIND OWNER (pop up in a stack). The specification work was conducted from 1981 to 1986 by the ANSI X3H2 Database Committee. No follow-on standards activities are being conducted by ISO or ANSI for NDL [Ref. 64, 65].

**6.2.2.2 Database Language SQL.** (U) SQL (ISO 9075, ANSI X3.135-1986, FIPS 127) is based on a relational database model; the specification work was conducted from 1982 to 1986 by the ANSI X3H2 Database Committee. Future work in the standards for database management systems by ISO and ANSI/X3H2 will be on distributed database processing (e.g., remote data access protocol) and extensions to SQL.

(U) Both ISO and ANSI are working closely together and in parallel on SQL2 (CD 9075.2), a follow-on standard. A draft proposal version of the SQL2 standard was released in 1989. SC21 has recommended that SQL2 proceed to a second CD ballot in July 1990. Due to the length of the document, 5 months has been allowed for comments. An editing meeting is planned for January 1991, IS text is expected in 1992. SQL2 is expected to incorporate the following draft addenda:

- Addendum 1 (ISO 9075 AD1, *Integrity Enhancement Feature*) provides for check clauses, default clauses, and referential integrity constraints.
- Addendum 2 (SC21 N 2663) would formally incorporate the appendix in ISO 9075 on embedded SQL for COBOL, FORTRAN, PL/1, and Pascal as a standard. Further, it would extend standards for embedded SQL to two more programming languages, Ada and C.

(U) Work has already begun on SQL3 (WD 9075.3), which is planned to become a standard about 1993. SQL3 would contain the following features:

- Generalized triggers (similar to IF...THEN statements; based on a condition of data, not time)
- Generalized assertions (given a certain condition, to trigger integrity checks on the database; e.g., to do before and after validation on values in the database)
- Recursive expressions (these allow an open-ended subordinate assertion, e.g., to completely search a tree--currently, only finite queries to specified levels are permitted)
- Escape from SQL to call external features
- Basic capability for user-defined data types (the only structure in SQL is a table; this allows the user to declare a domain separate from a table)

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- Support for subtables, provided through inheritance and generalization features
- Appropriate support tools for object-oriented and knowledge-based systems.

### 6.2.3 Standards for Interfacing Data Definition and Manipulation Languages to OSI Service Elements

**6.2.3.1 Remote Data Access (RDA).** (U) RDA<sup>12</sup> is an ISO standard to facilitate access to databases from intelligent workstations and from other database systems. It is essentially a (standard) generalization of certain operations of database systems, file servers, and document servers. RDA will allow, with minimum of technical agreement outside the interconnection standards, the interconnection of applications and database systems from different manufacturers, under different managements, of different levels of complexity, and exploiting different technologies. Since an application may itself be a database system, RDA can be used to support multi-database system interworking.

(U) RDA service is designed to provide all possible valid data manipulation functions on any database. The functions needed (and available) depend on the structure and content of the database, so the definition of these functions must be accomplished at run time (not explicitly coded into software). Thus, RDA allows data management language operations to be defined and named (actually numbered) so they can be repeatedly invoked later in an application and association.

(U) The ISO standard for RDA (DP 9579) defines the format and meaning of messages that support this application. RDA uses common OSI services for the association control service element (ACSE)--ISO 8649 and ISO 8650, commitment concurrency and recovery (CCR) service elements--ISO 9804 and ISO 9805, and ROSE (ISO 9072) to provide the communications services. RDA can be viewed as a composition of ACSE and CCR with a specialization of the ROSE.<sup>13</sup> RDA needs no specific protocol of its own; it only requires additional sequencing rules and a method for handling violations of them. The Abstract Syntax Notation standards (ISO 8824 and 8825) are used in the Presentation Layer to define structures (data types) and rules for encoding structures so that the structures can be transmitted.

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<sup>12</sup> (U) Discussion taken from *Remote Database Access*, Tutorial, SC21 N 1927, ISO/TC97/SC21, 28 July 1987, UNCLASSIFIED; and DP 9579-1, 29 March 1990 [SC21 N 4282].

<sup>13</sup> (U) Application Service Elements ACSE, CCR, RTSE, and ROSE are discussed in Section 4.3.5.

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(U) The ISO standard DP 9579 is based on work of the ECMA Technical Committee on Databases, CCITT, and ISO SC18. ECMA TR30 (December 1985) was the starting point for RDA, and ECMA TR31 initially defined the concepts, notation, and connection-oriented mappings for remote operations. DP 9579 has two parts:

- DP 9579-1, *Generic Model, Service, and Protocol* [SC21 N 4282, March 1990]
- DP 9579-2.1, *SQL Specialization* [SC21 N 4282, March 1990].

(U) The remote operations philosophy is based on object modelling in which the functionality of an object is modelled as a set of operations available at its interface. Object modelling also includes the notion of object classes, subclasses, and property inheritance. In RDA these concepts are used to define a generic RDA, which defines a class of remote database access applications, and specific RDAs, each of which defines a subclass of RDA applications. Those properties common to all RDA applications are defined in the generic RDA. Those that relate to subclasses are defined in RDA specializations.

(U) The generic RDA can support any data management language. One of the specific RDAs is a specification for the Database Language SQL [Ref. 66]. Other specific RDAs to be developed in the near future are also expected to be based on the relational approach. The relationship data management language was chosen because it supports complex selection functions and multi-record operations for updating and deletion. This enables the RDA to accomplish selection processing in the database server (the place where the data is stored). This reduces the amount of unneeded data that is transferred to the client (user) and thus minimizes use of communications [Ref. 67].

(U) The generic RDA standard has completed its first DP ballot. Alignment with the Application Layer Structure (ISO 9545) and TP (DIS 10026) is required. SQL1 (DP 9579-2.1) and SQL2 (WD 9579-2.2) specializations for RDA are being developed; a CD draft of the SQL2 specialization is expected in June 1991.

(U) The SQL1 specialization (DP 9579-2.1) defines the service and protocol for access to databases and supports the data manipulation functions of SQL. This is done through specifying the transfer syntax for specific data manipulation functions, as provided for in ISO 9075 for SQL database systems. The elements of the SQL (or any other) specialization are definitions for [Ref. 68]:

- Data resources available as a result of establishing a dialogue and any constraints on opening and closing further data resources
- Data structure of a class of data objects supported

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- Permissible classes of operations upon the objects
- Representation of all operations in an abstract syntax
- Representation for data passed as parameters for these operations.

(U) The SQL specialization for RDA (DP 9579-2.1) augments the generic RDA (DP 9579-1) so that the two parts together define the following:

- Capabilities of an SQL database server that supports dialogues with clients
- Model of dialogues between the SQL database server and remote users
- Model of a dialogue between an RDA client and an SQL server
- Abstract service interface for the RDA SQL ASE that models the communications facilities supporting interaction between the SQL client and the SQL server
- RDA SQL ASE protocol to support the RDA SQL service
- Characteristics of application contexts that include the RDA SQL ASE
- Application contexts that support remote database access using SQL, specifically the RDA Basic Application Context and the RDA TP Application Context.

(U) SC21/WG3 is considering standardizing some or all of the following properties of distributed database systems [Ref. 69]--the new work would be done in conjunction with RDA:

- Single database image presented to the user
- Location transparency (includes automatic routing and transaction decomposition)
- Distributed transaction management
- Query optimization (to minimize communications flows)
- Data replication (optional)
- Local autonomy for database administration (i.e., no requirement for a single DBMS)
- Decentralized schema management
- Distributed deadlock detection/avoidance
- Extensibility (heterogeneous database)
- Concurrency management.

**6.2.3.2 Remote Operations Service Element (ROSE).** (U) ROSE standards are discussed with the TF in Section 4.3.5.4. The RDA service and protocol are defined using the Remote Operations (RO) notation of ROSE (ISO 9072-1). The RO notation is syntactically an extension of ASN.1 (ISO 8824).

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**6.2.3.3 Commitment Control, Concurrency Control, and Recovery Control (CCR).** (U) CCR is architecturally part of the set of the Application Service Elements (ASEs) provided in the Application Layer (Layer 7). CCR (discussed in Section 4.3.5.2) supports distributed applications by defining service primitives for commencing and concluding protocol exchanges and related activity on each interconnection so that the entire sequence appears to other applications as atomic. CCR requires the cooperating application entities to organize their activity into a tree structure, either statically or dynamically defined. Commitment control uses a two-phase commit in which there is a phase to determine whether all the subordinates are prepared to carry out an atomic action (i.e., commit to the action) and a separate phase in which the subordinates are ordered to commit or roll back.

(U) Extensions to CCR being considered (amendments to ISO 9804 and 9805) include dynamic commitment tree, transfer of commitment decision to last subordinate (last subordinate optimization), real only optimization, heuristics, checkpointing (resumption after failure), return of rollback data, and negotiation of CCR facilities.

### **6.2.4 Information Resource Dictionary System (IRDS) Standards<sup>14</sup>**

(U) An IRDS is a system that provides facilities for creating, maintaining, and accessing an Information Resource Dictionary (IRD) and its IRD definition. The IRDS framework standard (ISO 10027, May 1990) provides a common basis for developing information resource dictionaries (IRDs), which are sharable repositories for the definition of the information resources relevant to all or part of an enterprise. Information resources may include:

- Data needed by the enterprise
- Computerized and possibly noncomputerized processes that are available for presenting and maintaining such data
- Available physical hardware environment on which such data can be represented
- Organization of human and physical resources that can make use of the information
- Human resources responsible for generating that information.

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<sup>14</sup> (U) Portions of the discussion of IRDS are taken from ISO 10027, *IRDS Framework*.

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(U) The IRDS standard does not provide a standard definition of all the above kinds of information. Rather, it provides a framework for defining such information in which the information can be represented and managed. The content of an IRD can be compared with the content of a typical application database--an application database contains data of relevance to the day-to-day operation of an enterprise. The difference is that the data is at a higher level (metadata or data about data) and may include such entities as data item types, data files, computer programs, and subsystems.

(U) An IRDS is used to control and document an enterprise's information resources. ISO 10027, *IRDS Framework*, defines a number of concepts that are basic to data management. A *database* is a collection of interrelated data stored together with controlled redundancy according to a schema to serve one or more applications. *Database integrity* is the consistency of a collection of data in a database. *Export* is the function of extracting information from an IRDS and packaging it to an export/import file. *Import* is the function of receiving data from an export/import file into an IRDS. An *IRD* is a part of a repository managed by an IRDS in which the information resources of an enterprise may be recorded. A *value* is an abstraction with a single characteristic that can be compared with other values and that may be represented by an encoding of the value. A *data modelling facility* is a set of data structuring rules and an associated set of data manipulation rules. An *application schema* is a set of definitions that control what may exist at any time in an application.

(U) The IRDS Framework identifies the kinds of data, together with the major processors and their associated interfaces and the broad nature of the services provided at each interface. Aspects addressed by various IRDS standards include programming language dependence, interface style, data modelling facility used, and data interchange format. Examples of processor interface styles are programmatic (such as a procedure call interface, consisting of a sequenced set of parameters and associated binding rules for the CALL statement in a programming language); syntax for execution time interpretation; and service convention (a standard set of programming language independent conventions for specifying parameter lists and service primitives for use in an open systems environment). Examples of alternative styles for human interfaces are panels (abstract screen formats), concrete syntax (such as a command language), and graphics.

(U) An abstract syntax is the specification of a service (such as for an interface style) by using notation rules that are independent of the encoding techniques used to represent them. An abstract syntax may be used to define a set of services without prescribing any linguistic form to be used when each service is initiated or invoked.

## UNCLASSIFIED

(U) Examples of data modelling facilities are those based on standard database languages such as NDL or SQL, based on a non-standard database language, specific to a standard programming language (such as COBOL or PL/1), specific to a non-language standard (such as OSI Directory services), or which are non-standard data modelling facilities (such as entity-relationship modelling). Each data modelling facility is an intrinsically independent means of representing data and possibly the services that may be specified for such data.

(U) Three types of support can be provided for a database using international standards. One is using standardized services at an interface, in which the contents of some part of the IRD are defined, together with the services by which those contents may be accessed and manipulated. The second type of support is by standardizing in precise terms the content of some part of an IRD according to some prescribed data modelling facility. The services that may be performed on that data may or may not be implicit in the general data manipulation services associated with that data modelling facility. The third type of support is the use of a standard data interchange format, designed to facilitate the interoperability of several real systems by standardizing the formats of the various kinds of messages sent from one real system to another. A data interchange format may be specific to an application.

(U) IRDS provides for two types of user interfaces: a menu-driven (panel) interface and a command language interface. The panel interface provides for a structured path of screens (i.e., panels) by which an inexperienced user can execute IRDS functions. The command language may be used in either an interactive or batch mode. One of the facilities provided in IRDS supports the moving of data from one standard dictionary to another.

(U) IRDS, including the command language and panel interfaces, is specified in terms of entities, relationships, and attributes. The entities represent or describe the concepts and data objects about which values are to be stored in the database. Relationships are binary associations between two entities (e.g., one contains the other). Attributes represent the properties of an entity or relationship. Each relationship and attribute is assigned a specific type. Entities can be compared if they have a common attribute with a common type. Ordered sets of attributes, called attribute groups, are also provided in IRDS. The IRDS schema that defines and controls what is permitted in a data dictionary is also defined using entities, relationships, attributes, and attribute groups. IRDS supports local and universal naming conventions through three types of entity names: access names (used with the command language), descriptive names (e.g., from an ATCCIS-wide data dictionary), and alternate names (e.g., aliases used for the convenience

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of one or more nations or one or more ATCCIS components). IRDS functions include adding, deleting, modifying, and copying entities and relationships, in addition to report writing.

(U) The IRDS is a data dictionary standard being developed in parallel by both ISO (JTC1 SC21/WG3) and ANSI (X3H4). The standard is based on the entity-relationship model and would be applicable to Database Language NDL and Database Language SQL. In addition to the ISO framework standard (ISO 10027), there is an ISO proposal for a *Command Language and Panel Interface* (DP 8800-1, March 1987). The project for DP 8800 has been suspended until the *IRDS Service Interface* (WD xxxx) reaches DIS status. The command language and panel interface are expected to be split into separate standards. Working drafts have been prepared in two other areas: *IRDS Design Support for SQL Applications* and *IRDS Export/Import*. CD texts for both these standards are expected in December 1991. The ANSI draft standard is identified as X3.138-1988.

(U) Unfortunately, the ANSI and ISO communities have diverged over the issue of whether relationships are permitted to have attributes (ANSI) or not (OSI). The rationale for the simpler model (no attributes) is that it would fit more easily with SQL tables. The rationale for the ANSI position is that a model permitting attributes, while more complex and more cumbersome, would provide greater flexibility. Further, a lot of existing products would be invalidated if no attributes were permitted for the relationships. A decision has recently been made by ISO that the IRDS Services standard should make use of the SQL data model and be defined in SQL terms [Ref. 70]. While this revision brings together two major database standardization activities, it further complicates the alignment of the ANSI and ISO standards.

(U) In WG3, development of the IRDS framework document is continuing and may require alignment of concepts with those of the Reference Model, which could take 2 years to complete. Ongoing work includes the *Services Interface* (scheduled for completion in 1991), *Export/Import* (scheduled for completion in 1993), *Support for SQL1 with Integrity Enhancement* (scheduled for completion in 1993), and two pending areas, *Command Language and Panel Interface*.

(U) Meanwhile, the US standards effort is building on the ANSI and FIPS IRDS. Three efforts are nearing US public review status, while five new work areas have been initiated. All of the new work is scheduled to be completed by early 1991. The three efforts that are nearing external review status are:<sup>15</sup>

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<sup>15</sup> (U) Personal communication with Jerry Winkler, Chair, ANSI X3H4 on IRDS standards, June 1990, UNCLASSIFIED.



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- *IRDS Services Interface (IRDS/SI)*. The ANSI draft proposal for IRDS/SI began its initial US public review in the summer of 1989. The target date for an ANSI standard for IRDS/SI is early 1991.
- *IRDS Export/Import File Format*. The ANSI draft proposal for IRDS Export-Import File Format, which supports the export-import requirements identified in the X3.138, was released for public review in late 1989 and should be an ANSI standard by late 1990.
- *Technical Report on the IRDS Reference Model*. This report will explain the relationship of the IRDS within the information environment of an enterprise. This document is expected to be released in 1990.

(U) The other five efforts are: (1) *IRDS Naming Convention Verification*, (2) *Technical Report on the Requirements for an IRDS in a Distributed Heterogeneous Environment*, (3) *Technical Report on Integration of IRDS Schemas*, (4) *Standard on Export/Import Extensions*, and (5) *Technical Report for IRDS in a Distributed Environment*.

### 6.2.5 Conceptual Data Modelling Facility Standards

6.2.5.1 Conceptual Schema. (U) SC21/WG3 has identified five different uses of the term "conceptual schema." The following identifies the five uses and provides WG3 comments on those uses [Ref. 71]:

- (1) The results of an analysis of the data and possibly the processes perceivable in some real-world situation.
  - There is considerable disparity among the data analysis techniques used in various parts of the world. Some are being energetically promoted by minority groups.
  - There are rapid developments in Computer Aided Software Engineering.
  - Attempts to standardize on any one technique may be premature. Such efforts should await availability of the Reference Model or Information Systems Engineering being developed by SC7/WG4.
  - Work on a conceptual data modelling facility should be considered as content of an IRDS and be conducted in accordance with the IRDS Framework (ISO 10027).
- (2) A repository of "metadata" in which it is possible to specify declaratively 100% of the semantics of the data in a computerized information system (the 100% principle of TR 9007).
  - The 100% principle has had major influence on SC21/WG3 work in the development of SQL. The SQL draft proposal being progressed contains language specifications that make it possible to specify declaratively a very large percentage of the constraints on the data that a database designer is ever likely to want to define.

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- While SQL is never promoted as a means of defining a conceptual schema, it is, in this very important respect, superior to many of the approaches developed especially for the purpose.
- (3) A data definition that has the property of being independent of its representation in storage.
- Some standards committees have adopted the term to refer to some kind of representation of the data definition that is above the level of stored representations.
  - SQL is a language that enables the preparation of a storage independent definition of data.
- (4) A data definition that is common to the collections of data at two separate sites, such that it can be used as a common frame of reference when exporting data from one site and importing it at another site.
- In electronic data interchange (EDI), one needs a definition of data to be interchanged that is common to all sites involved in a set of interchanges.
  - Much of the EDI work has been concerned with the specification of standard formats for an industry area, such as banking or travel. As EDI tends to adopt a more generalized approach to standardization, the need for a common definition facility becomes apparent.
- (5) A data modelling facility (see CD 10032 on data management) that is different from and therefore "neutral" with respect to broadly similar data modelling facilities used in commercially available database management systems.
- Data modelling facilities are also called data models; merits of various approaches are controversial topics.
  - Another "neutral" approach would lead to confusion, is not required, and is not recommended by WG3.

**6.2.5.2 Conceptual Schema Standardization.** (U) Work in the area of conceptual schema in ISO dates back to the early 1980s. In 1982, TC97/SC5 published *Concepts and Terminology for the Conceptual Schema and the Information Base*. This report was followed in 1985 by the *Assessment Guidelines for Conceptual Schema Language Proposals*. The 1982 document defined the "100% principle" now adopted by ISO [Ref. 72, 73]:

All relevant static and dynamic rules, law, etc., about the universe of discourse should be described in the conceptual schema. The information system cannot be held responsible for enforcing those rules described elsewhere, particularly those described in user procedures.

(U) SC21 has agreed to hold a workshop on conceptual schema and its relationship to the Common Data Modelling Facility. It is planned to be held in the Netherlands in November 1990.

(U) ANSI has proposed that a new Question be established in SC21 to determine the use, scope, and purpose of one or more standards for conceptual schema.

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The goal would be to address the need for models of a "universe of discourse." Such models are needed to clarify in a formal way the notion of a particular universe of discourse to which a standard applies (e.g., for Directory schema) and to facilitate the specification of a common universe of discourse for information exchange (e.g., for *Application Layer Structure*, ISO 9545) [Ref. 74].

**6.2.5.3 Conceptual Data Modelling Facility Standardization.** (U) Japan has proposed a new work item in SC21/WG3 for a conceptual data modelling facility [SC21 N 4280, February 1990]. The proposed standard would specify the facility to describe an application data model and the representation method of the result of the description of an application data model.

**6.2.5.4 Object-Oriented Database Support.** (U) SC21/WG3 is including in its work on SQL standardizing support for object-oriented databases. This work will impact SQL3 and potentially also IRDS and the Reference Model on Data Management [Ref. 75].

**6.2.5.5 Full Text Manipulation in Structured Data.** (U) SC21/WG3 is including in its work on SQL standardizing support for full text manipulation in combination with the management of structured data using SQL. SQL2 will support storage of a collection of text as a single data value, but will be capable of the complex requirements for full text manipulation [Ref. 76].

(U) Standardization of SQL metadata that goes beyond IRDS has been proposed. Currently, SQL is being used as both the IRDS modeling and implementation language. A new standard may be required for more general information modeling applications support, which would support metadata about classes of information other than those normally defined for data retrieval systems. Examples of data models for information modelling applications are binary entity-relationship data model such as IRDS, N-ary entity-relationship data model, and object-oriented data model. One effort being conducted in this area in SC21/WG3 is the Tool Integration Standard. Additional efforts on all of these models are now being conducted in the US. One standards issue in this area, as noted above, is whether relationships as well as entities should be permitted to have attributes. The OSI management information model (DIS 10165-1) has a containment relationship whose constraints could be represented as attributes of a containment relationship [Ref. 77].

## UNCLASSIFIED

### 6.2.6 Distributed Transaction Processing (TP) Standards

**6.2.6.1 TP Reference Model.** (U) A reference model for distributed Transaction Processing (TP), DIS 10026-1, has been developed by SC21/WG5. TP service elements are viewed as pertaining to the Application Layer. While TP services are discussed in relation to the DMF, some of these services may be provided by the SCF and TF.

**6.2.6.2 TP Requirements.** (U) The user requirements addressed by DIS 10026 are to:

- Define procedures that support distributed transactions in order to:
  - Allow a distributed transaction to be organized into a transaction tree
  - Provide multi-party coordination, including local resources
  - Allow restoration to a consistent state, following failure of the state/context of a distributed transaction and of distributed information
  - Allow the detection of failure to achieve consistency
  - Allow a distributed transaction to be restarted following successful state restoration
  - Indicate successful completion or failure of a transaction
- Provide for the delimitation of a sequence of logically related transactions
- Allow the grouping of transactions within an applications process
- Allow for access control, access control granularity on groups of TP objects, authentication, and non-repudiation
- Allow conformance testing of the protocol and delineate clearly the static and dynamic conformance requirements (through a PICS statement).

**6.2.6.3 TP Standards.** (U) The TP model, service, and protocol have now reached DIS status: DIS 10026--Parts 1, 2 and 3, respectively. CD 10026-4 is the *TP PICS Proforma*. DIS 10026 will be used by the RDA standard and is being considered for use by RPC, extensions to IRDS, and extensions to FTAM. It is the first Application Layer service for distributed processing [Ref. 78].

(U) An editing meeting for CD 10026-4 is planned for November 1990; DIS balloting is to begin January 1991, and the editing meeting to develop IS text is planned for September 1991. TP is dependent on a revised version of CCR, which was progressed in 1989. Two formal descriptions of TP have been produced, one in Estelle and one in LOTOS; both will be progressed as informative annexes to the TP protocol standard. TP activity will be conducted in coordination with work on RDA (WG3) and Application Layer standards (WG6).

## UNCLASSIFIED

**6.2.6.4 TP New Work Items.** (U) Table 7 identifies the new work items that have been proposed for TP [Ref. 79]. ISO is considering "sub-transaction" extensions to TP that would provide partial rollback and nested transactions. In the current TP standard (DIS 10026), all the bound data that are involved in a transaction tree for a transaction are committed together and, if the transaction fails, all the bound data are rolled back. Work in this area has already been done by ECMA and the US [Ref. 80].

(U) A new work item on TP security [Ref. 81] is intended to expand the TP model, service, and protocol (DIS 10026-1,2,3) to provide a secure environment for distributed transaction processing interactions involving multiple open systems. PDAD text is expected in 1992, DAD in 1993, and AD in 1994.

*Table 7. (U) New Work Items Proposed in ISO for TP*

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- TP Application-Context Proforma--use of OSI TP elements is expected to require the presence of one or more user application service elements (ASEs), in addition to the ACSE and the TP-ASE; therefore, some form of application context definition will be necessary [SC21 N 4165].
- TP Association Management--to provide for the management of application associations in a distributed processing environment involving multiple open systems [SC21 N 5177]. PDAD to be completed in 1992, DAD in 1993, and AD in 1994.
- TP Commitment Optimization--to improve the performance and functionality of the commitment operation of a distributed transaction. Mechanisms being considered include alternate commitment initiator, commitment indication service, explicit selection of commit coordinator, last subordinate optimization, multiple commitment initiators, real-only optimization, reversible ready, and unsolicited ready [SC21 N 4168].
- TP Data Transfer--standardizes appropriate data mechanisms to support frequently occurring models of data exchange and to allow for migration to the use of OSI TP facilities [SC21 N 4166].
- TP Dialogue Recovery--the third phase of recovery (as defined in DIS 10026-1); it is required to enable Transaction Processing Service User Invocations (TPSUIs) to continue normal operation following the re-establishment of bound data consistency [SC21 N 4170].
- TP Heuristic Decisions--provides advisory propagation of a heuristic decision to all nodes; advisory propagation to nodes in the subtree below the node taking the heuristic decision; mandatory propagation of a heuristic decision to all nodes; and mandatory propagation to nodes in the subtree below the node taking the heuristic decision [SC21 N 4167].
- TP Savepoints--service to enable a transaction to be able to save and later restore a consistent state of all bound data under its control [SC21 N 4171]; new work item not accepted by JTC1, June 1990.
- TP Security--considers requirements for provision of a secure environment for TP in areas such as access control, auditing, authentication, confidentiality, integrity, management, nonrepudiation, replay, and revocation [SC21 N 5176, approved June 1990]. PDAD to be completed in 1992, DAD in 1993, and AD in 1994.
- TP Conformance Testing [SC21 N 4172]
- TP PICS Proforma [SC21 N 4169]

*Report on JTC1 SC21/WG5 OSI Transaction Processing Rapporteur Group Meeting, Florence, 1-9 November 1989, BSI IST/21:1850, A. J. Bainbridge, 14 November 1989.*

**UNCLASSIFIED**

(U) A new work item has been accepted by JTC1 for Data Transfer for OSI TP. Included in the scope of this work is development of TP queue services that would support transactions broken down into multiple steps. These services could also be used as the basis for a deferred transaction initiation mechanism or as a mechanism for reliable message transfer [Ref. 82].

(U) A working draft for a standard for *Unstructured Data Transfer (UDT) for OSI Transaction Processing* has been developed [Ref. 83] by SC21/WG5. This standard would allow interconnection of computer systems from different manufacturers, including those under different management, of different levels of complexity, and of different technologies. UDT is not suitable outside the TP environment. The draft consists of a model, service, and protocol for UDT and an annex for the application context for UDT.

(U) Work has begun on TP association management. The work is expected to produce an addendum to DIS 10026: CD text is expected in 1992, DIS text in 1993, and international standard text in 1994 [Ref. 84]. The statement of requirements for TP association management was issued by SC21/WG5 in June 1990 [Ref. 85]. It addresses association management objects for both application associations and application association pools, negotiations with remote systems, pool sizing, query/status information, and manipulation of the authority to release associations.

(U) Two approaches are being considered for using RPC and TP together [Ref. 86]:

- With RPC as the data transfer paradigm for TP with use being made of TP dialogue management functions
- Using TP commitment functionality to complement the operation of RPC-based services (without necessarily making use of TP dialogues) to support "exactly once" semantics.

(U) In 1989 a potentially serious problem was identified for TP. Under certain circumstances, protocol exchanges from one transaction (such as rollback) could overtake those outstanding from a previous transaction (and could therefore be interpreted by the receiving node as pertaining to the previous transaction). This can occur if lower layer expedited services are used to convey particular PDUs. The interim solution that was adopted was to avoid the use of Transport expedited data transfer services. A long-term solution to this problem is required to progress TP; the goal is December 1990.

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### 6.2.7 Open Distributed Processing (ODP) Standards

(U) Open distributed processing (ODP) is a new area of standards development. Begun in 1987, the work has progressed so far in ISO that a new working group (WG7) has been formed in SC21 to progress the standards for an ODP Reference Model. The current work comprises the framework of abstractions (e.g., the nature of the different points of view of a system); functions and interfaces; and modelling.

(U) The Basic Reference Model of ODP is being developed in SC21/WG7. It addresses the following aspects:

- Modelling distributed processing in terms of components, the services they support, their environment, and the interactions between them
- Identifying levels of abstraction at which the services and interactions can be described
- Classifying the boundaries between components and identifying the points of interaction associated with them
- Identifying generic functions performed by distributed systems
- Showing how the elements of the model can be combined to achieve ODP.

(U) The Basic Reference Model of ODP further defines levels of abstraction at which services and interactions can be defined in other standards, generalizing the concepts of service and protocol defined in the OSI Reference Model (ISO 7498). The proposed structure of the Basic Reference Model is as follows [Ref. 87]:

- Part 1: *Overview*, containing a motivational overview of ODP, giving the scope, explained the key definitions (with no substantial architectural content), and enumerating required areas of standardization (not normative). WD is planned for 1993, CD in 1994, DIS in 1995, and IS status in 1996.
- Part 2: *Descriptive Model*, defining the concepts, analytical framework, and notation for normalized description of (arbitrary) distributed processing systems (not normative but establishes requirements for new specification techniques). WD is planned for 1991, CD in 1992, DIS in 1993, and IS status in 1994.
- Part 3: *Prescriptive Model*, specifying the required characteristics that qualify distributed processing as open--these are the constraints to which ODP standards must conform. WD is planned for 1992, CD in 1993, DIS in 1994, and IS status in 1995.
- Part 4: *User Model*, describing the resulting ODP environment from the users' point of view and containing explanatory material of how ODP is intended to be viewed by system engineers designing distributed applications to be run in the ODP environment (not normative). WD is planned for 1993, CD in 1994, DIS in 1995, and IS status in 1996.

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(U) The approach of SC21/WG7 is to identify and expand a number of ODP topics in parallel. The applicable documents are:

- *Topics List--November 1989 Version--for the Basic Reference Model of Open Distributed Processing*, December 1989 [SC21 N 4019]
- *List of Open and Resolved Issues--November 1987 Version*, December 1989 [SC21 N 4020]
- *Topic 1--The Problem of Distributed Processing*, March 1988 [SC21 N 2507]
- *Topic 2.2--Properties and Design Freedoms*, December 1988 [SC21 N 3288]
- *Topic 2.3--Framework of Abstractions*, December 1988 [SC21 N 3194]
- *Topic 3--Structure of ODP Standards*, March 1988 [SC21 N 2509]
- *Topic 4.1--Structures and Functions*, December 1989 [SC21 N 4022]
- *Topic 6.1--Modelling Techniques and Their Use in ODP*, December 1989 [SC21 N 4023]
- *Topic 6.2--Formalisms and Specification*, December 1989 [SC21 N 4024]
- *Topic 7.1--Basic RM of ODP*, December 1989 [SC21 N 4029].
- *Topic 8.1--Draft Basic RM of ODP, Part II*, December 1989 [SC21 N 4025].

In addition, SC21/WG7 has prepared a set of definitions and a glossary [SC21 N 2511], and a register of documents and bibliography [SC21 N 3192].

### 6.3 Other Standards Activities and Emerging Standards

(U) CODASYL data management standards are the responsibility of the CODASYL Systems Committee. A report on distribution alternatives and generic architectures for distributed database systems was produced by this committee in 1980 [Ref. 88]. One of the two standard ISO data management languages (NDL) is based on CODASYL concepts.

(U) ANSI standards for database architectures are produced by the Database Architecture Framework Task Group (DAFTG) through the Standards and Planning Requirements Committee (SPARC). A draft report [Ref. 89] from the DAFTG in 1982 provided a framework to support distributed databases, multiple data models, and data dictionaries. One concept, the ASN.1, has been specified [Ref. 90, 91].



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(U) In 1985, ECMA<sup>16</sup> issued a final draft report [Ref. 92] for remote database access service and protocol.

(U) CCITT does not provide standards for data management. The US Government Open Systems Interconnection Profile (GOSIP, see Section 9.3.3) does not address standards for data management [Ref. 93].

### 6.4 Options Within the Standards

(U) The ANSI standard X3.135-1986 SQL allows for two levels of compliance. Level 1 is a core standard that leaves many areas open to implementation definition. Level 2 contains many extensions over Level 1, but Level 2 still has a large number of options for implementation. Examples of facilities found in Level 2 but not in Level 1 are [Ref. 94]:

- Atomic transactions with respect to recovery
- Eighteen-character identifiers
- Table-name qualification by user-name
- Indicator variables
- Outer references
- Keyword ALL allowed in query-specifications, sub-queries, and set functions
- Updatable query-specification definitions
- Statements atomic with respect to database changes
- Not equal to comparisons (<>)
- Escape characters in the LIKE predicate
- REAL, DOUBLE PRECISION, and NUMERIC data types
- WITH CHECK OPTION on a view definition
- WITH GRANT OPTION on a privilege definition
- DISTINCT with AVG, MAX, MIN, and SUM.

### 6.5 Data Element Standardization

(U) The ISO has issued a draft standard (DP 7826) on the representation of data elements. This draft proposal sets out standard procedures for the identification and representation of existing and new coding systems, without providing any guidance on

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<sup>16</sup> (U) ECMA full membership is open only to companies who develop, manufacture, and sell computers in Europe. The restricted membership makes full consensus among participants in standards-making easier and quicker to reach than in ISO.

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specific coding systems.<sup>17</sup> It also specifies a technique for interchange of coded representations and the requirements for the administration of International Coding System Identifiers (ICSIs). This will permit the use of more than one coding system, reduce the possibility of ambiguity, reduce the need for human intervention, and diminish the time required to negotiate interchange of coded representation agreements. DP 7826 identifies three types of data element attributes: administrative, relational, and representative. These are the types of attributes described in WP 7L [Ref. 95] and recommended for ATCCIS.

(U) Substantial work has been done cooperatively by ISO JTC1/SC14 and ANSI X3L8 during the last 3 years; a draft proposal for data management is expected sometime in 1990. Once accepted by the working groups, this draft proposal will be offered to ISO for adoption [Ref. 96]. The general approach to the structure of data recommended for ATCCIS in WP 7L was derived from discussions with ISO JTC1/SC14 and ANSI X3L8.

(U) The data element naming convention and rules presented in WP 7L were derived from an emerging standard from the NIST *Guide to Data Entity Naming Conventions* [Ref. 97], which is expected to be offered to ISO in the near future. However, the rules were expanded to support the concepts and structure of data consistent with the needs in NATO, SHAPE, and ATCCIS, as well as the emerging ISO taxonomy.

(U) The US Army has recently published an Army Regulation (AR 25-9) [Ref. 98] to prescribe policies, responsibilities, and concept of operation for the management of data used in manual and automated information systems throughout the US Army. This document has been coordinated with ISO, ANSI, and the NIST, as well as with the US Joint Chiefs of Staff, to ensure alignment in the area of a data element naming convention. The US Army plans to maintain a Service-wide data encyclopedia of information about all data elements that have gone through a standardization process and are designated as Army standard elements. Additional information on AR 25-9 is provided in WP 7L.

### 6.6 Policy and Issues for Data Management

#### 6.6.1 Data Management Policy in NATO

6.6.1.1 NACISA Policy. (U) There is currently no data management policy for NATO. However, a draft statement was recently developed for the

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<sup>17</sup> (U) ISO 646, ISO 2022, ISO 6937, and ISO 8859 are examples of standard coding systems. (See Appendix D (Section I & E).)

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July 1990 meeting of the Information Systems Working Group (ISWG) of the NACISC that addresses data management policy [Ref. 99]. The statement was distributed by the Secretary of the ISWG on June 1990. It is a statement of the requirement, jointly revised and refined by staff of the ISWG and ADSIA, for a NATO data management policy. Table 8 provides excerpts from that draft statement. The conclusion is as follows:

Recognizing that there is further detailed work which will involve or indeed depend on the actions of the organisations, e.g. ADSIA, MAS, NACISA, etc., it is concluded that the ISWG should initiate, as a matter of urgency because of the advanced stage of SD&IC, the creation of a broad Data Management Policy to embrace: Data Management, Data Integrity, Data Dictionary, [and] Data Definition; and the relationship to Data Security. From this initial action, the position of Data Manipulation [and] Data Distribution should be clarified and tasking for detailed implementation identified.

**6.6.1.2 ADSIA Recommendations.** (U) In April 1986, ADSIA revised a working paper [Ref. 100] on the need for standardization of data management. The following actions were recommended:

- NATO Communications and Information Systems Agency (NACISA) to identify and collect the requirements for database management systems and for standardization of database schemes, file transfers, database information exchange, and configuration management procedures
- Subsequently, the Information Systems Working Group (ISWG) to develop a NATO policy on data management and on the use of database management systems in NATO CCISs
- ADSIA to coordinate the development of technical and procedural standards for databases
- ADSIA to develop the procedural standards for database information exchange
- TSGCEE SG9 to develop technical standards for database schemes and file transfer
- NACISA to control the implementation of the developed standards and NATO policy paper to ensure the interoperability of command and control systems within the NATO CCIS.

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Table 8. (U) Excerpts from the 1990 Draft Statement by NACISA on the Requirement for Data Management

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- The need for interoperability among fully automated information systems requires policies, procedures and standards of a different scope than currently available as NATO common interoperability standards. The resulting need is for a data management policy to ensure the data integrity throughout the NATO Interconnected Information System (NIIS), to include a NATO Data Dictionary to provide data definitions and a set of standards for database-to-database information exchange.
- Interoperability in the NIIS requires consistency and integrity of data throughout the system, which in turn requires NATO-wide data management standards. The use of invalid data or the incorrect interpretation of data by other information systems can be disastrous for any type of operations. Common and consistent definition of data that is subject to exchange is a prerequisite for data integrity. Data definitions are normally maintained in a data dictionary. Historically, data dictionaries have been tailored to the specific system being designed and the meanings have reflected the local users operational vocabulary. Emerging systems such as ACE ACCIS, ACCS, BICES, and ATCCIS have a requirement for a data dictionary. Only a NATO Data Dictionary can ensure that data integrity is maintained in the exchange among the various systems in the future NIIS.
- Elements of data management have been analysed to establish which of them, for reasons of operational interoperability, require to be subject to NATO-wide Data Management Policy. It has been concluded that the following six fall into this category to some degree:
  - Data Dictionary
  - Data Definition
  - Data Manipulation
  - Data Security
  - Data Integrity
  - Data Distribution.
- The following five elements of data management are considered not necessary to be subject to a policy, but necessary to be addressed internally in each information system. They are therefore not further considered in this policy statement:
  - Data Monitoring
  - Data Recovery
  - Data System Monitoring
  - Data Backup
  - Data Audit Trails.
- For NATO Data Management as a whole and for each of the elements identified above, a requirement exists to:
  - Define the data management element clearly,
  - Identify the policy activity necessary in its regard,
  - Identify the responsible authority for this activity, and
  - Identify the time scale, sequence and any internal/external dependencies as appropriate.

Source: *Statement of the Requirement for A NATO Data Management Policy*, Annex to AC/317(WG/2)WP/60 on Data Management, Working Paper, Information Systems Working Group, NACISA, 5 June 1990, NATO UNCLASSIFIED.

6.6.1.3 NIMP. (U) Many aspects of data management are procedural in nature and will be controlled by procedural and not technical standards. Several of these standards are also identified below. The NATO Interoperability Management Plan (NIMP)

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[Ref. 101] specifically identifies standards and rules for representing data as information procedural standards and assigns the responsibility for these standards to the Allied Data Systems Interoperability Agency (ADSIA). To emphasize the role of data management in achieving interoperability, the NIMP states:

In order for the information exchange to be effective, it is necessary that the meaning and relationships associated with that information [received from other facilities] is common and preserved, irrespective of the interoperability service and transmission media. A single common definition for all operational information throughout NATO is needed to achieve this goal.

**6.6.1.4 SHAPE Policy.** (U) The purpose of data management in NATO is to provide methods to ensure data availability, security, integrity, quality, and interoperability, and to provide data sharing. The ACE Manual (AM) on Data Management, AM 96-1-4 [Ref. 102], defines data as representing the elementary facts, descriptions, and qualifications about things of interest to some headquarters, unit activity, or enterprise. It further defines the role of a data dictionary as an automated tool that provides a centralized library of metadata covering all aspects of all types and structures of data residing in databases, file systems, and manual systems within an organization. AM 96-1-4 further asserts that:

- Evolution towards an ACE ACCIS will only succeed from the data management point of view by ensuring that the standardization of data definitions, the control of the data, and the maintenance of its overall integrity are systematically established on a command or site basis.
- The fundamental key to data management is the early definition and identification of data elements and, later, data fields. The definition and corresponding name should be clear, accurate, and meaningful, but reference should be given to connotation, which relates to the interpretation that bears upon the specific context of usage of data.

**6.6.1.5 STC Work.** (U) In 1975, Shape Technical Centre (STC) published a Technical Memorandum (TM) on data management standardization for the ACE ACCIS [TM-776, Ref. 103]. TM-776 recommends standardization of the architecture, functionality, and structure of the Data Management Subsystem (DMS) of the ACE ACCIS. These areas of standardization include data management methodologies and the tools used to design, build, and maintain the ACE ACCIS databases. TM-776 accomplished the following:

- Identified the requirement that the DMS at each ACE ACCIS node must agree on the semantics and syntax of the information exchange.
- Recommended that there be a standard ACE data definition or conceptual schema, where a schema defines all application object types, including their

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attributes, relationships, and static constraints, and where a database is an instance of a schema.

- Stated that a data classification method must be used that is based on the principle of sorting data according to the type of information provided by their values, independent of their use in particular databases, messages, or applications.
- Identified the need for a methodology for formal definition of data elements based on standardized terminology, including the use of naming conventions:
  - A data element is defined as a basic unit of data that has a name, a definition, and a set of values for representing particular facts. A data element and its definition should not include any application or usage information.
  - A method is needed for analysing, defining, and controlling data elements. This method should have three components: a type classification of data elements, syntax rules for the structure and completeness of formal definitions, and a controlled vocabulary of permitted terms for formal definitions.
  - Standard data elements and relationships should be placed into an ACE common data structure.

**6.6.1.6 NATO Publications on Data Management.** (U) AAP-6, *NATO Glossary of Terms and Definitions (English and French)*, standardizes terminology used throughout NATO, thereby promoting mutual understanding. The criterion for inclusion is that the term be of a general military application. While earlier editions put qualifiers immediately following the term, such qualifiers are now embedded in the definition. In addition, terms and definitions are not to be composed of, nor contain, abbreviations and acronyms. A term and definition are included in the glossary only when they have been agreed upon by all nations in both English and French.

(U) The terms defined in ADatP-2 [Ref. 104], *Automatic Data Processing (ADP) NATO Glossary, English and French*, are derived from glossaries, dictionaries, and vocabularies from ANSI, American National Directory for Information Processing, ISO, International Business Machines, and ACP 167. The definitions are annotated by source and may include abbreviations, examples, notes, diagrams, accepted synonyms, contrasting terms, related terms, and cross-references for multiple uses. This information is noted when harmonization is being examined for multiple uses.

(U) ADatP-3 (STANAG 5500) [Ref. 105], *NATO Message Text Formatting System (FORMETS)*, provides the rules, constructions, and vocabulary for standardized character-oriented message text formats that can be used in both manual and computer-assisted operational environments.

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(U) ACP 167 [Ref. 106], *Glossary of Communications-Electronics Terms*, provides definitions of terms used by communications, electronic warfare, and operational personnel for Allied networks.

### 6.6.2 Data Management Issues in EDI

(U) The Special Working Group on Electronic Data Interchange (SWG-EDI) of JTC1 has identified a number of data management issues that require coordination within JTC1 (SCs 14, 18, 21, and 24) and with other Technical Committees (TCs) such as TC 46, 68, 154, and 184. The issues include [Ref. 107]:

- Ensuring a complete separation of semantic and form of data elements, for which the conceptual schema is defined at a level other than the actual applications
- Accommodating different types of data representations, specifically with regard to the data models for different types of data, so as to assure logical relationships between data of different types can be expressed
- Structuring precisely the dictionaries of data elements and groupings, to include all the attributes of data elements and to permit unambiguous reference to other directories
- Assuring coherence of dictionaries across time (updating and maintenance) and sectors and also with generic dictionaries.

### 6.6.3 Data Management for Distributed Applications

(U) The Workshop on Distributed Applications held by JTC1 in March 1990 noted that "very similar data management requirements are being addressed by differing standards applications" and that "potential exists for prevention of a considerable amount of duplication of effort and overlap...by increasing the extent of utilization of common aspects of data management facilities." Coordination was recommended among SC21/WG3(Database) and WG7(ODP), SC14, SC18, SC22, SC24, SWG-EDI, TC46, and CCITT SGs VII and VIII. Table 9 identifies common requirements for data structures and data models being addressed in ISO [Ref. 108].

## 6.7 Assessment of Coverage by Standards

(U) Until recently, there were very few standards that applied to the DMF other than those for SDL and NDL. Even so, the SDL standard is not very mature, and extensions will have to be agreed to and options reduced before SDL implementations can be expected to be interoperable.

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(U) Standards for RDA and concepts for ODA show promise for use with standardizing DMF services and protocols. It is too early to tell how well these standards activities will cover DMF requirements.

*Table 9. (U) Data Management Requirements Identified in ISO Relating to Data Structures and Data Models*

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- Federated data models
- Mapping to user-oriented data structures/operations
- Ability to support access control to data structures
- Wide range of sizes--large and small volumes of data
- Logging of operations for audit
- Ability to combine separately defined data types (static and dynamic)
- Application-oriented operations (e.g., searching)
- Support for internationalization
- Version control (including data structure modifications)
- Distribution, transparency support, and modelling location
- Handling of uninterpreted data
- Support of different levels of consistency and data integrity
- Ability to relate families of specifications for different levels of abstraction
- Support for recursive and structured definitions
- Persistent storage of results of operations
- Ability to support pointer types
- Ability to support powerful query languages
- Support for Directed Acyclic Graphs (including selection)
- Support for uniqueness requirements
- Independence from programming languages and means of access
- Support of declaration of hotspots and triggers
- Choice of granularity

Source: *Consideration of the Data Management Component of Application Standards*, Workshop on Distributed Applications, SC21 N 4524, 23 April 1990.

(U) SC21 has identified three issues regarding its future study items, all related to databases. These issues are [Ref. 109]:

- (1) There is an urgent need to develop clear views on the relationships between database activity and OSI activity. Two major areas need to be addressed:
  - Relationship between IRDS work and activity on directories, and on the structure of management information
  - Relationship between export-import requirements and distributed database work, and OSI standards, in particular those to do with the storage and manipulation of information (i.e., FTAM).



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- (2) There is a need to clarify conformance requirements in relation to database standards, in particular:
  - Nature of conformance statements in database standards
  - Need for, and nature of, conformance test specification standards.
- (3) There is a need to clarify security requirements in relation to database standards, in particular:
  - Security needs
  - Security approaches and mechanisms
  - Relation of SC20 work to database security requirements
  - Relationship of database security needs to other security work (in particular to OSI security) and to overall system security policies.

## 7. THE SYSTEM MANAGEMENT FACILITY (SMF)

### 7.1 Description of the SMF

(U) The system management functions are identified in WP 24 as managing and updating a set of parameters that relate ensemble operations to other parts of the host system or other ATCCIS systems. The parameters (not yet specified) would be those required to ensure maximum continuity of service to the users in the event of equipment failure. The majority of system management services will be provided by the transfer of system management data using standard DMF services.

(U) The SMF is a logical entity that will interact on a peer basis as appropriate to provide specified services that cannot be provided by alternate means. Examples of system management data may be the logical-to-physical tables used by the TF and the tables defining the DMF domains.

(U) WP 24, Annex D, identifies as system management functions all activities of the system controller, system administrator, database administrator, and network administrator with the aim to control the system operations. The system management activities identified were: allocate resources, expand resources, distribute/disperse resources, move/relocate, manage crypto, manage access rights, select mode of operation, initialize, monitor system status, control system operations, and terminate.

(U) SMF works at the application level. Functionality unique to the SMF is very limited. Specifically, SMF is required to manage the concepts for Service Requests that have been identified [WP 24, Annex D] for ATCCIS. This may mean that SMF-unique functions may be ATCCIS-unique, and there may not be standards that address it. Further, most of the system management functions are expected to be provided as national-unique system management applications that use the other basic ATCCIS facilities.

### 7.2 Standards to Support the SMF

(U) No standards unique to the SMF have been identified. Further, none may be required.

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## 8. STANDARDS FOR ALL BASIC FACILITIES

(U) This chapter summarizes the status of standards in five areas: security, network (OSI) management, registration authorities, conformance testing, and formal description techniques (FDTs). Appendix F identifies organizations and standards bodies that have contributed to development of these standards.

### 8.1 Status of Standards for Security

(U) Security requirements for ATCCIS and other NATO Command and Control Information Systems (CCISs) include authentication, access control, confidentiality, integrity, and non-repudiation. These features are required by both civil and military systems and may be expected to be addressed by ISO and CCITT standards in the future. Specific military requirements for security and the TSGCEE recommendations for addressing these requirements will be treated in Sections 10.2 and 10.3.7.

#### 8.1.1 Overview of Civil and NATO Security Standards

(U) Standards for security are being addressed in the following:

- ISO 7498-2 *Security Architecture*.
- DP 10181, *Security Frameworks in Open Systems*, December 1989.
- *NATO OSI Security Architecture (NOSA)*, March 1988, NATO UNCLASSIFIED [Ref. 110], defines the security services, based upon ISO 7498-2, required in the NATO OSI Reference Model.
- *Security Architecture for NATO Information Systems Interconnection (SANISI) (NU)*, Version 2.0, April 1989, NATO CONFIDENTIAL [Ref. 111]. SANISI is planned to be standardized as STANAG 4250-2.
- Security annexes (Annex B) for NATO OSI STANAGs 4250-56 and 4261-66 and other STANAGs planned for Layers 6 and 7 (a draft Annex B has been prepared for STANAG 4253 and 4263).
- A series of appendixes to SANISI are expected to be developed to expand on the actual implementation of a secure protocol. The first of these, Trusted Communications Sublayer (TCS), is defined in the NOSA and SANISI documents.
- Secure Data Network System (SDNS) security protocols for the network and Transport Layer. (There is a close correspondence of services between the Layer 3 SDNS security protocol and TCS [Ref. 112].)
- Extensions to SDNS protocols, such as the End-to-End Security Protocol (EESP) being developed in the UK for submission to ISO SC21/WG1.

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### 8.1.2 Security Standards Work in ISO

(U) JTC1 SC21/WG1 has begun a number of initiatives to address the models and standards frameworks required to progress OSI security standards. Work is progressing on security enhancements to presentation standards, to association control standards, and (as necessary) to other Application Layer standards. In 1988 and 1989, WG1 circulated a number of documents to SC21:

- Plan of work on security [SC21 N 3267]
- Proposed drafts for an Upper-Layer Security Model [SC21 N 3225] and a Lower-Layer Security Model [SC21 N 3283]
- Security enhancements to presentation standards, to association control standards, and (as necessary) to other Application Layer standards
- Draft standards *Security Frameworks in Open Systems* (DP 10181)
- Discussion of the security management domain and security policies [SC21 N 3337]
- *Management Plan for Security*, November 1989; maintained as an internal SC21 document to indicate projects, priorities, and liaisons concerned with OSI security.

**8.1.2.1 Security Framework.** (U) DP 10181, *Open Systems Security Framework*, defines the framework within which security services for open systems are specified. These open systems include database, distributed applications, ODP, and OSI. The framework addresses data elements and sequences of operations (but not protocol elements) that are used to obtain security services. These security services may apply to the communicating entities of systems as well as to data exchanged between systems and to data managed by systems. Note that the security framework is being developed by SC21/WG1, whereas the Upper Layer Security Model is the responsibility of SC21/WG6. Table 10 identifies the scope of the individual parts of the framework.

(U) In 1990, two new projects were transferred from SC20 to SC21 in the OSI security area: (1) presentation cryptographic techniques and (2) protocol conditions for ACSE authentication. SC21/WG1 will conduct the work in these areas.

**8.1.2.2 Upper Layer Security Model.** (U) The Upper Layer Security Model is intended to provide the necessary basis for the development of security related protocol elements for the secure exchange of information between open systems, with the interchange of information related to security policy control and management, and with services and mechanisms for controlling access to resources accessible via OSI. It will address the following:

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- Security aspects of OSI-pertinent relationships between communicating application processes
- Relationships between security services and mechanisms in the Upper Layers, to be considered in greater detail than is provided in ISO 7498-2
- Properties of the possible combinations of security services and mechanisms in the Upper Layers
- Interactions among Application, Presentation, and Session Layers in providing security services
- Placement of security functions in the Application Layer Structure (ISO 9545)
- Invocation of Lower Layer security services
- Requirements for security management in the Upper Layers.

Table 10. (U) OSI Security Framework--DP 10181

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- Part 1 (WD 10181-1), *Overview*, December 1989 [SC21 N 4210]--Describes the organization of the security framework, defines security concepts that are required in more than one part of the security framework, and describes the interrelationship of the services and mechanisms identified in other parts of the framework.
- Part 2 (DP 10181-2), *Authentication Framework*, 13 December 1989 [SC21 N 4207]--Authentication is the process of corroborating an identity. Voting results on DP 10181-2 [April 1990, SC21 N 4585] indicates that a second ballot will be required.
- Part 3 (WD 10181-3), *Access Control Framework*, December 1989 [SC21 N 4206]--Access control is the process of determining whether the use of resources within an open system is permitted. The access control framework did not proceed to a DP ballot early in 1990 due to the extensive revisions made in the Florence meeting in November 1989.
- Part 4 (WD 10181-4), *Non-Repudiation Framework*, December 1989 [SC21 N 4209]--Non-repudiation is a security service that provides proof of origin or delivery of data in order to protect the sender against the false denial by the recipient, that the data has been received, or to protect the recipient against false denial by the sender that the data has been sent. The use of appropriate mechanisms is coupled with the necessary assurance mechanisms providing proof about certain properties of the communications between the entities involved, such as its integrity, origin, time, and destination. Non-repudiation implies the existence of an agreed third party whose primary role is to arbitrate disputes resulting from non-repudiation.
- Part 5 (WD 10181-5), *Confidentiality Framework*, December 1989--There were no substantial contributions to the confidentiality framework in November 1989 and it remains as only a list of planned contents.
- Part 6 (WD 10181-6), *Integrity Framework*, December 1989 [SC21 N 4208]--The integrity framework addresses the constancy of a data value and not any other form of invariant that such a value may possess. In particular, it does not address the constancy of any information that the data is deemed to represent. There are two types of integrity mechanisms needed for two types of constancy. The first is the constancy of the value of data in an environment in which a *random* modification to integral data may be made. The second is the constancy of the value of data in an environment in which a modification to integral data may *deliberately* be made to defeat the integrity mechanism.
- Part 7 (WD 10181-7), *Audit Trail Framework*, December 1989.

## UNCLASSIFIED

**8.1.2.3 Requirements and Approaches for Security.** (U) In March 1990 at the Workshop on Distributed Applications in Phoenix, the following observations on security were made [Ref. 113]:

- It is highly desirable to standardize a general approach to providing security in the Application Layer. This can be accomplished by supporting a variety of security methods that involve communication of security information. Examples of such methods could be:
  - Two-way or three-way authentication exchange
  - Privilege attribute certificate transfer
  - Key negotiation sequence.
- A security method would consist of semantics, syntax, and procedural rules relating to the communications aspects of the method.
- There appear to be three possible OSI architectural approaches to supporting security methods:
  - No generic security ASE(s), in which the syntax and procedural rules for any security method are imported into the specification of an application-specific ASE.
  - One generic ASE, in which one ASE is provided that can import into its abstract syntax the syntax of any security method. Possibly, the procedural rules associated with all security methods could be incorporated into the ASE specification.
  - Multiple purpose-specific security ASEs, in which each ASE incorporates the procedural rules and syntax for a particular security method or group of closely related methods (e.g., an ASE to support two-way authentication exchanges).
- Satisfaction of security requirements of TP, Directory, and OSI Management will depend on addressing security modelling issues related to distributed applications. The Upper Layer Security Model includes this in its scope, but the current draft of the model suggests little will be done in this area when it is first released.
- Access control to data resources must address the data model being used by individual applications such as DFR, DTAM, FTAM, IRDS, etc. Use of a common data modelling approach provides the potential for use of common access control facilities to such data resources and consequently increases the attractiveness of the common data model approach in order to prevent the need for re-specification of access control facilities for data management applications.

**8.1.2.4 FTAM Security.** (U) Most FTAM security appears to be based around access control lists, such as listing "people" and "groups of people" that are or are not allowed access. Change of access control lists is a procedural matter outside of OSI. FTAM can pass names and passwords (both encrypted and unencrypted), but this may better be supported with the Peer Entity Authentication framework of ISO 10181

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[Ref. 114]. This approach may not be general enough to address all types of access control (e.g., label-based security as mandated in the Orange Book).

**8.1.2.5 TP Security.** (U) A new work item is being drafted in SC21/WG5 for Transaction Processing security.

**8.1.2.6 ODA Security.** (U) Changes are being made to ODA, ISO 8613, to improve the security aspects. ODA provides protection for documents as a whole or for parts of a document. Confidentiality, integrity, authentication, and non-repudiation of origin are all supported using encipherment, fingerprints, and seals [Ref. 115].

**8.1.2.7 Directory Security.** (U) An access control framework for the Directory was recommended for DP status at the November 1989 meeting in Florence. A second DP ballot is planned in 1990, DIS status in 1991, and International Standard status in time for the next CCITT meeting in 1992. Access control is planned to be available at the attribute value, attribute type, directory entry, and domain levels. Two types of access control rules would be supported: (1) absolute access controls that are evaluated with outer domains taking precedence, and (2) default access controls that are evaluated with inner domains taking precedence. If no access control rules are found of either type that refer to an individual access, access is denied. The types of accesses controlled include manage, administer, compare, read, add, delete, and modify.

(U) The need for a key management framework has been identified by SC21/WG1. A liaison statement between SC21 and SC27 for such a framework is planned for 1990 [Ref. 116].

**8.1.2.8 Database Security.** (U) SQL2 specifies some security functionality but the standard (ISO 9075) does not address how a secure database should be built. Since the security of the operating system needs to be considered in building a (secure) database, POSIX standards are also relevant to the security of databases.

**8.1.2.9 Layer 3 Security.** (U) The UK plans to submit a proposal for an end-to-end security protocol (EESP) that operates at the top of Layer 3 as a separate protocol. EESP may require changes to ISO 8648, *Internal Organization of the Network Layer* [Ref. 117].

**8.1.2.10 Proposed ASE for Security.** (U) CCITT SG VII has identified a need to define an ASE capable of providing arbitrarily complex n-way security exchanges, where such exchanges could occur in conjunction with association establishment or after an association has been established. The SG VIII proposal [Ref. 118] identifies such application-layer exchanges as peer-entity authentication exchanges, exchanges of keying information, and combinations of these. The proposed



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Security Exchange Service Element would address ACSE shortcomings: peer authentication in ACSE (ISO 8649 DAD1) applies only at the time of association establishment and is limited to a single two-way exchange.

(U) A new work item on security exchange ASE has been adopted by SC21 that will provide for the transfer of information between a pair of application-entity invocations in support of security services such as authentication, access control, confidentiality, and integrity. The security exchange would be allowed to occur either in conjunction with association establishment or at any time on an established association. Encryption/signature functions could be located in either the Application Layer or the Presentation Layer. A standard method for defining security exchange information using ASN.1 would be defined as part of this work item [Ref. 119].

**8.1.2.11 Security Exchange Information.** (U) Canada has proposed the following approach for introducing a flexible means of generating protocols to support general-purpose security services in the Application Layer [Ref. 120]:

- Identify concepts of security exchange and security exchange information (SEI) and general approaches to defining such information
- Provide an ASN.1 framework for defining SEI to support the incorporation of SEI into existing or new Application Layer protocols based on ASN.1
- Specify a generic security-exchange ASE that provides a standard means of transporting SEI in application contexts where no other ASE provides for this transport.

**8.1.2.12 JTC1 Workshop on Security.** (U) JTC1 has scheduled a Workshop on Security in London during 5-7 November 1990. JTC1 participants are expected from the Special Working Group (SWG) on Security, SWG-EDI, SC6 (WG2/WG4), SC17(WG4), SC18(WG1/WG4), SC21(WG1), SC22 (POSIX Security), and SC27. Additional participants are expected from TC68 and TC154. The security topics proposed for this workshop are wide ranging and indicate the scope of ongoing work and areas envisioned for standardization in the next 5 or more years [Ref. 121]:

- Information security technology
- Information security risk analysis methodology
- Access control to applications and or security objects (e.g., for confidentiality and integrity)
- User authentication
- Indirect access to security objects or delegation mechanisms

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- Physical security in such areas as biometrics equipment, TEMPEST equipment, tamper resistance, computer room design, and card access control equipment
- Network security management
- Network access control
- Syntax and data elements for audit trails
- Secure version of OSI protocols (e.g., Data Link Layer, Transport Layer, upper layers)
- Secure versions of EDI
- Secure versions of standards for office documentation
- Standards for secure application design
- Secure versions of databases
- Generic security techniques and mechanisms in such areas as message authentication, digital signatures, peer entity authentication, and key management
- Security of distributed applications
- Security of transaction processing
- Information technology security evaluation criteria
- Integrated circuit cards security.

### 8.1.3 Security Standards Work in NATO

**8.1.3.1 TSGCEE SG9 AHWG on Security.** (U) The TSGCEE SG9 Ad Hoc Working Group (AHWG) on Security is developing the NOSA and SANISI documents, whereas the security annexes for the layer STANAGs are the responsibility of TSGCEE SG9 WG1 and WG2. NOSA was developed to give guidance to contractors and procurement managers on the preferred placement of security services within OSI-conformant systems. SANISI provides more detailed rationale on the placement of security services and mechanisms within the NATO OSI Reference Model. The emphasis has been to derive appropriate refinements and augmentations to ISO 7498-2 so that a comprehensive set of security facilities can be defined to satisfy the NATO secure interoperability requirements. SANISI is expected to remain classified for the foreseeable future. Annexes in SANISI are planned to address LANs, security management, and TCS services. There are some terminology differences between NOSA and SANISI; otherwise these documents are considered stable. The AHWG on Security has also developed a classification guide [Ref. 122].

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(U) The TCS architecture has been broken down into five functional modules. A description of this internal architecture was presented at the SHAPE Technical Centre Military OSI Symposium in June 1990 [Ref. 123]. Two of the five TCS modules identified so far now have service definitions and protocol specifications in draft form [Ref. 124]. Work is continuing in the AHWG on Security to make the TCS conform to the eventual security protocol agreed by ISO--only the implementation would be unique to NATO. Further, security issues have been identified by the AHWG on ISDN; when a security architecture is defined for ISDN, that architecture will be assessed to see how it relates to NOSA.

**8.1.3.2 NOSA.** (U) NOSA identifies OSI security services for the Physical, Network, and Presentation/Application Layers. These are [Ref. 110]:

- Physical Layer will provide two services by transparent means without requiring modifications to the Physical Layer protocols:
  - Connection confidentiality, which is capable of dealing with circumstances where the physical communication is intermittent or asymmetric.
  - Traffic flow confidentiality.
- Network Layer security services are provided within subnetwork-dependent roles and within a TCS:
  - Subnetwork-dependent services are peer entity authentication, data origin authentication, access control, connection confidentiality, connectionless confidentiality, traffic flow confidentiality, connection integrity without recovery, and connectionless integrity.
  - Security services that can be provided by the NATO TCS are identical to the eight identified above for subnetwork-dependent roles.
- Presentation/Application Layers could provide as many as 14 security services:
  - The eight services identified above for the Network Layer.
  - The following additional six services: selective field confidentiality, connection integrity with recovery, selective field connection integrity, selective field connectionless integrity, non-repudiation with proof of origin, and nonrepudiation with proof of delivery.

### **8.1.4 Other Security Standards Work**

**8.1.4.1 Secure Data Network System (SDNS).** (U) The goals of SDNS are to create specifications for end-to-end security; to utilize the OSI Reference Model; to design an architecture to include electronic mail and end-to-end encryption; to provide transparent key management; and to demonstrate feasibility of techniques. The US National Security Agency (NSA) is supporting the SDNS project [Ref. 125], which has released to the public domain several standards for security protocols [Ref. 126-136]. The elements of SDNS are described in Table 11.

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Table 11. (U) Security Protocols Developed in SDNS

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- Security Protocol 3 (SP3). Provides various security services in the Network Layer through the use of cryptographic mechanisms; SP3 is a subnetwork independent convergence protocol (SNICP, ISO 8648) that extends the CLNS (ISO 8348/AD1) with confidentiality (protection against passive monitoring), integrity (protection against modification, replay, addition, or deletion), or both. SP3 is designed to be used at the top of Layer 3 [Ref. 126].
- Security Protocol 4 (SP4). Specifies optional extensions of the COTS (ISO 8072) and connectionless transport service (ISO 8072/AD1) for the Transport Layer. The extensions permit the use of cryptographic techniques to provide data protection for transport connections for connectionless-mode Transport Protocol Data Unit (TPDU) transmission. SP4 can be used with the CONS or the CLNS. SP4 is designed to be used at the bottom of Layer 4 [Ref. 127].
- Message Security Protocol (MSP). Defines additions to the CCITT X.400 (either 1984 or 1988) that permit any type of message (including interpersonal messages) to be sent and received securely. When used with the conventions defined by ANSI for the X.400 Message Transfer System, MSP can be used to exchange EDI messages securely. The MSP provides writer-to-reader confidentiality, access control for message transfer, and request for a signed receipt of the received message. SDN 701 [Ref. 129] specifies the MSP, and SDN 702 [Ref. 130] defines new attribute types and object classes for inclusion in the X.500 Directory in support of key management functions used by MSP.
- Key Management Protocol. Key management provides for the generation, distribution, and updating of traffic encryption keys (TEKs). The abstract model for a Key Management Application Process (KMAP) consists of two parts: the information processing part that is supported by Management Information Bases (MIBs) for keys and for TEKs, and the communication part, called the Key Management Application Entity (KMAE). The KMAE consists of the Layer 7 ACSE (ISO 8649) and a Key Management Application Service Element (KMASE). The Key Management Protocol provides Layer 7 peer-level services between the KMASEs of two KMAPs. The Key Management Protocol assumes the use of the connection-oriented presentation services (ISO 8822) [Ref. 128, 134-136].
- Access Control. Access control is the prevention of the unauthorized use of a resource, including the prevention of use of a resource in an unauthorized manner (ISO 7498-2). SDN 801, SDN 802, and SDN 802/1 [Ref. 131-133] specify an access control framework based on a four-tiered model and an Access Control Information System (ACIS) that provides a uniform method for encoding access control information that is independent of any particular security policy. The ACIS also provides a standard algorithm for interpreting and comparing access control attributes. The access control framework provides for authentication data and access control checks that will allow communication between different SDNS users/systems when their respective security policies allow it. The framework provides two processes: a Peer Access Approval process for interpreting the data of the four-tiered mode, and the Peer Access Enforcement Process for enforcing access control on a Protocol Data Unit (PDU) basis [Ref. 131-133].

(U) The SP3 protocol is comparable to the TCS requirement identified by TSGCEE SG9. However, it does not meet all the TCS requirements and it requires a CL network services. For example, traffic flow confidentiality is not supported by SDNS. The UK has recently introduced the EESP, which could address the TCS requirements more fully, and support services for CO networks [Ref. 137]. There is some question as to whether the security models and the mechanisms that provide security services

## UNCLASSIFIED

underlying SDNS and the TCS are so different that SDNS can meet the TCS requirements [Ref. 138].<sup>18</sup>

(U) NSA is working with NIST to incorporate the SDNS protocols into US GOSIP. The SDNS protocols will also be introduced into the ANSI by NIST and, if accepted, into the ISO OSI Security Architecture. SP3 and SP4 have already been submitted by ANSI to ISO: SP4 has been accepted as a new work item, and SP3 is expected to be accepted as a new work item after some modifications. Testing of breadboard hardware with the SDNS protocols was conducted in 1989.

**8.1.4.2 NIST Recommendations.** (U) The NIST approach to OSI security standards includes the following features [Ref. 139]:

- Security encapsulation standard to provide cryptographic protection of integrity and confidentiality. A common format and processing standard that is independent of the algorithm to be used is needed.
- Security Protocol at Layer 2 (SP2), between the logical link control and the media access control protocols. This is being developed by IEEE under P802.10 as a Standard for Interoperable LAN security (described below).
- Security Protocol at Layer 3 (SP3). There are four subclasses: N-no routing, A-routing but no fragmenting and reassembly, I-fragmenting and reassembly, and D-fragmenting and reassembly for DoD Internetwork Protocol.
- Security Protocol at Layer 4 (SP4).
- Mail handling security system for MHS, to be used between the User Agent and the Transfer Agent to encapsulate the entire message contents; this requires posted keys and certificates. (One candidate is from X.411; another is the MSP from SDNS.)
- Cryptographic key management, a service to be provided at the Application Layer to support real-time (SP2, SP3, and SP4) as well as posted (MHS) requirements. Current proposals are based on private key (ANSI X9.17) or public key (SDNS) techniques.
- Security labels and labelling. These are planned to be strongly coupled with data.
- Authorization and access control. These features would permit policies to be specified within security domains and would support multiple policies and models (candidates are from ECMA and SDNS).

In addition, NIST is developing standards for digital signature and nonrepudiation where a message and the identity of the sender are cryptographically combined in such a way that

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<sup>18</sup> (U) In a private communication with Clive Walmsley, RSRE, in March 1990, a comment was made that the prospect of interoperability between the two models would be remote.

## UNCLASSIFIED

any unauthorized change to the message is detectable and the originator cannot deny creating the message. This feature would require trusted notarization and storage. Finally, NIST is developing standards outside the OSI model for personal identification and authentication. Approaches include knowledge, token, or physical means. Technologies being considered include a smart card and use of passwords.

(U) The NIST OSI Implementor's Workshops have a Special Interest Group (SIG) on OSI Security Architecture. The purpose of this group is to develop an overall OSI security architecture that is consistent with the OSI Reference Model and that economically satisfies the primary security needs of both the commercial and Government sectors. The SIG on OSI Security Architecture plans to address key management and security management functions that must be performed between the layers and the peer entities defined in the OSI architecture. Once SP3 and SP4 are adopted as Draft International Standards, the SIG on OSI Security Architecture can consider them for Interim OSI Implementor's Agreements.

**8.1.4.3 ECMA Recommendations.** (U) In July 1988, ECMA issued a technical report (TR46) entitled *Security in Open Systems--A Security Framework* [Ref. 140]. This document describes a framework for the development of security provisions in the Application Layer.

**8.1.4.4 IEEE Work on Secure Local Area Networks (LANs).** (U) Draft standards are being developed for secure LANs. IEEE P802.10 has released (January 1989) a draft of the Standard for Interoperable LAN Security (SILS) [Ref. 141]. The draft standard provides different service interfaces for key management, secure data exchange, and system management. System management primarily addresses security management, but may be expanded to include fault, performance, and configuration management as well. In addition, IEEE P802.2 is considering an optional security sublayer for logical link control [Ref. 142].

**8.1.4.5 BLACKER.** (U) On the Defense Integrated Secure Network (DISNET), the Defense Communications Agency (DCA) operates a standard end-to-end encryption (E3) system called BLACKER. A BLACKER front end (BFE) device is installed on each host-to-switch access path of all hosts used by subscribers, including terminal access controllers. The BLACKER system includes key distribution center (KDC) and access control center (ACC) hosts that automatically manage encryption keys via DISNET. BLACKER ensures that no network malfunction can permit or cause an unencrypted packet to be delivered to a host not authorized to receive it [Ref. 143-145].

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(U) BLACKER is designed to satisfy Class A1 of the DoD Trusted Computer System Evaluation Criteria (TCSEC), also known as "the Orange Book," by encrypting the application data in each X.25 packet while leaving header data unencrypted for backbone use. BLACKER makes DISNET multilevel secure in three ways. First, BLACKER separates subscriber security communities from each other, allowing the DISNET communities to share one backbone. Second, on the host side, the BFE recognizes a security label on each packet, allowing DISNET to serve a multilevel secure host through one BFE. Third, BLACKER separates the entire host community on one side of the BFEs from the backbone on the other, allowing the backbone to operate at a lower, less costly security level.

(U) The host interface to the BFE is based on standards defined for the 1983 DDN X.25 interface, and requires that the Internet Protocol (IP) be used as the next layer above X.25. The BFE presents a Data Circuit-Terminating Equipment (DCE) interface to the host. Only DDN "Standard Service" X.25 is offered at the host interface; no provisions for "Basic Service" will be made.

(U) The BFE conforms to the following Layer 3 specifications [Ref. 145]:

- *Defense Data Network X.25 Host Interface Specification*, DCA, December 1983.
- *Interface Between Data Terminal Equipment (DTE) and Data Circuit Termination Equipment (DCE) for Terminals Operating in the Packet Mode on Public Data Networks*, Recommendation X.25, CCITT, 1980.
- *WD2512 X.25 Packet Network Interface (LAPB)*, Western Digital Corp., 1989.

(U) In the fall of 1989, a multi-Service demonstration that used BLACKER communications security and off-the-shelf gateways and routers was held in the US. The Integrated Tactical-Strategic Data Networking (ITDN) demonstration was attended by the ATCCIS PWG. ITDN used only non-developmental item components, standard data communications protocols (X.25 with TCP/IP), and existing military communications systems. ITDN interconnected automated systems at multiple echelons at widely dispersed (over 1,000 miles) locations with multiple-security-level interconnected networks.

(U) Work similar to BLACKER is being done in other NATO nations to achieve the same ends.

**8.1.4.6 Computer Security (COMPUSEC) Guidance.** (U) In order to guarantee secure handling of data and information technology systems, it is

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necessary to comply with security standards appropriate to the respective risks in differing operational environments. The most commonly referenced security standards in NATO for COMPUSEC guidance are [Ref. 146-150]:

- *IT-Security Criteria, Criteria for the Evaluation of Trustworthiness of Information Technology (IT) Systems*, published by the Zentralstelle für Sicherheit in der Informationstechnik (ZSI, German Information Security Agency) in 1989.
- *Computer Security Requirements--Guidance for Applying the Department of Defense Trusted Computer System Evaluation Criteria in Specific Environments (Yellow Book)*, issued by the DoD Computer Security Center (DoDCSC) in June 1985.
- *Technical Rationale Behind CSC-STD-003-85: Computer Security Requirements--Guidance for Applying the Department of Defense Trusted Computer System Evaluation Criteria in Specific Environments (Yellow Book Rationale)*, issued by DoDCSC in June 1985.
- *Department of Defense Trusted Computer System Evaluation Criteria (Orange Book)*, issued under the authority and in accordance with DoD Directive 5200.28 in December 1985.
- *Trusted Network Interpretation (Red Book)*, issued by the National Computer Security Center in July 1987.

### 8.2 Status of Standards for OSI Management

(U) The OSI Reference Model identifies three areas of OSI management: systems management, layer management, and application process management. Development of international civil standards for the overall management architecture and for systems management is being coordinated through SC21 WG4 on OSI Management.

(U) Figure 10 identifies the classes of OSI management standards and indicates the relationships among these classes. ISO standards are identified where they apply. One standard, CD xxxxx, *Guide to Systems Management*, has not yet been drafted. It will be informative, independent of the other standards, and based on the guidelines contained in the early working documents on the five management functional areas: fault, configuration, security, accounting, and performance.

(U) All the Systems Management CD/CDAM progressions were passed by SC21 in June 1990. One of the NWI items failed--the proposal for a formal description of the CMIP.

(U) Work is progressing in SC6/WG2&WG4 on OSI management in the lower layers. A working draft specification of the elements of network layer management



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information has been developed [February 1989] and circulated to SC6 and SC21 [SC6 N 5448, October 1989; and SC21 N 4347, January 1990]. SC6 has developed a set of general principles for the definition of lower layer management [SC6 N 5784, January 1990; SC21 N 4630, April 1990]. These principles extend and refine the *Guidelines for the Definition of Managed Objects* (DIS 10165-4).

### 8.2.1 Development of OSI Management Standards

(U) Network management standards are being developed by the ISO/IEC JTC1 SC21/WG4. TSGCEE SG9 activities have been directed at identifying issues and positions of concern to military applications and influencing the direction of the work in ISO/IEC. The emphasis of the TSGCEE SG9 issues has been in the area of quality of service (QoS).

### 8.2.2 ISO Approach to OSI Management<sup>19</sup>

(U) OSI Management concerns itself with three things: inter-system communications carrying management information, structure of the management information, and management functions to be undertaken by end systems. There are three ways by which management information is communicated:

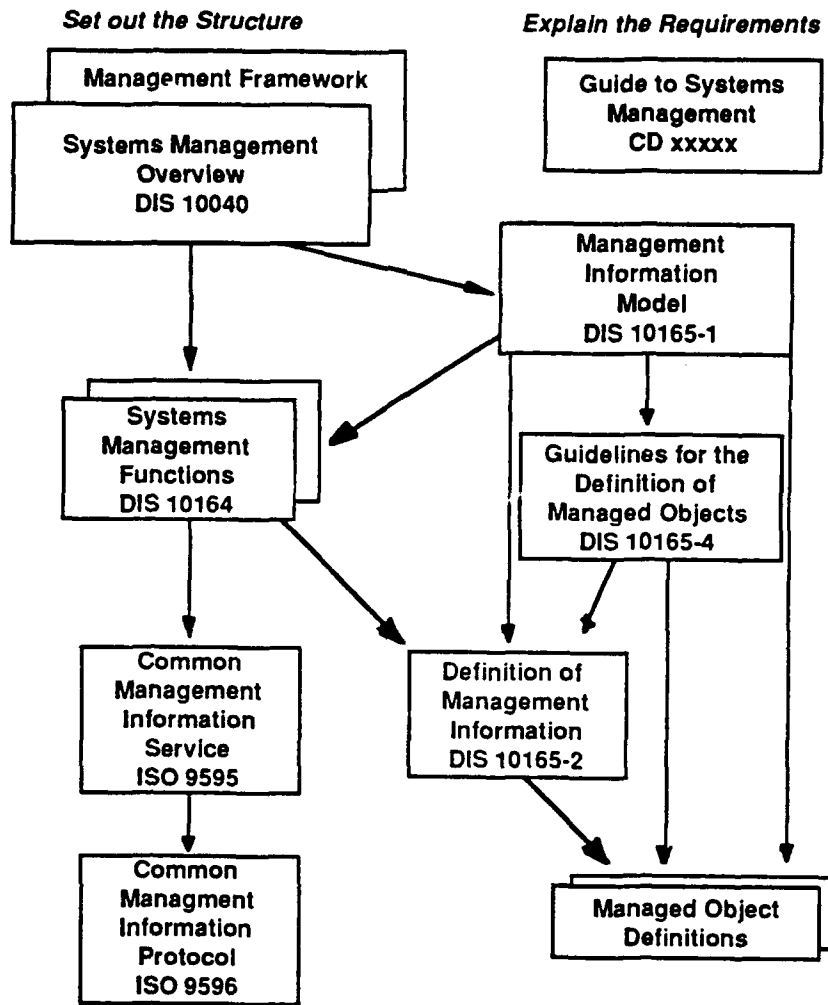
- Systems Management protocols at the Application Layer
- Layer management protocols at lower layers
- Normal operation of layer protocols.

Systems Management is the preferred method. The others are required only because OSI Management concerns the resources and activities needed to monitor and control the open communications environment. They are not required for management outside OSI Management.

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<sup>19</sup> (U) The discussion of the ISO approach to OSI management is taken from a working paper, *Open Distributed Management Standards--The OSI Management Approach*, A. Langsford (British Standards Institute IST21/P4 Chair), July 1989, UNCLASSIFIED.

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Source: DIS 10040, *Systems Management Overview*, SC21 N 4865, 29 May 1990, UNCLASSIFIED.

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Figure 10. (U) Application Functional Profiles

(U) Systems Management uses a Common Management Information Protocol (CMIP) to communicate information between systems. This identifies information to be transferred and whether the transfer concerns an event report or an operation. Event reports are generated to notify another system of an asynchronous happening. Operations can monitor data and can exercise control either by assigning data values or initiating actions through a synchronous communication between end-systems.

## UNCLASSIFIED

**8.2.2.1 Functional Areas.** (U) Establishing the scope of OSI Management is deemed necessary to establishing a consensus concerning the requirements. This led to identifying five functional areas for management: fault management, configuration management, accounting management, performance management, and security management. Although this approach had some advantages in resolving basic elements of functionality, it also exercised a constraining influence over the organization of work. Each functional area became concerned with its narrow perspective. This led to questions concerning the interplay between functional areas, exemplified by the following: "How does one handle standards for reconfiguring a system once a fault has been detected?"

**8.2.2.2 Focus on Managed Objects.** (U) A clarification came from a shift of emphasis to the data of concern to management. Only when the data have been defined are the functions, which use the data through monitoring or controlling activities, considered. This has resulted in simpler functional standards. Each function can now stand alone rather than being bound into a composite document covering all the functions conceived as belonging to a particular area. It also enabled functions that cross the preconceived functional area boundaries to be handled in a natural manner. The result is that a particular function can be issued as a CD proposal when it is deemed to be technically stable without being unduly delayed by less mature work considered as belonging to the same functional area.

(U) With this shift of emphasis towards data, the aim is now to identify the objects of concern to management, their attributes, and the operations that may be performed upon them. The communication services are thus the vehicles for carrying the values of attributes and a coded field identifying the operation to be carried out on a specific object, not for carrying information specifying a functional area. The approach is very close to (but not quite identical with) object-oriented methods. It has meant that work has concentrated on the management interchanges between systems performing a managing role and systems operating in an agent role manipulating internal managed objects. There has been little investigation of management exchanges between peer, managing entities, or of the management procedures invoked by managers.

(U) The object-oriented approach has enabled OSI Management experts, in collaboration with those developing standards for various OSI layer protocols, to identify classes of managed objects and commonly used attributes. This in turn has promoted the development of a standard naming scheme through which to identify instances of object classes. The naming scheme is based on that used for Directory

## UNCLASSIFIED

services. This facilitates the use of directories, conforming to ISO 9494 (CCITT Recommendation X.500), when management makes references to OSI objects.

**8.2.2.3 Distributed Processing Aspects.** (U) The shift of emphasis has been further beneficial in bringing into relief the fact that some management has been recognized as a distributed processing activity with its own managed objects. For example, the "event forwarding discriminator" takes management decisions about what should be done to asynchronous notifications flowing from OSI managed objects.

(U) Thus, OSI Management standards are beginning to reveal explicitly what has always been known by management specialists; i.e., management is a distributed processing activity and has much in common with other distributed processing activities. Management's distinguishing feature is that the scope of the distributed application is limited to manipulating the information processing, storage, input/output, and communications environments themselves. Hence, particular attention is paid to controlling the permission to obtain an act upon system information.

**8.2.2.4 Results of Work in OSI Management.** (U) OSI Management has had a long learning process. The lessons learned have been valuable and appear to be applicable to management in general. The following steps are important in creating new management standards:

- Establish a requirement, since this sets the scope for the standard.
- Identify the objects of concern to management through which that requirement is realized. With identification of the objects goes the identification of their attributes, operations, and of any objects that can be encapsulated within the identified objects.
- Establish a naming scheme for the objects and their attributes.
- Identify management procedures that, through monitoring and controlling activities, meet the requirement. Where a procedure requires inter-system communication, the communication is provided through the use of CMIP.

(U) The Structure of Management Information (SMI) standards for OSI set out rules for specifying managed objects, attributes, and their operations. Although detailed investigations remain to be carried out, first impressions are that these rules are applicable to all aspects of management. However, it could be that further investigation will reveal places where detail may need to be refined.

(U) OSI Management standards identify a number of attributes that are common to many management activities (e.g., counters, gauges, thresholds, status, logs) and many events that have general applicability (e.g., fault reporting, exception handling). Though not yet as well developed, it appears that OSI management procedures for testing,

## UNCLASSIFIED

accounting, managing, and accessing logs have the same general applicability. Adopting this work as a basis and providing extensions where required will (a) obviate rework, (b) help limit the unnecessary proliferation of managed standards, and (c) help reduce the diversity of management software that suppliers have to write to support open distributed management.

(U) In communicating related sets of operations to be performed or invoking remote operations, a managing system may wish to assert relative priorities to various tasks. If and how priority should be handled and communicated through CMIP is an open question.

**8.2.2.5 Conformance.** (U) SC21/WG4 has only begun to describe how conformance statements should be constructed so that they apply meaningfully to OSI Management. The one exception is CMIP for which, being a conventional Application Layer protocol, the task of generating conformance statements is straightforward.

(U) The main problem is that OSI Management is concerned not just with "how" something is communicated (CMIP) but "what" is communicated (SMI) and "why" (management functions and procedures). Whereas conformance and particularly the demonstration of conformance through conformance testing is readily applied to CMIP since the communication is visible and monitorable, the "what" and "why" require that conformance testing be applied to activities taking place within end systems. There is a need to investigate whether the approach of the OSI Conformance Testing Methodology is applicable or whether another method needs to be developed. Any method must recognize the distributed nature of management operations and so would probably be appropriate to other classes of distributed processing enterprise.

(U) Consideration of conformance to management standards, with the wider scope of open distributed processing, could have the beneficial effect of clarifying the conformance requirements, conformance clauses, PICS proformas (or the equivalent), and profiles for OSI Management standards [Ref. 151].

### **8.2.3 ISO Standards for OSI Management**

**8.2.3.1 Status of OSI Management Standards.** (U) The following are the standards documents being developed in ISO by SC21/WG4 for OSI management:

- *OSI Management Framework*, ISO 7498-4, November 1989. The Framework document provides an architectural overview (CCITT X.700).
- *Systems Management Overview*, DIS 10040, May 1990 [SC21 N 4865]; a meeting is scheduled for June 1991 to resolve comments on the DIS ballot.

## UNCLASSIFIED

The *Overview* document provides more detailed architectural concepts. It may contain normative material that an implementor must know but will probably not contain specific requirements that would be reflected in conformance testing. The DIS balloting for the *Overview* (and the first seven parts of DIS 10164) will take 6 months; it will be followed by a period to review and respond to ballot comments. The editing meeting will be in June or September 1991, after which the international standard text could be issued (CCITT X.701).

- *Systems Management*, DIS 10164:
  - Part 1: *Object Management Function*, DIS 10164-1, July 1990 [SC21 N 4067, December 1989]--editing meeting on responses to DIS balloting for Parts 1-7 planned for June 1991 with IS status at the end of 1991 (CCITT X.730).
  - Part 2: *State Management Function*, DIS 10164-2, July 1990 [SC21 N 4068, December 1989] (CCITT X.731).
  - Part 3: *Attributes for Representing Relationships*, DIS 10164-3, July 1990 [SC21 N 4069, December 1989] (CCITT X.732).
  - Part 4: *Alarm Reporting Function*, DIS 10164-2, July 1990 [SC21 N 4070, December 1989] (CCITT X.733).
  - Part 5: *Event Report Management Function*, DIS 10164-5, July 1990 [SC21 N 4071, December 1989] (CCITT X.734).
  - Part 6: *Log Control Function*, DIS 10164-6, July 1990 [SC21 N 4063, December 1989] (CCITT X.735).
  - Part 7: *Security Alarm Reporting Function*, DIS 10164-7, July 1990 [SC21 N 4064, December 1989] (CCITT X.736).
  - Part 8: *Security Audit Trail Function*, CD 10164-8, July 1990 [SC21 N 4955]--editing meeting on responses to CD balloting for Parts 8-11 planned for March 1991; open issues would be discussed at the May 1991 SC21 plenary meeting. DIS balloting could begin later in 1991 with IS status in 1992 (CCITT X.740).
  - Part 9: *Objects and Attributes for Access Control*, CD 10164-9, July 1990 [SC21 N 4956] (CCITT X.741).
  - Part 10: *Accounting Meter Function*, CD 10164-10, July 1990 [SC21 N 4958] (CCITT X.742).
  - Part 11: *Workload Monitoring Function*, CD 10164-11, July 1990 [SC21 N 4959] (CCITT X.739).
- *Structure of Management Information (SMI)*, DIS 10165 (a meeting is scheduled in June 1991 to resolve comments on DIS ballot):
  - Part 1: *Management Information Model*, DIS 10165-1, July 1990 [SC21 N 4484] (CCITT X.720).
  - Part 2: *Definition of Management Information*, DIS 10165-2, July 1990 [SC21 N 4867] (CCITT X.721).
  - Part 3: Cancelled in November 1989 by recommendation of SC21 and incorporated into Part 2.
  - Part 4: *Guidelines for the Definition of Managed Objects*, DIS 10165-4, 15 June, 1990 [SC21 N 4852].

## UNCLASSIFIED

- *Common Management Information Service (CMIS) Definition*, ISO 9595 (formerly DIS 9595-2), January 1990 [SC21 N 33874] (approval was received at the SC21 meeting in Seoul in June 1990 to proceed to IS status); CCITT and ISO/IEC are collaborating on CMIS and CMIP. CMIS defines services for acting on an object and include creation and deletion. Services can apply to values from a set of attribute values; the attribute values can have the structure of a table, so that services can affect entries, entire rows, and entire columns (CCITT X.710).
  - DAD 1: *CancelGet Service*, February 1990 [SC21 N 3876].
  - DAD 2: *Add/Remove Service*, February 1990 [SC21 N 3877].
  - PCDAM 3: *Support of Allomorhism*,<sup>20</sup> July 1990 [SC21 N 4966] (CDAMs for CMIS and CMIP are expected in November 1990).
  - PCDAM 4: *Access Control*, July 1990 [SC21 N 4999]; CMIS has an access control field--the issue is how to use it.
- *Common Management Information Protocol (CMIP) Specification*, ISO 9596 (formerly DIS 9596-2) [SC21 N 3698]; CMIP defines peer protocols for layer services between Systems Management entities (CCITT X.711).
  - DAD 1: *CancelGet Protocol*, February 1990 [SC21 N 3878].
  - DAD 2: *Add/Remove Protocol*, February 1990 [SC21 N 3879].
  - PCDAM 3: *Support of Allomorhism*, July 1990 [SC21 N 4967].
  - PCDAM 4: *PICS Proforma*, July 1990 [SC21 N 4965].

**8.2.3.2 New Work Items.** (U) Work in SC21/WG4 on OSI management is continuing on several new parts for *Systems Management*, DIS 10164. CD text for these parts is expected in November 1990. These are [Ref. 152]:

- Part Y: *Test Management Function*, July 1990 [SC21 N 4978].
- Part Z: *Confidence and Diagnostic Test Classes*, July 1990 [SC21 N 4957].
- Part A: *Measurement Summarization Function*, July 1990 [SC21 N 4972].

New work items include:

- *Systems Management Tutorial*, July 1990 [SC21 N 4942] (planned to be a new technical report) (CCITT X.702) [Ref. 153].
- *State Tables for CMIP*, January 1990 [SC21 N 4058] (accepted by JTC1 in June 1990, but will probably not be addressed by SC21/WG4 until late 1991).
- *Software Management Function*, July 1990 [SC21 N 4976], expected to be a new part of DIS 10164 and an addendum to DIS 10165-2 (accepted by JTC1 in June 1990; CD text expected in June 1992).

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<sup>20</sup> (U) An object in a refined class (i.e., a subclass) of a class definition (e.g., a modem) could behave in certain situations as if it were the parent. This characteristic, called polymorphism or more recently allomorhism, would support backwards compatibility. The way in which an object would respond would depend on how it is addressed. This work will lead to a change in both CMIS and CMIP.

## UNCLASSIFIED

- *Time Management: Representation of Time*, July 1990 [SC21 N 4953] (accepted by JTC1 in June 1990; expected to be a new part of DIS 10164)--deals with the distribution and synchronization of time in a distributed environment.
- *Extensioned Systems Management Architecture*, July 1990 [SC21 N 4943] (planned to be an amendment to DIS 10040).
- *Formal Descriptions of CMIP*, July 1990 [SC21 N 4947].
- *Systems Management Relationship Model*, July 1990 [SC21 N 4948]--expected to use entity-relationship modelling (planned to be a new part of DIS 10164).
- *Systems Management: Response Time Monitoring*, July 1990 [SC21 N 4949] (planned to be a new part of DIS 10164).
- *Generic Managed Objects*, July 1990 [SC21 N 4944] (planned to be a new part DIS 10164).
- *Definition of a Management Information Register and Registration Procedures*, July 1990 [SC21 N 4945]--to define a mechanism for registering system management information and procedures for maintaining the register. The Management Information Register would contain information describing:
  - Support managed object classes.
  - Generic managed object classes.
  - Definitions of attribute types, support objects, system management notifications, system management actions, name bindings, and management information parameters.
- *Requirements and Guidelines for Managed Object Conformance Statement (MOCS) Proformas*, July 1990 [SC21 N 4946]--to provide requirements and develop a standard specification technique (template) for MOCS proforma, thus helping to ensure their completeness, consistency, and ease of use. MOCS proformas are analogous to PICS proformas, but apply to managed object definitions as opposed to protocols. Designed to be an addendum to DIS 10165-4 (PDAD in 1991, DAD in 1992, and AD in 1993).
- *Management Information for the OSI Upper Layers* (approved by JTC1 in May 1990) [Ref. 154].
- *General Model for Relationship Management* to support DIS 10164-3, which addresses three methods of representing relationships: by name binding, by attributes, and by managed objects [Ref. 155].

(U) In addition, SC21/WG4 is preparing a draft technical report containing the general information generated for the five functional area documents (configuration management, fault management, accounting management, performance management, and security management). Extensions to the architecture document, *System Management Overview*, DIS 10040, include scenarios, associations (e.g., initialization),



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and management of system management. Generic managed object registration and registration procedures have been accepted as a new work item. Further, SC21/WG4 will begin work on managed objects and conformance statement proforma (guidelines). Finally, SC21/WG4 will work on CMIS/CMIP in areas such as superclasses and state tables for CMIP.

**8.2.3.3 Systems Management, DIS 10164.** (U) DIS 10164, *Systems Management*, establishes user requirements for each management function, establishes a model that relates the services and generic definitions provided by this function to user requirements, defines the services provided, defines generic notification types and parameters documented in accordance with the guidelines for the definition of managed objects, specifies the protocol necessary to provide the service, specifies the abstract syntax necessary to identify and negotiate the functional units in the protocol (if necessary), defines the relationship between the services and SMI operations and notifications, specifies compliance requirements placed on other standards that make use of these generic definitions, defines relationships with other systems management functions, and specifies conformance requirements. DIS 10164 does not define implementation aspects, specify the manner in which management is accomplished, define interactions that result in the use of management functions, specify services for establishment and normal or abnormal release of a management association, or define managed objects.

(U) DIS 10164 defines particular systems management functions and how these are achieved by use of CMIS. ASN.1 is the notation used to express the abstract syntax of the data elements associated with managed object, attribute, event, and action definitions that shall be carried in CMIP.

(U) The major management functions addressed in SMI are defined in Table 12.

**8.2.3.4 Major Remaining Issues for DIS 10164.** (U) The following technical issues are not yet addressed by DIS 10164 [Ref. 156]:

- Renaming managed objects--requirements for renaming managed objects, including classes to be renamed, conditions under which rename would be permitted, constraints on renaming objects in standardized procedures, and changes that need to be coordinated to make a renaming operation consistent and meaningful.

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- Service access control--mechanism to address the need for individual open systems to have the option of protecting themselves against the invocation of services that would forcibly change existing configured relationships among managed objects.
- Startup and shutdown--addressing the requirement to manage the state of an object as regards invoking startup (or initialization) and shutdown.

### 8.2.3.5 Structure of Management Information (DIS 10165).

(U) The purpose of DIS 10165-1, *Management Information Model*, is to give structure to the management information conveyed externally by systems management protocols and to model management aspects of the related resources (e.g., an X.25 protocol machine). Managed objects are abstractions of data processing and data communications resources (e.g., protocol state machines, connections, modems) for the purposed of management. It is the attributes, operations, and notifications of managed objects that are visible to management, whereas the internal functioning of the managed object (i.e., the resource it represents) is not otherwise visible to management. DIS 10165-1 describes the model of management information in terms of managed objects and the set of operations that may be performed upon them and notifications that they may generate. It also defines, using object-oriented principles, key concepts such as inheritance, allomorphism, containment, and naming as they relate to managed objects.

UNCLASSIFIED

Table 12. (U) Definitions of OSI Management Functions From DIS 10164

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- Object management--ability to create, delete, examine, and change sets of management information that describe parts of the OSI environment.
- State management--the ability to examine and be notified of changes in state, to monitor overall operability and usage of objects in a consistent manner, and to give or withhold permission for the use of specific objects.
- Relationship management--the ability to examine the relationships among various parts of the system, to see how the operation of one part of the system depends upon is depended upon by other parts.
- Alarm reporting function--reports alarms, errors, and related information. Malfunctions will range in severity from minor, where a minimal impact upon the quality of service to the user occurs, to major, where it is no longer possible to provide the quality of service requested (or promised) to the service user.
- Event report management--the ability to specify conditions to be satisfied by a potential event report relating to a particular managed object or a set of managed objects, in order to be sent to specified destinations.
- Log control--the ability to preserve information about events that may have occurred or operations that may have been performed by or on various objects.
- Security alarm reporting function--provides such capabilities as the means to receive notifications of security-related events, alerts of any misoperations in security services and mechanisms, alerts of attacks on system security, and information as to the perceived severity of any misoperation, attack, or breach of security. The standard provides notifications that include reporting of the clearance of fault conditions.
- Security audit trail--the ability to maintain a record of security-related events that occur in the management domain and to review and analyse these events to detect security breaches, malfunctions, and effectiveness of the security services and mechanisms that are implemented pursuant to the security policy.
- Access control--provides consistent levels of granularity necessary to a homogeneous control policy, preventing management notifications from being sent to unauthorized recipients, preventing initiators from having access to management operations, and protecting management information from unintended disclosure. Various levels of access control will be supported: some users may be given read and write access to specific attributes while other users have only read access or no access; some users may be granted access only to specific managed objects; and some users may not be allowed to establish management communications at all.
- Test Management Function--remote control of tests involving real open systems and the specification of tests that exercise OSI resources.
- Confidence and Diagnostic Test Classes--defines service in the form of test classes that are required in order to investigate the ability of a resource to perform its allotted function, the ability of the communications mechanism to make a connection between a number of open systems and to transfer data without modification between a number of open systems, the integrity of a protocol, and the effect of increased utilization of a resource.
- Measurement Summarization Function--measures throughput, time delays, message round trips, response times, and other measures of congestion and resource utilization for performance monitoring and statistics related to performance monitoring.

(U) DIS 10165-2 defines the generic object classes, support managed object classes, abstract attribute types, attributes types, notifications types, action types, parameter types, and associated abstract syntaxes that may be applicable to a number of

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different standards. It also specifies compliance requirements place on other standards that make use of these definitions.

(U) DIS 10165-4 defines the management information that is to be transferred or manipulated by means of the OSI management protocol and the managed objects to which that information relates. DIS 10165-4 provides developers of managed object class definitions with the information and documentation tools that are required in order to produce complete managed object class definitions.

### 8.2.4 Telecommunication Management Network (TMN)

(U) The Telecommunication Management Network (TMN) is concept developed by CCITT (Recommendation M.30) to manage a telecommunication network (e.g., the public telephone network or an ISDN). A TMN is conceptually a separate network that interfaces a telecommunications network at several different points to receive information from it and to control its operations. A TMN may use parts of the telecommunications network to provide for its own communications.

(U) Architecturally, the TMN functions are divided into three blocks:

- Operation System Function (OSF) that processes the information related to telecommunication management to support or control the realization of various telecommunication management functions.
- Mediation Function (MF) that acts on information passing between Network Element Functions (see below) and OSFs to achieve smooth and efficient communication. The main MFs are communication control, protocol conversion, data handling, communication of primitives, processing involving decision making, and data storage.
- Data Communication Function (DCF) that provides the means to transport information related to telecommunication management between functional blocks.

(U) The three functional blocks can communicate with two external blocks. One is the Network Element Function (NEF) that communicates with a TMN for the purpose of being monitored and/or controlled. The other is the Workstation Function (WSF) that provides the means for communications between function blocks (OSF, MF, DCF, and NEF) and the user. The current draft of the *NATO C3 Architecture Communications Subsystem* (July 1989) indicates that the management of the NATO ISDN will be based on the TMN concept [Ref. 157].

### 8.2.5 Military Concerns in Network Management

(U) Some concerns in the OSI management area involve the direction and support of work being done by ISO for Quality of Service (QoS) and multipeer/multiaddressing. Both of these areas were reassessed in 1989 due to lack of support from the nations. Specifically, a formal question<sup>21</sup> has been raised and put to a ballot on the need for a framework for quality of service within the ISO standards. Since these areas have been found to be priority items for achieving military requirements within NATO, it is important for the nations individually and collectively to increase their support for additional work in these standards areas.

(U) The Ad Hoc Working Group on OSI Management (AHWG-OM) of TSGCEE SG9 has been formed to address OSI management issues for NATO.<sup>22</sup> The major standing document of the AHWG-OM is *NATO Requirements for Open Systems Management* [Ref. 158]; some key elements are the following:

- Part 1: *Rationale and Objective* (of which Section 7 is *Military Features and Their Impact on OSI Management* and Annex A.2 is the *Work Plan*), 28 June 1990
- Annex H: *Notes Concerning the Quality of Service Issue*, Third Draft, 9 February 1990
- Appendix 4, *Requirements for a Network Management Broadcast Facility*, 1 May 1990.

### 8.2.6 Quality of Service (QoS)

(U) In the framework of OSI, QoS provides the capability to measure the service level provided by the communications service provider and the means to request a target service from the communications service provider. QoS parameters now used in ISO standards<sup>23</sup> include transit delay and priority.

(U) SC21/WG1 posed Question 62 (Q62) in 1989 to query whether a QoS Architecture was necessary since such an architecture would require modification to the OSI Reference Model. The first step to developing such an architecture would be defining the components of a QoS Framework. A concern of several national bodies in

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<sup>21</sup> (U) ISO/IEC JTC1/SC21/WG1 Question 62: "Is Quality of Service an architectural issue which needs overall guidance and consistent approach across all layers?" Balloting closed in May 1989.

<sup>22</sup> (U) The work TSGCEE SG9 working groups is discussed in Section 10.3. The AHWG-OM is addressed in Section 10.3.5.

<sup>23</sup> (U) ISO/IEC references to QoS are in Layer 3 (ISO 8438), Layer 4 (ISO 8072, 8073), Layer 5 (ISO 8326), Layer 6 (ISO 8822), and Layer 7 (ISO 8649, 8650, 8571-3).

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WG1 is that a new QoS Architecture would destabilize the existing standards. At the May 1990 SC21 Plenary in Seoul, WG1 did not progress the QoS Framework as a new work item. WG1 reported to SC21 [Ref. 159]:

[WG1] believes that it is still premature to progress the work any further at the current stage. The group noted that only [a] limited number of national body contributions [were] received on this question; also noted that there is not enough technical contributions and general consensus for progressing the work, although renewed expressions of interest have been received from several national bodies.

WG1 has requested additional contributions from national bodies by January 1991 on the QoS Framework.

(U) The AHWG-OM (see Section 10.3.5) has identified [Ref. 160, 161] the following deficiencies and requirements relative to QoS:

- Only static QoS parameters have been defined--the relationship of various QoS parameters to each other and actions to take upon dynamic change in QoS are not yet supported.
- A tight coupling between QoS and communications services is needed to support applications in areas such as military and real-time process control and high assurance of message delivery. Specifically, this means that applications need:
  - Capability to clearly express the QoS requirement to the underlying communications service
  - Notification of changes in QoS
  - Close monitoring of the QoS
  - Assurance that QoS is maintained in a deterministic manner.
- While the need of the layer services have led to protocol definitions that include parameters for specifying QoS, no syntax or semantic meaning of those parameters has been defined.

Further, the AHWG-OM has recommended that:

- An overall framework for OSI QoS be developed and, specifically, ISO/IEC SC21/WG1 raise the priority of QoS discussions in this area.
- QoS be expanded to provide five functions: establishment, monitoring, maintenance, notification of change, and negotiation.

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- The definition of QoS be modified to include the following four classes of QoS parameters:
  - Quality of addressing--the correct assignment of addresses to the originator and the recipient.
  - Quality of message--the reliability of message delivery against data loss, data corruption or insertion, misdelivery, duplicate delivery, or out-of-sequence delivery.
  - Quality of timeliness--the delay of transferring information across a communications service, including specification of requirements on time limits for delivery of a message. The latter may be in terms of the time after which the message is no longer valid, allowable delay in the transfer, and the action to take on failure to meet the criteria.
  - Quality of confidentiality--the ability of the system to protect its resources from unauthorized use and to prevent unauthorized interception of information relative to the transfer of a message. Clearly this quality overlaps security requirements.

(U) The AHWG-OM in its meeting in June 1990 recommended three steps for progressing work on QoS: (1) establish an ad hoc working group on QoS in TSGCEE SG9 to define QoS requirements and a QoS Framework; (2) apply the QoS Framework in other SG9 working groups; and (3) provide additional information to ISO and other standards bodies on the need for QoS. AHWG-OM recommended that the proposed framework consider the application QoS parameters, the application actions (procedures used by applications in processing QoS information), and QoS facilities for establishment, monitoring, maintenance, notification, and negotiation of QoS [Ref. 162].

(U) A key background paper for QoS is *Management Requirements Arising from a NATO Study of Quality of Service* [Ref. 163]. This paper identifies QoS requirements in such areas as specification, establishment, application actions, monitoring, maintenance, notification, negotiation, information flow, and applicability. It also addresses the QoS framework, information model, and interaction model. Four QoS parameters are identified: addressing, message, timeliness, and confidentiality. The June 1990 recommendations of the AHWG-OM to SG9 were based, in part, on material described in this paper.

**UNCLASSIFIED**

**8.2.7 Special Interest Groups for OSI Management**

(U) A number of special interest groups have been formed to promote standardization of OSI management. These include [Ref. 164]:

- Network Management Experts Group--formed within EWOS with plans to meet four times per year
- Network Management Forum (NMForum)--developing specifications that will be demonstrated in September 1990 during the first Network Management Showcase
- NIST Network Management Special Interest Group (NMSIG)--developing specifications for the *Stable Implementor's Workshop Agreements* with a target date of December 1990. The 1990 version will define, in coordination with EWOS and the NMForum, managed objects for LANs including FDDI, X.25, and ISDN. Additional managed objects would be defined in 1991 for Layer 3-7 protocols and routers and in 1992 for applications, operating systems, and database management systems.

**8.3 Standards for Registration Authorities**

(U) Registration provides unambiguous identification of instances of certain types of information objects within the OSI environment. Examples of these instances are an application process, an application entity, and the definition of a class of information such as a file format. Registration is the assignment of an unambiguous name to an instance of a type of information object in a way that makes the assignment available to interested parties. It is carried out by a registration agent that may be either a standard or an organization.

(U) SC21 and SG VII have agreed to collaborate in work on registration authorities. The groups have concurred that "the establishment and operation of registration is critical to communications in a distributed environment and that, without procedures for the operation of registration, interoperability between applications is unlikely" [Ref. 165]. An area of disagreement is the presence of the Name Form in DIS 9834-1, included to support the specification of procedures to ensure the assignment of unambiguous names for registration purposes.



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(U) ISO JTC1 SC21/WG1 has developed<sup>24</sup> a standard (DIS 9834, *Procedures for the Operation of OSI Registration Authorities*) for the operation of OSI registration authorities. The status and structure of this standard is as follows:

- DIS 9834-1 (Part 1): *General Procedures*, March 1990 [SC21 N 4352]
- DIS 9834-2 (Part 2): *Registration Procedures for Document Types*, May 1988 [SC21 N 2605]
- ISO 9834-3 (Part 3): *International Register of Object Identifier Component Values for Joint ISO/CCITT Use*, 1989 [SC21 N 4718, April 1990]
- DIS 9834-4 (Part 4): *Registration of VTE Profiles*, March 1990 [SC21 N 4325]
- DIS 9834-5 (Part 5): *Registration of VT Control Objects*, March 1990 [SC21 N 4322]
- DP 9834-6 (Part 6): *Registration Authority Procedures for AP Titles and AE Titles*, July 1989 [SC21 N 3185] (DIS text expected in 1990).

DIS balloting on 9834-1 was suspended and will begin again in August 1990 on recommendation to SC21 by WG6 [Ref. 166].

(U) Work in registration authorities (SC21/WG1) is ongoing in one additional area: registration of system titles, for which DP status is expected in November 1990. Prior work on authentication mechanisms, application context names, abstract syntaxes, and transfer syntaxes is now considered as not required.

### 8.4 Status of Standards for Conformance Testing

(U) Conformance testing is crucial to the achievement of OSI to ensure comparability of test procedures and results by different test centres. Standardization of conformance test suites needs to be based on a standard testing methodology and approach to test suite specification, which is reflected in DIS 9646, *OSI Conformance Testing Methodology and Framework*. Work has already begun in standardizing test suites based on DIS 9646 for X.25 terminals, the connection-oriented transport protocol (ISO 8073), MHS, FTAM, ACSEs, session, and presentation protocols. A detailed description of OSI conformance testing is provided in Reference 167. ISO/IEC work in conformance testing is done by SC21/WG1.

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<sup>24</sup> (U) Work on Registration Authorities beginning in November 1989 was transferred to SC21/WG6.

## UNCLASSIFIED

(U) DIS 9646 is being developed in six parts, all of which are stable:

- DIS 9646-1, Part 1: *General Concepts*, May 1990 [SC21 N 3429] (CCITT X.290)
- DIS 9646-2, Part 2: *Abstract Test Suite Specification*, May 1990 [SC21 N 3430] (CCITT X.291)
- *Addendum to Part 2 on Testing and Formal Description Techniques (FDTs)*, DIS 9646-2 WDAD1
- DIS 9646-3, Part 3: *The Tree and Tabular Combined Notation (TTCN)*, January 1990 [SC21 N 4327] (CCITT X.292)
- *Addendum on Extensions to TTCN Including Parallel Tree*, DIS 9646-3 WDAD1, March 1990 [SC21 N 4219, December 1989]
- DIS 9646-4, Part 4: *Test Realization*, May 1990 [SC21 N 3504] (CCITT X.293)
- DIS 9646-5, Part 5: *Requirements on Test Laboratories and Clients for the Conformance Assessment Process*, May 1990 [SC21 N 3503] (CCITT X.294)
- DP 9646-6, Part 6: *Interpretation of Test Report*, 1989
- *Protocol Profile Testing Methodology*, May 1990 [SGFS N 9].

(U) There are four primary areas for standardization of conformance testing in the near future: multi-protocol (profile) testing, multi-party test methods, additional features in TTCN and multi-test case tables, and the nature of profile conformance testing and configurability [Ref. 168]. Specifically,

- *Protocol Profile Testing Methodology* is a proposal for a new work item, January 1990. This standard will supersede TR 10000-1 as far as conformance aspects are concerned. A joint meeting with CCITT SG VII is planned for February 1991; CD text as Part 7 and addenda are expected in June 1991.
- Multi-party test methods will be addenda to parts of DIS 9646. A joint meeting with CCITT SG VII is planned for February 1991, and CDAMs are expected in June 1991.
- Work on TTCN extensions has already begun. As an addendum to DIS 9646-3, *TTCN Extensions* introduces the notion of parallelism in order to ease the writing of test cases, provide a language means to describe explicitly the cooperation of (distributed) components of a test architecture, and to make TTCN a test notation that covers the aspects of a multiparty test methodology. WDAD text was distributed for comment in March 1990, and CDAD text is expected in October 1990.
- Formal methods in conformance testing is a proposal for a new work item, January 1990. A joint meeting is planned with CCITT SG X in November 1990, and CD text is expected in May 1992.

## UNCLASSIFIED

Additional topics to be addressed for conformance testing in 1991-1992 are ISDN and multimedia concerns, application of formal methods, and protocols for test support.

(U) *The Protocol Profile Testing Methodology* will extend the OSI conformance testing methodology and framework (DIS 9646) to make it applicable to OSI protocol profiles as well as base protocols.

(U) The multi-party test methods (MPTM) addenda to DIS 9646 [SC21 N 4218, January 1990] define the main requirements concerning MPTM and a multi-party test architectural model. The model will be used to map abstract test methods on which to base the development of abstract test suites and means of testing for the various multi-party protocols and multi-party testing configurations using more than one protocol or more than one channel.

(U) SC21/WG1 has noted concerns [Ref. 169] about the available resources and direction of work on upper layer conformance testing. Work has slipped 2 years on abstract test suites for FTAM and 3 years for embedded test suites for ACSE, Presentation Layer, and Session Layer. There is an imbalance between work on the basic methodology and that applied to the actual conformance tests, specifically on abstract test suites.

(U) EWOS has agreed [Ref. 170] to convene an activity to study and investigate OSI Conformance Testing Methodology. This work would examine central aspects of OSI testing methodology that are necessary to support standardization of test specifications. CEN has been assigned leadership of the work.

(U) TTCN is a unique, informal notation that was developed by ISO and CCITT for specifying generic and abstract test cases [Ref. 171]. Other formal description techniques in use for this purpose are the Language of Temporal Ordering of Specification (LOTOS) and Estelle--both accepted in the *NTIS Transition Strategy*--and the System Development Language (SDL), developed by CCITT (Recommendation Z.100). Both Estelle and SDL are Pascal-based notations. These formal description techniques (FDTs) are described in detail in Section 8.5.

(U) TTCN provides a notation in which generic and abstract test cases can be expressed in test suite standards, which is independent of test methods, layers, and protocols, and which reflects the abstract testing methodology of DIS 9646. TTCN provides a naming structure to reflect the position of test cases in the abstract test suite hierarchy (complete test suite, test groups, test cases, test steps, and test events). TTCN also provides the means of structuring test cases as a hierarchy of test steps culminating in test events.

## UNCLASSIFIED

(U) An approach used in conformance testing (and in other applications) to specify interoperability parameters for an implementation (or a functional profile) is called a protocol implementation conformance statement (PICS). A PICS specifies all the parameters and options required to show how a particular implementation meets static conformance requirements. As such, it is the first tool in conformance testing. A PICS proforma is a PICS template developed and standardized in conjunction with a protocol standard. TSGCEE SG9 will use the PICS proforma as part of the functional profile guidelines.

(U) Many organizations have been formed to address OSI conformance testing. These include Corporation for Open System (COS), SPAG, European Committee for Standardization (CEN)/European Committee for Electrotechnical Standardization (CENELEC), NIST, Industrial Technology Institute (ITI), World Federation of Manufacturing Automation Protocol (MAP) and Technical and Office Protocol (TOP) User Groups, Conformance Testing Services-Wide Area Network (CTS-WAN), National Computing Centre (NCC), and EurOSInet. TSGCEE SG9 is addressing [Ref. 172] NATO requirements in this area and whether NATO-specific activities need to be supported. The following are areas in which existing civil organizations may be expected to contribute to conformance testing to support NATO requirements [Ref. 173]:

- Developing standards and conformance certification criteria: ISO, CCITT
- Developing abstract test suites for OSI upper layers: ISO
- Developing test profiles and provisioning testing under military requirements: COS, SPAG
- Developing site accreditation criteria: Industrial Technology Institute (ITI)
- Implementing site accreditation and testing tools, and specifying test control and maintenance procedures: NIST
- Developing standards and test methodologies: CEN/CENELEC, ANSI.

(U) COS [Ref. 1742] and SPAG have now completed formal agreement to combine their conformance test products within a single integrated tool set (ITS). In addition, COS, POSI, and SPAG have completed (June 1989) an Initial Strategic Technical Cooperation Agreement that commits the organizations to a strategic cooperative arrangement designed to provide a common technical solution to conformance testing, building upon the ITS. The agreement is also known as "CPS" (both for Conformance Promotion Strategy and for COS-POSI-SPAG).

## UNCLASSIFIED

### 8.5 Formal Description Techniques (FDTs)<sup>25</sup>

(U) FDTs are used to produce unambiguous descriptions of OSI services and protocols in a more precise and comprehensive way than natural language descriptions. Further, FDTs provide a foundation for analysis and verification of a description. The objectives of FDTs are to provide:

- Unambiguous, clear, and concise specifications
- Basis for determining completeness of specifications
- Foundation for analysing specifications for correctness, efficiency, etc.
- Basis for determining consistency of specifications relative to each other
- Basis for implementation support.

(U) There are three international standard FDTs that range from abstract to implementation-oriented: Estelle, LOTOS, and SDL. Since emerging standards are being written in one or more of these FDTs, the following sections are provided to give some technical information, together with the basis, derivation, and character, for these description techniques [Ref. 175]. DTR 10167, *Guidelines for the Application of Estelle, LOTOS, and SDL*, SC21 N 4259, January 1990, provides guidelines for applying these three FDTs. A fourth FDT--TTCN--was described in Section 8.4.

(U) SC21/WG1 has developing a working draft for *Architectural Semantics for FDTs* [SC21 N 4231, April 1990]. This work was planned to assist development of formal descriptions of standards for data communications, networking, and distributed computing. The draft defines and catalogues a set of selected elementary concepts, which act as a bridge between the architectural concepts and structures and the semantic models of the FDTs (Estelle, LOTOS, and SDL). SC21 approved the May 1990 recommendations developed by a reassessment of the work associated with the *Architectural Semantics for FDTs*. The current work in SC21/WG1 will be terminated and a subproject initiated in SC21/WG7 in the area of ODP architectural semantics [Ref. 176].

#### 8.5.1 Estelle

(U) Estelle (ISO 9074, *Estelle, A Formal Description Technique Based on an Extended State Transition Model*, July 1989) is a formally-defined specification language for describing distributed or concurrent processing systems, in particular those that implement OSI services and protocols. The language is based on widely used and

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<sup>25</sup> (U) Discussion of FDTs is taken, in part, from DTR 10167, *Guidelines for the Application of Estelle, LOTOS, and SDL*.

## UNCLASSIFIED

accepted concepts of communicating non-deterministic state machines (automata). An Estelle specification defines a system of hierarchically-structured state machines. The machines communicate by exchanging messages through bidirectional channels connecting their communications ports. These messages are queued at either end of the channel. The actions of machines are specified in (extended) Pascal; hence, familiarity with Pascal makes Estelle specifications easily readable. Estelle uses Pascal data types in its data descriptions.

(U) Estelle is based on an extended state transition model, i.e., a model of a nondeterministic communicating automaton extended by the addition of the Pascal language. Estelle may be viewed as a set of extensions to Level 0 of ISO 7185 (*Programming Language - Pascal*) that models a specified system as a hierarchical structure of communicating automata that may run in parallel and may communicate by exchanging messages and by sharing, in a restricted way, some variables. As in Pascal, all manipulated objects are strongly typed, which enables static detection (e.g., during compilation) of specification inconsistencies.

(U) Estelle language mechanisms allow modelling of synchronous and asynchronous parallelism between state machines of a specified system. They also permit dynamic development of the system configuration. Estelle specifications can be prepared at different levels of abstraction, from abstract to quite implementation-oriented. The latter may be derived from the former with the aid of supporting tools. An Estelle tutorial has been developed and is intended to become Annex D (informative) of the Estelle base standard (ISO 9074 PDAD1, *Estelle Tutorial*, SC21 N 4230, December 1990).

### 8.5.2 LOTOS

(U) LOTOS (ISO 8807, *LOTOS, A Formal Description Technique Based on the Temporal Ordering of Observational Behaviour*, February 1989) is a mathematically-defined FDT, developed from a large, well-established body of theory based on three mathematical techniques: Calculus of Communicating Systems (CCS), Communicating Sequential Processes (CSP), and ACT ONE. Having a well-defined mathematical foundation, it provides a solid basis for both analysis and development of reliable tools, including simulation, compilation, and test sequence derivation. The basic constructs of LOTOS allow modelling of sequencing, choice, concurrency, and nondeterminism in an entirely unambiguous way. In addition, LOTOS permits modelling of both synchronous and asynchronous communication. LOTOS, like SDL, uses abstract data types in its data descriptions.

(U) LOTOS may be applied to produce a specification of the allowed behaviours of a system, i.e., the set of all behaviours that may be observed of a

## UNCLASSIFIED

conforming implementation. Furthermore, LOTOS permits the description of allowed behaviours without describing how this may be achieved or by describing particular mechanisms that achieve the required behaviour.

(U) Formal descriptions of the session service and protocol using LOTOS have been developed:

- TR 9571, *LOTOS Description of the Session Service*, September 1989
- TR 9572, *LOTOS Description of the Session Protocol*, September 1989.

### 8.5.3 SDL

(U) SDL is based (CCITT Z.100-Series recommendations) on the extended finite state machine model supplemented by capabilities for abstract data types based on the initial algebra model (the same one used in the ACT ONE part of LOTOS). This combination is supported by well-defined formal semantics. SDL provides constructs to present structures, behaviours, interfaces, and communications links. In addition, it provides constructs for abstraction, module encapsulation, and refinement. All of these constructs were designed to assist the representation of a variety of telecommunications systems specifications, including aspects of protocols and services.

### 8.5.4 G-LOTOS

(U) Text for a standard for a graphical syntax, G-LOTOS, has been submitted [Ref. 177] that provides an extension to LOTOS (ISO 8807) to facilitate production and enhance clarity and readability of formal descriptions, simplify teaching and learning the language, favour the development of advanced user-friendly software tools, and promote the diffusion and application of the language [Ref. 178].<sup>26</sup>

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<sup>26</sup> (U) New work item [JTC1 N 485] for G-LOTOS was not accepted; status of PDAD1 is uncertain (April 1990).

## 9. STANDARDS FOR ENHANCED INTEROPERABILITY

(U) Previous chapters have identified technical standards needed to achieve basic interoperability, which is defined as the exchange of information that preserves meaning and relationships. Chapters 4-7 reviewed standards applicable to one of the four basic facilities, and Chapter 8 addressed standards applicable to all four basic facilities. This chapter summarizes standards and technical approaches to selecting interoperability parameters from standards that would go beyond basic interoperability and beyond the four Basic Facilities that support basic interoperability.

### 9.1 Enhanced Interoperability

(U) Enhanced interoperability includes all the functionality required to provide basic interoperability, together with additional functionality and characteristics. Standards for enhanced interoperability would go beyond those required for ATCCIS-conformant systems and would require additional agreements. Examples of enhanced interoperability would be application-level facilities (ALFs) for performing certain key tasks, a human-computer interface service facility, a user-interface management system (UIMS), and specialized input-output facilities (IOFs). These are discussed in WP 24.<sup>27</sup>

### 9.2 Standards for Enhanced Interoperability

(U) There is a potential for cost savings and improved interoperability if standards are adopted for use by two or more nations in ATCCIS-conformant systems. These standards could be in the areas of operating systems, human-computer interfaces, database management, graphics interchange, document interchange, and programming services (e.g., languages for software development). Use of such standards can lead to portable application software for use in more than one type of ATCCIS-conformant system, not only to implement applications that go beyond basic interoperability, but also to achieve basic interoperability in a more cost effective way.

(U) In April 1988, JTC1 of the ISO/IEC began a formal Technical Study Group (TSG-1) for Interfaces for Applications Portability (IAP). Managed directly under the JTC1, and not any of the subcommittees, the IAP study will identify user requirements and standards needed to support those requirements. The TSG-1 will address several aspects of portability, including moving applications across a range of machines, minimizing

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<sup>27</sup> (U) WP 24 refers to the human-computer interface service facility as the Man-Machine Interface (MMI) Service Facility (MSF).



## UNCLASSIFIED

training and simplifying user interfaces (user portability), recognizing different underlying philosophies/architectures, and distinguishing among possible levels of portability.

(U) ISO has recognized that standardization is needed for information processing that goes beyond data communications services and protocols. As will be shown in the sections that follow, there are major efforts under way in the areas of standard interfaces to operating systems, databases, graphics, user input and display devices, and programming languages. In addition, open systems standards are being developed for document interchange and distributed processing.

(U) SC21 has identified [Ref. 179] the need to provide standardization in areas related to both basic and enhanced ATCCIS interoperability. These areas are:

- Information exchange
- Internetworking of systems
- Specification of functions needed in systems built for specific purposes
- Portability of applications across system hardware and software
- Definition of common interfaces to system services
- Security of systems
- Reliability of systems
- Human/computer (man/machine) interfaces
- Definition of common concepts
- Safety and legal requirements.

SC21 specifically plans to address standardization for database management systems and single and distributed processing environments, in addition to open systems interconnection.

### 9.2.1 Operating System Standards

(U) When common operating systems are used, there is a potential to reduce the development of ATCCIS system elements by sharing software. Even when different operating systems are used, adoption of operating system interface standards can increase application software portability. In ATCCIS, the recommended approach would be to agree on a standard operating system interface (i.e., POSIX), but *not* to seek agreement on a standard operating system. Operating system interface standards (specifically POSIX) are discussed in Sections 5.2 and 5.3. Standards for applications portability are addressed in Section 9.4 below.

## UNCLASSIFIED

(U) SC21 has begun work in the area of Operating Systems Command and Response Language (OSCRL). A draft proposal for OSCRL is planned, but has not yet been promulgated.

(U) Two communities of operating systems standards have received strong support from vendor groups promoting application portability. One group is UNIX International (formerly Archer, with a membership of 42 corporations and user groups), which promotes UNIX System V, a proprietary standard of AT&T. Availability of Release 4.0 of UNIX System V was announced at the UNIX EXPO (November 1989) and is now commercially available. This release aims to:

- Merge all the major versions of the UNIX operating system (i.e., the /usr/group Xenix, the Berkeley 4.x BSD, and the Sun Operating System)
- Enhance data networking with the addition of Remote File Systems and Remote Procedure Calls
- Address real-time applications and environments
- Ensure conformance to POSIX through enhanced signal handling, multiple groups and ownership, and job control
- Achieve and maintain full compliance with the X/OPEN CAE.

(U) The other major group promoting operating systems is the Open Software Foundation, which has adopted the IBM AIX Version 3 of UNIX. This version conforms to POSIX, and future releases will comply with Issue 3 of the X/Open Portability Guide (XPG3). IBM intends to support both TCP/IP and OSI protocols that will operate over various physical connections (to include X.25). Other features of this operating system are the provisions for network management functions via OSI's Common Management Information Service/Protocol (CMIS/CMIP), electronic mail via X.400, and presentation services via X Windows [Ref. 180].

### 9.2.2 Terminal and Human-Computer Interface (HCI) Standards

(U) Human-computer interfaces comprise two levels of standardization. One level is the specification of how computer system elements shall interface to display terminals, workstations, and other output devices for which there is capability for human interaction. The second level is the look, feel, and layout of the display screens, keyboards, and other elements of the workstation that would define the way information is displayed and how the user interacts with the information provided. In ATCCIS, the recommended technical approach is to standardize the interfaces. This is

## UNCLASSIFIED

distinct from the military necessity of standardizing information formats and presentations at workstations for operational reasons.

**9.2.2.1 HCI Work in ISO.** (U) The standards work in ISO/IEC covers both levels of HCI. These standards activities seek to:

- Provide consistency--in screen and keyboard layout, terminology, semantics, user action, and syntax--across and within manufacturers, systems, and applications
- Enhance comfort and well-being
- Enhance usability<sup>28</sup>
- Assist in product procurement and evaluation.

Specifically, ISO/IEC JTC1 SC18 (Text and Office Systems) has a working group, WG9 (User System Interfaces and Symbols), that is developing standards to support keyboard layout, user interfaces, cursor control, and icons (e.g., symbols) to be displayed. In addition, the Ergonomics Technical Committee (TC159) of ISO is addressing, through SC4 (Signals and Controls) and WG5 (Software Ergonomics and Man-Machine Dialogue), standards for dialogue interface, coding, formatting, menus, and usability assurance. Other areas of standardization related to the user interface to information systems being addressed by ISO are [Ref. 181]:

- Documentation (JTC1 SC7/WG2)
- Software quality characteristics (JTC1 SC7/WG3)
- Text interchange (JTC1 SC18/WG4)
- Terminal management (JTC1 SC21/WG4)
- Form Interface Management System (JTC1 SC22)
- POSIX (JTC1 SC22/WG15)
- Commands for Interactive Text Searching (TC46/SC4)
- Software quality assurance (TC176 SC2/WG5).

**9.2.2.2 Visual Display Terminal.** (U) SC18/WG9 seeks to develop a User Interface Standard that would address names of basic objects and actions, user guidance, dialogue interaction, and graphical symbols used on screens. A working draft of part of this standard is planned for 1989 and an initial draft proposal for 1990. TC159 SC4/WG5 is developing a standard (DIS 9241) for VDTs that addresses office task

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<sup>28</sup> (U) As used in SC18/WG5, usability of a product is defined as the degree to which specific users can achieve specified goals in a particular environment effectively, efficiently, comfortably, and in an acceptable manner.

## UNCLASSIFIED

requirements, visual requirements, keyboard ergonomics, work place design and environment, surfaces and filters, use of colour and graphics, non-keyboard input devices, usability, coding, formatting, and terminology.

**9.2.2.3 Virtual Terminal (VT).** (U) VT standards (ISO 9040 and 9041) define a communications protocol between a terminal and its host in terms of a conceptual terminal, where the mapping from the conceptual terminal to the physical device is an implementation issue outside the standard. Several classes of display and data manipulation capabilities will eventually be addressed by VT standards [Ref. 182]:

- Basic class, for textual data in a rectangular array of character boxes
- Forms class, similar to the basic class, but with the ability to define fields with control over data entry
- Graphics class, for geometric data such as lines and circles (as defined, for example, in GKS)
- Text class, for structured data such as provided by ODA data streams
- Image class, for bit-mapped displays.

(U) The initial VT standards address the basic class of capabilities. They will contain addenda that provide extensions (AD1, *Extended Facility Set*) to the basic class for enhanced access rules, structured control objects, blocks, fields, and reference information objects. These enhancements will be incorporated into the base text before the standards are submitted for ballot as international standards. Three additional extensions are being developed [SC21 N 3366 and N 3367, December 1988] for VT: ripple, to provide facilities to undertake simple text editing by the addition of control objects and operations; exception reporting for non-fatal errors; and context retention for multiple VT sessions. These extensions are being progressed as Addendum 2 (DAM2, *Additional Functional Units*) to both ISO 9040 and 9041. CD 9041-2, *VT PICS Proforma*, is planned for June 1991. SC21/WG5 expects DIS text for the PICS Proforma to be available in November 1992. In addition, registration authority procedures are being developed for the Virtual Terminal Environment (VTE) and VT Control Objects: DIS 9834-4 and DIS 9834-5, respectively. Finally, a guide to VT standards has been developed by SC21/WG5 [SC21 N 3365, December 1988]. A draft *Conformance Test Suite for the VT Protocol* [SC21 N 4161] has also been developed.

(U) DAM2 [SC21 N 5031, May 1990] for ISO 9040/9041 enhances the capability of the VT environment by use of the Association Establishment or Negotiation functions, extends the set of objects and operations provided by the Data Transfer function, and enhances error handling capabilities of the service provider. DAM2 provides additional functionality for ripple mode editing (insertion, deletion, and copy

## UNCLASSIFIED

operations for a Display Object), exception reporting (provides mechanisms by which non-fatal exception conditions may be reported by the VT service provider to VT users), and retention of VT context across Negotiation (retention of the information stored in selected VT Objects--Display Object and Control Objects--to be retained between successive VT environments within the life time of a VT association).

(U) VT profiles are being developed by two regional workshops: the European Workshop for Open Systems (EWOS) and the NIST OSI Implementor's Workshop. EWOS is working on synchronous-mode profiles that are based on a two-way exchange with a single display object requiring the exchange of an access token. EWOS profiles include Forms, Page, Enhanced, and Enhanced Page. The NIST Workshop is developing asynchronous-mode profiles. These are based on a character-by-character interworking, in which there are two display objects, but the user at each end is allowed to update only one of the objects. NIST Workshop profiles include TELNET, Transparent, Forms, Scroll, Page, and X29 (of which the first three are in the Stable Agreements).

**9.2.2.4 Terminal Management (TM).** (U) SC21/WG5 is working on a program for developing standards for TM, directed at support for multi-function workstations. The role of TM is to support the control and manipulation of logical devices typically associated with workstations. Logical devices are defined in TM to provide a mapping between transferred data such as ODA documents and the physical devices such as a workstation screen, taking into account control information such as synchronization and the use policy of a particular application. TM is related to Document Transfer and Manipulation (DTAM, CCITT), user interface standards (SC18), Forms Interface Management System (FIMS, SC22), and window management (SC24). The TM standard consists of three parts: *TM Model* (CD 10184-1), *TM Service* (WD 10184-2), and *TM Protocol* (WD 10184-3). The first, *TM Model*, progressed to CD status in April 1990. CD status for the other two is expected in July 1991 [Ref. 183].

(U) TM provides a general framework for defining interactive processes that support in a systematic way such diverse features as: (1) combining different data types (e.g., presenting diagrams with a telephone conversation); (2) handling multiple simultaneous dialogues from a single terminal, and (3) interacting with several levels of processes in a single session, in which low-level functions such as echoing and simple checking are done locally and responses to more demanding operations such as

## UNCLASSIFIED

database access are generated by a remote system. The TM draft standards address the following requirements [Ref. 184]:

- Presenting data from several sources on a single display, for example using a window system.
- Moving data between windows presented together.
- Supporting multiple users and displays attached to one application.
- Handling the same data at several different levels of abstraction; for example, a graphics image may need to be manipulated at the level of a display list, at the level of various geometric objects, or at the bit-map level.
- Controlling how the logical structure of dialogues is mapped onto real resources, such as open systems and OSI application associations.

(U) TM permits the establishment of a general network of processes with dialogues between them. The dialogues may be of a variety of types, such as VT, bit-map graphics, or ODA. TM does not itself define the operation of an individual process, nor does TM define the data stream for a particular dialogue type--these are specified by other standards. Where a process has input parameters that may be adjusted, such as the specification of the positions and priorities of the various windows in a window system, these are provided by TM. The TM model addresses the following:

- Model for Terminal Management Application Service Elements (ASE) in two or more open systems that collectively are defined as a Terminal Management Domain (TMD)
- Model for the information flows between ASEs within a TMD
- Model for the shared use of interactive resources within a TMD
- Mechanisms for the representation of information in a window environment
- Relationships between the Terminal Management ASE and other ASEs within a Single Association Control Function
- Relationship between the Terminal Management ASEs and other ASEs within the Multiple Association Control Function.

(U) A User Descriptor Object (UDO) is defined in TM; the UDO is updated and maintained by a TM control process within a TM domain. The UDO supports the following mechanisms and requirements:

- End-user specific libraries
- User Interface Management System (UIMS) tool kits

## UNCLASSIFIED

- Local system characteristics such as devices supported, window management system information in support of specific menus and icons, peripherals to be supported during a given instance of communication, and a user clipboard for the storage of miscellaneous information
- Application-specific information (known to the user)
- Window management system and user interface dependencies, such as sizing a user interface to fit window instructions
- State information for devices supported, UIMS in general, and active and de-activated applications.

(U) TM contains a User Window Manager Interface onto which users may interface their own window manager. If a user-supplied window manager is in place, all user requests are first sent to the user window manager. In cases where the user window manager makes decisions in conflict with the TM domain user policy, these are resolved within the TM process.

**9.2.2.5 Status of X-Windows.** (U) The X-Windows standard effort, a UNIX-based user interface standard, began as a *de facto* standard developed at the Massachusetts Institute of Technology (MIT). It was developed by Project Athena and the Laboratory for Computer Science at MIT with funding and participation by Digital Equipment Corporation (DEC) and IBM [Ref. 185]. Currently in Version 11 (Release 3), X-Windows sets a standard to provide portability of information across different hardware and operating systems. In contrast to the kernel-based architecture of traditional windowing systems, it has a network-based architecture. *User Interface*<sup>TM</sup> is based on this standard as is *DEC windows*<sup>TM</sup> software from DEC.<sup>29</sup>

(U) The strategic direction in ISO OS/2 for support of windowing environments is Terminal Management. However, there is a rapidly growing demand for the use of the X-Windows System. This demand is being satisfied by the use of X-Windows clients and servers co-located in the same machine or over LANs using protocols such as TCP/IP. Some large user communities are now trying to run X-Windows over WANs and in some cases may plan to install TCP/IP networks in competition with the emerging OSI networks based on ISO protocols [Ref. 186].

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<sup>29</sup> (U) See "DEC Opens an X Window for Control Systems," J. M. Stoffel, *Control Engineering*, Vol. 36, No. 4, April 1989, and "OSF Motif, the User Interface Standard," H. Oldenburg, *IEEE Colloquium on User Interface Management Systems, Digest*, No. 135, Issue 2, IEEE, 17 November 1989.

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(U) Three options are being considered by ANSI Committee X3H3.6 for developing an efficient OSI compatible way of supporting the X-Windows System in an OSI environment:

- Map X-Windows directly onto the Layer 7 ACSE.
- Map X-Windows directly onto a Connection-Oriented Transport Service.
- Rewrite X-Windows completely, removing the session and presentation functionality it concurrently contains. Map X-Windows onto ACSE properly using all the facilities that can be provided by Layer 7 services.

While the last option is preferable from the standards point of view, it would require developmental effort and dedicated expertise that does not appear to be available. Further, by the time any such standard becomes complete, it would likely be too late to gain acceptance. The advantage of the first two approaches is that each recognizes the large body of user pressure that might well precipitate a non-OSI solution before the Terminal Management standard becomes available.

(U) Because Version 11 of X-Windows (X11) has limited two-dimensional (2D) graphics capabilities, a consortium of organizations under the auspices of MIT has developed X3D-PEX, an extension to the X11 standard that supports the Programmers' Hierarchical Interactive Graphics System (PHIGS) and the three-dimensional version of the Graphical Kernel System (GKS-3D) [Ref. 187]. PHIGS and GKS are discussed in Sections 9.2.3.5 and 9.2.3.3, respectively.

(U) Despite competition from other UNIX-based windowing systems like Sun Microsystems' *News*<sup>TM</sup>, *Silicon Graphics*<sup>TM</sup>, *4 Sight*<sup>TM</sup>, and Carnegie-Mellon's *Andrew*<sup>TM</sup> [Ref. 188], X-Windows has received rapid and overwhelming acceptance as an industry standard [Ref. 189]. X-Windows is the subject of NIST, IEEE, and ANSI standards projects. FIPS-158, *X-Window User Interface*, was approved in May 1990 as a US mandatory standard. It comprises the first three layers (Layers 0-2) of the User Interface Reference Model developed by NIST [Ref. 190]. The NIST Model consists of:

- Layer 0: Data Stream Encoding
- Layer 1: Data Stream Interface (Xlib)
- Layer 2: Subroutine Foundation (Xt Intrinsics)
- Layer 3: Toolkit
- Layer 4: Dialogue
- Layer 5: Presentation
- Layer 6: Application.



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(U) Layer 0 is an X- Protocol for messages between client and server. It equates with ANSI X3H3.6 (Window Management) Project 0672-D, "X Data-Stream Encoding for Window Management X Window System VII Data Stream Definition." The target date for completion of this standard is the second quarter of 1991. Layer 1 is a library interface that provides a C language interface to the X-Protocol. Layer 2 consists of basic functions for controlling windows and acts as a tool kit for building tool kits [Ref. 190].

(U) An IEEE P1201 Reference Model, which is built on the NIST Reference Model relates X, 1201 work, and other systems. IEEE Project P1201.4, "X Library" (Layer 1 of the NIST Model) is expected to go to direct ballot in 1990 using a forthcoming draft from the MIT X-Windows group. Xt Intrinsic (Layer 2 from the NIST Model above) may be taken on by IEEE P1201, but a formal proposal has not yet been made for this work.

(U) NIST Reference Model Layers 3 through 5, while not part of FIPS-158, are the subject of IEEE projects. Layer 3 is equivalent to IEEE Project 1201.1, "Toolkit--High-Level Windowing Applications Program Interface." It is the application-level interface for higher level functions. Layers 4 and 5 are addressed respectively by the User Interface Language and User Interface Management Systems work of IEEE Project 1201.3 and are still in the research stage. IEEE has formed a study group, but not a working group, for this work.

(U) The Graphical User Interface is part of the IEEE P1201 Reference Model but is not included in the NIST Reference Model. The Graphical User Interface is the subject of IEEE Project 1201.2, "Drivability Guide," which provides a recommended practice for minimal commonality for window systems (see Table 15 in Section 9.4.4.2). It uses the analogy of controls for driving a car [Ref. 190].

### 9.2.3 Graphics Interchange Standards

(U) This section reviews standards being developed in ISO/IEC, CCITT, and the nations for computer graphics. These include the Computer Graphics Reference Model, Computer Graphics Metafile (CGM), Graphics Kernel System (GKS), Computer Graphics Interface (CGI), Programmer's Hierarchical Interactive Graphics System (PHIGS), and the Initial Graphics Exchange Specification (IGES).

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**9.2.3.1 Computer Graphics Reference Model.** (U) The Reference Model for Computer Graphics<sup>30</sup> defines a basic architecture and consistent terminology for computer graphics. It addresses environment; primitives; geometry, attributes, and aspects of primitives; pictures; collections; metafiles; and archives. There are four environments: application (to which an application interfaces), virtual, logical, and physical (to which the user interfaces) [Ref. 191].

**9.2.3.2 Computer Graphics Metafile (CGM).** (U) CGM standards provide a file format suitable for the storage and retrieval of picture information. The file format consists of a set of elements that can be used to describe pictures in a way that is compatible between systems of different architectures and devices of differing capabilities and design. ISO 8632 is a standard for producing a CGM in order to:

- Allow picture information to be stored in an organized way on a graphical software system
- Facilitate transfer of picture information between different graphical software systems
- Enable picture information to be transferred between graphical devices
- Enable picture information to be transferred between different computer graphics installations.

(U) The CGM standards are:

- ISO 8632-1, *Functional Specification*
- ISO 8632-2, *Character Encoding*
- ISO 8632-3, *Binary Encoding*
- ISO 8632-4, *Clear Text Encoding*.

**9.2.3.3 Graphics Kernel System (GKS).** (U) The GKS standard, ISO 7942, specifies a language-independent nucleus of a graphics system. For integration into a specific programming language, GKS is embedded in a language-dependent layer obeying the particular conventions of that language. This layer (technically referenced as a "binding") has been defined for the programming language Ada in ISO 8651-3, based on the Reference Manual for the Ada Programming Language (ISO 8652). It has also been defined for the programming languages FORTRAN (ISO 8651-1), Pascal (ISO 8651-2), and C (WD 8651-4).

(U) A 3D version of GKS is being developed in ISO. The purpose of GKS-3D is to specify extensions to GKS for defining and viewing 3D wire-frame objects.

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<sup>30</sup> (U) This model does not appear to have been published as an ISO standard.

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As such, the GKS-3D documents only describe additions to be made to GKS. The GKS-3D portions of the GKS standards are:

- ISO 8805, *GKS for Three Dimensions (GKS-3D) Functional Description*, October 1988, and ISO 8805/WDAD1, Addendum 1: *Name Set Addendum*, April 1987
- DIS 8806-1, GKS-3D Language Bindings - Part 1: *FORTRAN*, November 1988
- DIS 8806-3, GKS-3D Language Bindings - Part 3: *Ada*, 1989
- DIS 8806-4, GKS-3D Language Bindings - Part 4: *C*, 1989
- ANSI X3.122.5, *GKS-3D Language Bindings - LISP*.

(U) One of the major design goals in ISO is compatibility between GKS-3D and GKS. The 2D primitives of GKS can be seen as a subset of the 3D primitives obtainable via GKS-3D. This allows a GKS-3D program to read both 2D and 3D metafiles (by forcing 2D primitives to the  $z=0$  plane); however, GKS is unable to use 3D metafiles. Thus, upwards compatibility has been achieved but not downwards compatibility.

**9.2.3.4 Computer Graphics Interfacing (CGI).** (U) The ISO/IEC approach to defining a CGI is provided in the document, "Interfacing Techniques for Dialogues with Graphical Devices" (CGI) [SC21 N 1179]. The governing standard is DIS 9636, which has the following parts:

- Part 1: *Overview, Profiles, and Conformance*
- Part 2: *Control, Negotiation, and Errors*
- Part 3: *Output and Attributes*
- Part 4: *Segmentation*
- Part 5: *Input and Echoing*
- Part 6: *Raster*
- Part 8: *FORTRAN Language Binding of CGI* (working draft)
- Part 11: *C Language Binding of CGI* (working draft).

**9.2.3.5 Programmer's Hierarchical Interactive Graphics System (PHIGS).** (U) The following are the standards for PHIGS, defining language bindings for graphics interfaces:

- ISO 9592-1, *PHIGS - Part 1: Functional Description*
- ISO 9592-2, *PHIGS - Part 2: Archive File Format*
- ISO 9592-3, *PHIGS - Part 3: Clear-Text Encoding of Archive File*

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- ISO 9593-1, *PHIGS Language Bindings - Part 1: FORTRAN Binding*
- DIS 9593-2, *PHIGS Language Bindings - Part 2: Extended Pascal*
- DIS 9593-3, *PHIGS Language Bindings - Part 3: Ada*
- DIS 9593-4, *PHIGS Language Bindings - Part 4: C.*

### 9.2.3.6 Initial Graphics Exchange Specification (IGES). (U)

The IGES, Version 4.0, is an ANSI standard (Y14.26M-1989) developed by the American Society for Mechanical Engineers (ASME). It establishes information structures to be used for the digital representation and communication of product definition data used by various Computer Aided Design and Computer Aided Manufacturing (CAD/CAM) systems. ASME is currently working on Version 5.0.

### 9.2.4 Geographic Information Exchange and Data Compression Standards

(U) This section covers the US military and government, foreign, and commercial standards and standardization activities in geographic information exchange and data compression. Digital cartographic and geographic information systems have existed for several years, however their widespread use has been impeded by difficulties in data collection and the need for information sharing standards. Perhaps the most fundamental distinction between the digital representation of cartographic data and the conventional printed graphic is the need to explicitly and unambiguously code the attributes and spatial relationships among the various data elements. Because of the massive amounts of information that must be stored, data compression is a related topic of interest.

(U) There are four basic types of digital cartographic and geographic data:

- (1) Digital elevation data
- (2) Digital planimetric data
- (3) Digital land use and land cover data, and
- (4) Digital geographic names data.

(U) Several United States Geological Survey (USGS) circulars cover these types of data:

- FIPS Pub 70-1, *Specifications for Representation of Geographic Point Location for Information Interchange* (1986) [USGS Circular 878-B]
- FIPS Pub 103, *Codes for Identification of Hydrologic Units in the US and the Caribbean Areas* (1983) [USGS Circular 878-A]
- USGS Circular 895-B - *Digital Elevation Models*

UNCLASSIFIED

- USGS Circular 895-C - *Digital Line Graphs from 1:24,000 Scale Maps*
- USGS Circular 895-D - *Digital Line Graphs from 1:2,000,000 Scale Maps*
- USGS Circular 895-E - *Land Use and Land Cover Digital Data*
- USGS Circular 895-F - *Geographic Names Information System.*

(U) FIPS PUB 70-1 specifies a uniform format for representing geographic point location data in digital form for purposes of information interchange among data systems. It applies only to the three coordinate systems most widely used in the United States to define the position of a point that may be on, above, or below the earth's surface.

(U) FIPS PUB 103 adopts the set of codes used to identify hydrologic units published in Geological Survey Circular 878-A. These codes identify a hydrologic system that divides the United States and Caribbean outlying areas into 21 major regions. These regions are further subdivided into approximately 2150 units that delineate river basins having drainage areas usually greater than 700 square miles. The codes provide a standardized base for use by water-resources organizations. The UK MoD has related standards, *Digital Terrain Elevation Data* and *Digital Feature Analysis Data*.

(U) Several US military specifications also cover digital geographic information exchange:

- MIL-D-89000, *Digital Terrain Elevation Data*
- MIL-D-89005, *Digital Feature Analysis Data*
- MIL-A-89007, *Arc Digitized Raster Graphics.*

(U) The NATO Standardization Agreements (STANAG) relevant to this area include:

- STANAG 3809, *Digital Terrain Elevation Data Exchange Format*
- STANAG 3985, *Preferred Magnetic Tape Standards for the Exchange of Digital Geographic Information*
- STANAG 3986, *Digital Data File Transmittal Form for Geographic Information.*

**9.2.4.1 Digital Geographic Information Exchange Standard (DIGEST).** (U) The 10-nation Digital Geographical Information Working Group (DGIWG) is working on DIGEST and is expecting to submit it to NATO to become a STANAG. DIGEST may be submitted to ISO, but there is no definite plan for this. The present concern is for magnetic tape exchanges, with electronic communications exchanges possible in the future. The position of the DGIWG is that DIGEST is intended for standardizing exchanges of data between map-producing agencies, such as the Defense

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Mapping Agency (DMA), and not between operational units. Standards governing exchanges between field systems are the responsibility of the system development organization. This is a traditional view in military systems development organization, and leads to substantial interoperability problems, particularly intra-national. The official position notwithstanding, the DGIWG is encouraging the distribution of DIGEST by its member nations to the widest possible audience, including the services and civilian users.

**9.2.4.2 Vector Product Standard (VPS).** (U) This standard is currently in a prototype stage, but nearing finalization. A military standard is expected to be issued in early 1991. Although the standard is being distributed to the civilian community, there are currently no plans to offer VPS as a civilian standard.

**9.2.4.3 Spatial Data Transfer Specification (SDTS).** (U) The United States National Committee for Digital Cartographic Standards, a multi-agency working group headed by the USGS which is responsible for most of the US non-military geographic information exchange standards has issued SDTS. The DMA was an original participant in the development of this standard, but dropped out in favor of its own activities. SDTS is expected to become a FIPS in mid 1991. Other standards under development by USGS include:

- Aquifer names and geologic unit codes
- Classification of wetlands and wildlife services
- Environmental Protection Agency (EPA) parameter codes
- Codes for taxonomic identification of flora and fauna
- Land use and land cover codes
- Public land survey codes
- Cartographic attribute/feature codes.

**9.2.4.4 Data Compression Standards.** (U) An area closely related to map and geographic information is data compression because maps require large quantities of data. For example, at a scale of 1:1,000,000, a digitized map of the world requires 30 CD-ROMS. The Army wants maps that are 1:250,000 and 1:50,000. A 1:50,000 scale map of just the land portions of the world would be about 130 times bigger, assuming the same degree of color. There are currently not any known data compression standards, although two, JPEG and DVI are emerging.

(U) The Joint Photographic Experts Group, a joint project of ISO and CCITT, has issued a proposed standard currently referred to as the JPEG standard. The JPEG standard was originally conceived as a companion standard to Group 3 and 4

## UNCLASSIFIED

facsimile standards covering compression of data for gray scale and color. A second proposal is under development by the Moving Picture Experts Group.

(U) A potential de facto standard, called Digital Video Interactive (DVI), uses a proprietary compression scheme, but is backed by Intel Corporation, IBM, and AT&T. IBM and Intel are already marketing DVI products for personal computers.

### 9.2.5 Standards for Document Interchange Formats

(U) This section summarizes Electronic Data Interchange (EDI) standards, including the EDIFACT standard adopted by ISO. It also addresses standards for office document interchange architectures and formats.

**9.2.5.1 Electronic Data Interchange (EDI).** (U) EDI provides for a standardized exchange of data between systems by a wide range of means, including exchange of magnetic tapes and the transmission of data by Telex. EDI is a standard for the data, and as such, is outside OSI (OSI standards are for the means of moving that data). EDI is intended to enable data to be interchanged without networking and is used mainly for interorganization communication where internetworking may be undesirable (internetworking is a primary feature of OSI).

(U) Prior to 1985, there were two world-wide EDI standards, UN-TDI/GTDI in Europe and ANSI X12 (*An Introduction to EDI*, July 1987) in North America.<sup>31</sup> At that time, the United Nations tried to produce a single standard for both communities. This standard was the EDI for Administration, Commerce, and Transport (EDIFACT). The syntax for EDIFACT is now an ISO standard (ISO 9735). EDIFACT is based on ISO 646 encoding (7 bits per character--ASN.1 Basic Encoding Rules use the full range of 8 bits in each octet), but it still is not aligned with ANSI X12. A large number of standard messages have been developed based on EDIFACT, and the EDIFACT has been endorsed by many standards bodies and user groups. However, another standard, TRADACOMS, has been developed for use in the UK, based on the UN-GTDI syntax. TRADACOMS is now in wide use in the UK. EDI is cited in UK GOSIP 3.0 in the interim advice on standardization [Ref. 192].

(U) EDIFACT provides data structure and content standards for developing messages for use by importers, exporters, transportation firms, financial institutions, ports, customs, and other business and administrative activities (e.g.,

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<sup>31</sup> (U) The number of companies currently using EDI has been estimated at 15,000. Up to 13,000 of these are in the US and about 1,600 in the UK. The number of users is reported to be doubling every

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insurance, tourism, construction). EDIFACT was developed by the UN working party on Facilitation of International Trade Procedures to ensure there is only one worldwide standard for EDI. EDIFACT is ISO 9735 and uses the international standard Trade Data Element Directory (ISO 1372).<sup>32</sup> ANSI Committee X12 guides, stimulates, and promotes the development and use of the EDIFACT standards in the United States and Canada. The ANSI X12 Secretariat has noted that differences in syntax control segments, data segments, and data elements continue to exist between EDIFACT and the X12 standard for EDI.<sup>33</sup>

(U) CCITT is preparing a fast-track recommendation in 1990 for an electronic data interchange (EDI) over X.400. This standard will use a new User Agent protocol called PEDI that will include security services necessary to support nonrepudiation. The CCITT EDI user agent will allow CALS formats (e.g., US MIL-STD-1840A, *CALS Originator File Sets and Transfer*) to be supported as body parts.

(U) The US Government Computer Acquisitions and Logistics Support (CALS) initiative is the largest and best known of the EDI proponents. CALS requires full compliance to EDI standards for digital delivery of technical information and interoperability among DoD systems beginning in January 1990. Major applications areas are automation of technical manuals, computer-assisted design, and spares acquisition. CALS standards include EDI for data interchange file management, IGES for engineering drawings, Standard Generalized Markup Language (SGML) for automated publishing, and CGM for technical manual illustrations. The standard currently being used for raster graphics representation is US DoD-unique (MIL-R-28002).

**9.2.5.2 Office Document Architecture (ODA).** (U) ODA is one of two standards used for describing documents in preparation for electronic interchange, the other is SGML. ODA (ISO 8613) was originally designed for the interchange of office documents between different word processors. The equivalent CCITT Recommendations are the T.410 series (see Appendix D). ODA describes a document in terms of its logical

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year. Source: International Network Services, Limited. Reference: *OSN: The Open Systems Newsletter*, Volume 3 Issue 1 (January 1989).

<sup>32</sup> (U) *UNEDIFACT Information Pack*, SC21 N 3885, 19 September 1989.

<sup>33</sup> (U) *X12/DISA Information Manual*, Data Interchange Standards Association, Inc., (DISA--The ANSI X12 secretariat), Spring 1990.



## UNCLASSIFIED

structure or its layout structure or both together. The ODA standard is divided into several parts:

- ISO 8613-1, Part 1: *Introduction and General Principles*
- ISO 8613-2, Part 2: *Document Structures*
- ISO 8613-3, Part 3: *Document Processing Reference Model*
- ISO 8613-4, Part 4: *Document Profile*
- ISO 8613-5, Part 5: *Office Document Interchange Format (ODIF)*
- ISO 8613-6, Part 6: *Character Content Architectures*
- ISO 8613-7, Part 7: *Raster Graphics Content Architectures*
- ISO 8613-8, Part 8: *Geometric Graphics Content Architectures*.

(U) Part 5 of ODA specifies a second method of representation and interchange, using the Office Document Language (ODL) and the SGML Document Interchange Format (SDIF). ODL is an application of the Standard Generalized Markup Language (SGML), and may be used to represent a document structure in accordance with ODA in SGML.

(U) The Profile Alignment Group for ODA (PAGODA) has been formed from the three special interest groups (SIGs) and expert groups (EGs) from the three regional OSI workshops: AOW ODA SIG, EWOS ODA EG, and the NIST ODA SIG. PAGODA is developing ODA profiles based on ISO 8613, *Office Document Architecture (ODA) and Interchange Format*. The Office Document Format (FOD) provides for two types of structure in its proposed taxonomy [Ref. 193]:

- Hierarchically related based on increasing complexity and functionality (simple, enhanced, and extended document structures). The simple document structure is intended to address the general requirements of current word processing applications. The enhanced document structure is intended to address the general requirements of emerging word processing applications that have been enhanced over current applications. The extended document structure would address the general requirements of emerging personal publishing and document processing applications.
- Content architectures for various combinations of character, raster graphics, and geometric graphics content architectures.

**9.2.5.3 Standard Generalized Markup Language (SGML).** (U) SGML formalizes markup, making it system and processing independent. It is designed for full multi-media database publishing. SGML is a

**UNCLASSIFIED**

meta-language, providing the rules for designing and applying a system of markup tags rather than the specific set of tags. The SGML standards are:

- ISO 8879, *Standard Generalized Markup Language (SGML)*
- TR 9573, *SGML Support Facilities--Techniques for Using SGML*
- ISO 9069, *SGML Support Facilities--SGML Document Interchange Format*
- DIS 9070, *SGML Support Facilities--Registration Procedures for Public Text Owner Identifiers*
- DTR 10037, *SGML and Text-Entry Systems--Guidelines for SGML Syntax-Directed Editing Systems.*

(U) SGML has been chosen by the Department of Defense as the documentation standard for its CALS strategy. This strategy is designed to take defence information from its current paper form to a totally electronic mode over the next decade.

**9.2.5.4 Distributed Office Applications Model (DOAM).** (U) The Distributed Office Application Model (DOAM), DIS 10031, was established to provide a set of common principles to which all DOA standards must adhere. The two parts of this standard, *General Model* and *Referenced Data Transfer*, do not contain any implementable protocols; they are limited to the description of models and tools to be used by DOA standards developers.

(U) An important feature of the DOAM is the client-server model, which allows one part of an application to be implemented in a "client" machine and another part to be implemented in a "server" machine. This possibility of splitting an application allows certain central resources, such as a large database or an expensive laser printer to be shared among a number of users from their work stations.

(U) DOA consists of the DOA model (DOAM) and two specific DOAs: Document Filing and Retrieval (DFR, DIS 10166) and Document Printing Application (DP xxxxx). The DOAM (DIS 10031) addresses the general model, design guidelines for the peer-to-peer (Application Layer) protocol, and Referenced Data Transfer (RDT). Use of ROSE is mandatory in DOAM. The DOAM guidelines are used to define DOA objects (e.g., documents), together with object attributes and criteria for filtering those objects. The DOAM guidelines identify a set of abstract operations such as List, Read, Write, Modify, Copy, Move, Search, Create, Delete, Reserve, Unreserve, Notify, and Abandon. RDT is the mechanism used to perform transfer of objects. RDT was developed to permit "small" systems (e.g., workstations) to handle "large" objects, such as moving an object from a document store to a print service. DFR defines the structure of a document store

and an associated access protocol. DPA defines an access protocol for print services. DOA is being developed by SC18/WG1 [Ref. 194].

### 9.2.6 Open Distributed Processing (ODP)

(U) ODP falls outside the OSI Reference Model but clearly provides services that could be applicable to ATCCIS. While ODP is discussed in Section 6.2.7, use of ODP may fall within the scope of enhanced interoperability.

### 9.2.7 Programming Service Standards

(U) This section identifies the types of language, language bindings needed for SQL, software development environments, tool sets, process models, and methodologies, and other programming service standards. It needs to be expanded to address specific tools such as compilers, syntax (e.g., ASN.1) analyzers, and other support tools.

**9.2.7.1 Ada.** (U) Ada is a programming language agreed to be used within NATO and the US DoD<sup>34</sup> as a standard general-purpose high-level programming language. It was introduced in 1979 after the US DoD became concerned about the proliferation of computer languages it was using and determined that none of these languages was suitable for writing DoD software. Ada uses the latest ideas in language design and a standard programming support environment is suggested. In 1983 it was adopted as a standard by ANSI and as a US Military Standard (MIL-STD-1815A). It was adopted as a Federal Information Processing Standard (FIPS 119) on 8 November 1985. In 1987 ISO endorsed it as an ISO standard (ISO 8652).

(U) In 1988, the Ada 9X project was undertaken to revise ANSI/MIL-STD-1815A through a three step process: (1) requirements development, (2) revision of the Ada Language Reference Manual, and (3) implementation demonstrations. In May 1990 the requirements process culminated in the publication of the Ada 9X Project Report: Ada 9X Revision Issues, Release 2 [Ref. 195].

**9.2.7.2 Ada Programming Support Environment (APSE).** (U) An APSE is an environment for developing software systems written in Ada. At its core is a kernel APSE (KAPSE), which represents general operating system services such as file management services and process and device control services, as well

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<sup>34</sup> (U) DoD Directive 3405.1 states that Ada is the preferred computer programming language for all DoD applications except when the use of another higher order language is most cost effective over the application's life cycle. DoD Directive 3405.2 mandates the use of Ada in all computers integral to weapons systems (embedded systems).

**UNCLASSIFIED**

as object management services. It is at this level, as opposed to the outer layers, the MAPSE (Minimal APSE) and APSE, that a common set of interfaces is required. The MAPSE consists of software tools that minimally support software development, such as compilers, editors, and linkers, while the APSE provides project-specific tools and services.

**9.2.7.3 Common APSE Interface Set (CAIS).** (U) CAIS provides a common set of interfaces to the KAPSE. The CAIS standard (US DoD MIL-STD-1838A, 1989) defines a set of interfaces that allows APSE tools to use common operating services and facilities in a standardized fashion. The original plan for the designing of CAIS in the US called for one set of interfaces to be produced at the end of 4 years' work (the original target was 1987). As pressure mounted for an earlier release, the Ada Joint Program Office (AJPO) decided that a limited capability version should be provided before the full CAIS was complete.

(U) The first version of CAIS (US DoD MIL-STD-1838) was published in October 1986. It comprised only those interfaces common to two different APSEs being developed by the US Army and the US Air Force: the Ada Language System (ALS, for the Army) and the Ada Integrated Environment (AIE, for the Air Force). Because of divergent approaches at the KAPSE interface level taken by the ALS and AIE contractors, the KAPSE Interface Team (KIT) and the KAPSE Interface Team from Industry and Academia (KITIA) were formed. Together, the KIT/KITIA produced the first version of the CAIS.

(U) In parallel, the Requirements and Design Criteria Working Group (RACWG), composed of KIT and KITIA members, was established in July 1983 for the purpose of defining a set of requirements and criteria for the design of a second version of the CAIS. In 1985, a contract was awarded to SofTech, Inc., to continue development of this second version of CAIS (CAIS-A). CAIS-A was reviewed publicly in 1987 and was published as a military standard (MIL-STD-1838A) on April 6, 1989 [Ref. 196].

(U) There are no plans, nor is a mechanism currently in place, to update CAIS-A. However, there are plans to merge two standards efforts: CAIS-A and PCTE+ (Portable Common Tool Environment) over the next several years. PCTE is an effort of the European Strategic Programme of Research and Development in Information Technology (ESPRIT); see Section 9.2.7.10. At least two implementations of CAIS-A now exist, one by SofTech for the VAX/VMS environment and one by UNISYS for the SUN/UNIX environment.

## UNCLASSIFIED

**9.2.7.4 Pascal.** (U) Pascal is a computer programming language originally designed to satisfy two principal aims. The first was to provide a language suitable for teaching programming as a systematic discipline based on certain fundamental concepts clearly and naturally reflected by the language. The second aim was to define a language whose implementations could be reliable and efficient on then-available computers. A Pascal standard was adopted in 1983 as ANSI X3.97 and IEEE 770.

(U) At the same time that the ANSI/IEEE Pascal standard was being developed, the British Standards Institution (BSI) sponsored an ISO draft proposal for Pascal. In 1983, ISO adopted Pascal as a standard (ISO 7185), endorsing British Standard (BS) 6192-1982. While the ISO and ANSI/IEEE Pascal standards are compatible, there are some differences in technical substance as well as some errors in the ISO standard.

(U) In January 1985 the US Federal Government adopted the ANSI/IEEE standard as FIPS 109. The implementation of FIPS Pascal involves three areas of consideration:

- Acquisition of Pascal processors
- Interpretation of FIPS Pascal
- Validation of Pascal processors.

On 10 April 1990, ANSI X3 and the IEEE approved the Extended Programming Language Pascal standard as IEEE 770 and ANSI X3.160.

**9.2.7.5 Programming Language C.** (U) C originated in the late 1970s as the programming language of the UNIX operating system. It is a general-purpose programming language that features economy of expression, modern flow control and data structures, and a rich set of operators.

(U) C is not a very "high level" language, nor a complex one. Its particular area of application is systems programming (e.g., software for an operating system). Although it was originally implemented on a DEC PDP-11, it is now widely used [Ref. 197].

(U) Its growing popularity, changes in the language over the years, and the creation of compilers by groups not involved in its design, raised the need for a standard in the early 1980s [Ref. 197]. In 1989, ANSI promulgated X3.159, Programming Language C. This standard has not been adopted by ISO or the US Federal Government. However, there is an X3 project (0743-D) to promulgate a standard for Programming Language C++, a higher-level update of C. There is no draft standard as yet, since the first meeting was in March 1990. Estimated completion is 1994. The ISO project designation is JTC1.22.14.

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**9.2.7.6 COBOL.** (U) This programming language, which is primarily used for business applications, is an ANSI (X3.23-1985) standard that was also adopted in 1985 by ISO (ISO 1989). On 18 March 1986, it was adopted by the US as FIPS 21-2. A revision of ANSI X3.23 is currently in the planning stages. Public review began in 1990 with approval expected about 1999. An addendum to ANSI X3.23 for intrinsic functions (ANSI X3.23A-1989) was recently approved, and a Correction Addendum to ISO 1989 (*Programming Language COBOL*) is currently out for public review. The X3J4 Accredited Standards Committee on COBOL has recently received approval to work on an Addendum for Multi-Octet Character Sets that are necessary for Asian languages. It is also working on a COBOL Interface to the Forms Interface Management System (FIMS) (ANS Project 0676-D). Object-oriented extensions to COBOL are also under consideration by the committee.

**9.2.7.7 FORTRAN.** (U) In 1978, ANSI promulgated a standard for FORTRAN (ANSI X3.9), a programming language for scientific numerical computation that has wide use and many variations. In 1980 this standard was endorsed by ISO (ISO 1539). FIPS 69 adopted X3.9-1978 on 4 September 1980 as a US standard to promote portability of FORTRAN programs for use on a variety of data processing systems. The most recent FIPS (FIPS 69-1) was issued on 24 December 1985; a revised ANSI standard has yet to be issued.

**9.2.7.8 LISP.** (U) LISP is currently the most popular computer language used in artificial intelligence (AI) programming in the US, although Prolog standardization efforts are underway in the UK. LISP is designed for supporting symbolic manipulation and the interactive, trial-and-error style of programming employed by many AI researchers. It was invented in 1958 and has many dialects. The dialects tend to fall into one of two main camps: INTERLISP and MACLISP. In the interest of standardization, Common LISP was developed [Ref. 198]. It is not yet an official standard, but was created at the initiative of many vendors and is increasingly becoming the preferred version. Common LISP compilers exist for several mainframe computers [Ref. 199], minicomputers, and microcomputers. The ANSI Standards Committee X3J13 is working on an ANSI standard for Common LISP. Currently, a full draft is under review by the X3J13 committee, and a public review is expected by the end of 1990. Except for efforts to standardize Schema (IEEE P1178) and the AI programming language Prolog, there are currently no standards for knowledge-based specifications or notations.

**9.2.7.9 BASIC.** (U) BASIC is distinguished from other programming languages in its concern for the unsophisticated or novice user. While BASIC is a general-purpose programming language, it is designed primarily to be easy to

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learn, easy to use, and easy to remember. It is oriented toward, but not restricted to, interactive use. Its constructions are kept simple and special rules are kept to a minimum. The ANSI standard for Minimal BASIC (X3.60) was promulgated by ANSI in 1978 and adopted as FIPS 68 in 1980. It was subsequently adopted by ISO in 1984 (ISO 6373). In 1987, ANSI withdrew X3.60-1978 and superseded it with a standard for Full BASIC (X3.113-1987), which was adopted as FIPS 68-2 on 28 August 1987. This revision reflects major changes, improvements, and additions to the BASIC specification. In December 1989 ANSI issued the standard ANSI X3.113A, *Addendum to Programming Language Full BASIC, Modules, and Individual Character Input*.

### 9.2.7.10 Portable Common Tool Environment (PCTE). (U)

The PCTE project was begun in 1983 by the Commission of the European Communities (CEC) European Strategic Programme for Research in Information Technology (ESPRIT). It is now being considered by ECMA Technical Committee 3.3 and is expected to be submitted to ISO for balloting as an international standard [Ref. 200].

(U) The goal of the PCTE project was to describe and prototype tool interfaces that could be used to define a software development environment. The environment would comprise a set of public tool interfaces (PTIs) as well as a data management system. As defined by the PCTE project, a PTI is a non-proprietary interface existing as a library unit that may be used by a tool to provide access to system services. Tool builders might use the interfaces to either integrate or attach their tool products to an environment. The distinction between integration and attachment reflects the degree to which the environment monitors, controls, and makes use of the information on a given tool. An integrated tool makes full use of the services provided by the environment such as logging an audit trail and data management. An attached tool does not. For example, data is maintained in a repository known only to that tool.

(U) The criteria for development of the PCTE were that it be policy and mechanism independent, support a distributed environment, provide easy tool integration, provide a complete interface definition, and provide multi-language support. To accomplish this, PCTE defines the services needed by the tools. The services provided by PCTE include data management, tool execution and communication, distribution and environment management, and programmer interface for user interface management.

(U) Several environments are currently being developed based on PCTE. A highly secure version of PCTE, PCTE+, is also being developed. PCTE+ is planned to be suitable for civil and defense applications [Ref. 201]. ECMA has a PCTE standard based on PCTE+. Issue 3 of the ECMA standard contains an abstract specification with bindings for C and Ada.

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(U) The ESPRIT project "accueil de logiciel futur" aims to provide a knowledge-assisted software process model on top of the PCTE [Ref. 202].

### 9.2.8 Software Environment

**9.2.8.1 Bindings.** (U) In addition to programming language standards, several standards provide interfaces or connectivity between programming languages and applications. Such "bindings" as they are called exist or are being proposed for the POSIX (IEEE P1003), GKS (ISO 7942), GKS-3D (ISO 8805), PHIGS (ISO 9592), and CGI (ISO 9636) standards.

(U) POSIX bindings are planned for Ada, C, and FORTRAN. The Project Authorization Request (PAR) for IEEE project P1003.5, *Ada Bindings for POSIX*, was approved in December 1987, but a target date has not been established. The PAR for the FORTRAN binding (P1003.9) was approved in February 1989. A PAR has not yet been approved for the C binding (P1003.X).

(U) ANSI and ISO have approved standards for FORTRAN, Pascal, and Ada bindings for GKS. The C binding is currently in the working draft stage. They are:

- ISO 8651-1, *FORTRAN Binding* (ANSI X3.124.1-1985), October 1988.
- ISO 8651-2, *Pascal Binding* (ANSI X3.124.2-1985), October 1988.
- ISO 8651-3, *Ada Binding* (ANSI X3.124.3-1985), October 1988.
- WD 8651-4, *C Binding* (ANSI X3.124.4-199x).

(U) ISO draft standards have been developed for GKS-3D bindings for FORTRAN, Ada, and C. Pascal and LISP bindings are under development. They are:

- DIS 8806-1, *FORTRAN Binding*
- DIS 8806-3, *Ada Binding*
- DIS 8806-4, *C Binding*
- *Pascal Binding* [SC24 N 190] (ANS Project 0545-I)
- *LISP Binding* (ANS Project X3.122.5-199x, estimated completion 1991).

(U) There are ISO standards for Ada and FORTRAN bindings to PHIGS. The Pascal and C bindings are awaiting balloting. All are draft ANSI standards. They are:

- ISO 9593-1, *FORTRAN Binding* (ASC X3.144.1-199x), October 1988.
- DIS 9593-2, *Pascal Binding* (ASC X3.144.2-199x)



## UNCLASSIFIED

- ISC 9593-3, *Ada Binding* (ASC X3.144.3-199x), March 1990.
- DIS 9593-4, *C Binding* (ASC X3.144.4-199x)

(U) FORTRAN and C bindings to CGI are currently ISO working documents and ANSI projects:

- WD 9636-8, *FORTRAN Binding* (ANS 0560-D)
- WD 9636-11, *C Binding* (ANS 0559-D).

**9.2.8.2 Software Engineering Environments.** (U) With the exception of CAIS and PCTE, few standards efforts exist in the areas of software engineering environments, tools, or toolsets. Among the limited work being done in this area is an IEEE Computer Society Project (P1209) for a Recommended Practice for Evaluating CASE Tools. The Project Authorization Request (PAR) was approved on 1 June 1989. The IEEE Committee has met four times and has published a draft that is still not stable. Balloting is expected within two years.

(U) The Institution of Electrical Engineers (IEE)/British Computer Society Joint Working Party on Software Engineering Standards has also discussed the possibility of investigating CASE tools, in particular, the way in which their use supports conformance to high quality standards. However, to date, their only planned activity is to comment on IEEE P1209. In discussions related to a proposed UK MOD *Ministry of Defence* standard (DEF-STAN-00-55), *Requirements for the Procurement of Safety Critical Software*, the remark has been made that currently available CASE tools would not meet their requirements, since none of the tools have been or can be subject to the kind of formal methods analysis laid down in the proposal [Ref. 203].

(U) Another issue with respect to tools and toolsets is the ability to interconnect tools from different software developers. Consequently, the IEEE Computer Society approved a PAR for a Standard for Interconnections Among Computing System Engineering Tools (P1175) in February 1988. The core of this standard is the Standard Text Language (STL), which describes concepts such as data, conditions, events, and states, as well as transformation, control-transition, and state-transition operations. The proposed standard supports both textual and graphical forms [Ref. 204]. It is currently in the final stages before IEEE balloting.

(U) Other areas where standards are lacking, probably due to technological immaturity, are knowledge-based systems (KBS), expert system tools, and software repository tools.

(U) The UK General Expert System Methods Initiative (GEMINI) is an example of a project that is addressing needs for knowledge-based standards. In

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mid-1988, the CCTA launched this project to lay the foundation for a systematic KBS development methodology. A feasibility study concluded that there is strong support for such a method and that its development is both timely and feasible [Ref. 205].

(U) An important method of integrating KBS is by means of the IRDS (ISO 10027). The first area of standardization for expert systems will likely be bindings between expert systems and programming languages, databases, and user interfaces. Progress towards providing decision support and decision making tools and methods is slow but may be stimulated by the early release of the IBM Repository [Ref. 206].

**9.2.8.3 Process Models and Development Methods.** (U) A software process model is the ordered sequence of activities that occur during the course of software development. Examples of software development process models include the waterfall method, rapid prototyping, and the spiral model. By contrast, a software development method (methodology) is the way the specific development activities are actually carried out by the developer. An example is the object-oriented approach.

(U) There is currently a single US standard, DoD-STD-2167A, *Defense Software Development Standard*, for the process of software development. It superseded DoD-STD-2167, which was tied to the waterfall method and did not easily allow tailoring to other methods. The IEEE has a project underway (IEEE P1074), *Standard for Software Life Cycle Processes*, which will define the processes which comprise the software life cycle and describe the activities required to develop or maintain software in accordance with existing IEEE standards.

(U) There are currently no standards specifically for the development of expert systems. It is not clear that the development of expert systems must follow a different or unique process model.

(U) Development methods tend to be proprietary and not subject to standardization. However, one IEEE project (P1152), *Standard for Object Oriented Programming Language and Environment*, is developing a standard based on the SmallTalk programming language and environment.

**9.2.9 Document and File Transfer Standards**

(U) ISO, CCITT, and ECMA have developed several standards for the transfer of files and documents. Harmonization of these standards efforts is one of the main topics for the Technical Study Group (TSG-1) on Interfaces for Applications Portability. The standards and their relationships are discussed in this section.

## UNCLASSIFIED

### 9.2.9.1 Document Transfer and Manipulation (DTAM). (U)

DTAM is being developed by CCITT SG VIII. The DTAM protocols are designed to support interactive as well as store-to-store real-time end-to-end communications. They are also suitable for multi-media applications. Telematic applications are currently defined within the integrated, modular approach based on Office Document Architecture (ODA), DTAM, and Document Architecture Operations (DAO, CCITT SG VIII). The telematic applications are Group 4 Facsimile, mixed mode, processable mode, and videotex internetworking. Each telematic application consists of equipment characteristics, document characteristics (selected from ODA), operational characteristics (optional, selected from DAO), and communications characteristics (selected from DTAM).

(U) DTAM differs from FTAM in that the standards address different environments. FTAM satisfies requirements for the transfer of files between different file systems, including retention of generic filing information. DTAM, on the other hand, provides facilities for the storage, management, and retrieval of documents in an integrated office application environment.

(U) Two types of telematic and office environment applications for DTAM are being developed by CCITT SG VIII and ISO JTC1 SC18: conference type and remote document handling. A service called Remote Open Document Editing (RODE) is being proposed for the telematics environment to provide real-time remote editing for content manipulation through use of ODA/DTAM. RODE is expected to fulfill such user requirements as observing changing documents; maintaining identical documents between partners, even when partners have different presentations; providing speedy manipulations; and potentially supporting participation of more than three partners. Services are being defined to enable RODE to support a desk top conference application using DFR as well as RODE [Ref. 207].

### 9.2.9.2 Document Filing and Retrieval (DFR). (U)

DFR (DIS 10166) is the responsibility of ISO/IEC JTC1 SC18/WG4. DFR is one of the office application standards defined by the DOAM and shares common mechanisms with directory services and MOTIS. These mechanisms include attribute definition and filtering facilities, and use of service elements for remote operations (ROSE) and reliable transfer.

(U) DFR also supports a "version management" mechanism. This mechanism allows a document to be declared as a new version of an existing document. When this is done, a "previous-version" attribute points to the previous version of the document, and the previous version correspondingly receives a "next-version" attribute, thus retaining the complete evolution of a given document. All versions of a document contain a "version-root" attribute indicating the first version of the document.

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(U) DFR is defined by two draft standards:

- DIS 10166-1, *DFR - Part 1: Abstract Service Definition and Procedures*, 1989 [SC18 N 1264, October 1987]
- DIS 10166-2, *DFR - Part 2: Protocol Specification*, 1989 [SC18 N 1265], October 1987].

(U) DFR and DTAM both handle primarily ODA documents. They differ in that DFR is not concerned with the inner content of a document, whereas DTAM is concerned with both the whole document and the inner content of the document. Further, DFR provides for filing and retrieval of (whole) documents, where as this capability is not supported by DTAM.

(U) DFR differs from FTAM in that filing and retrieval of documents is DFR's single specific office application. An important difference between these two standards is the manner in which a document or file is identified. DFR uses a "Unique Permanent Identifier" that remains with the object for its lifetime. FTAM uniquely identifies its objects by its pathname from the root through the directories leading to it. In FTAM if the contents of a file are moved to another directory the pathname will change. Also, there is no analogy in FTAM of DFR's version control mechanism.

(U) A joint meeting between SC21/WG5/FTAM and SC18/WG4/DFR in Stockholm in May 1989 concluded that, due to the different user requirements being met by the two standards, a general-store model could not be progressed [Ref. 208].

**9.2.9.3 Referenced Data Transfer (RDT).** (U) RDT standards have been under development within ECMA TC32-TG5 and ISO/IEC JTC1 SC18/WG4. The abstract service definition has progressed to DIS status as Part 2 of the DOAM (DIS 10031-2). The RDT protocol duplicates functionality provided by FTAM, specifically the simple, efficient transfer of unstructured data (this is provided by FTAM-3 and the FTAM Transfer Service Class). However, a minimal implementation of FTAM would not provide all the apparent RDT requirements, such as security, single/multiple use of reference, finite life of reference, and use over a single association along with the RTSE.

### **9.2.10 Job Transfer and Manipulation (JTM)**

(U) JTM (ISO 8831 and 8832) was originally designed for remote off-line (batch) processing. It uses a processing model based on movement of entities called "documents" and the exchange of these entities with users. Exchanges are specified in work specifications that include a data structure and an envelope carrying the document. In Basic Class JTM a single document can be sent to a processing element. In Full JTM (ISO 8832/DAM1, Full Class Protocol) multiple documents and multiple processing steps

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would be permitted.<sup>35</sup> Capabilities of JTM are being included in standards for FTAM (e.g., RA) and the ASEs (e.g., RPC) [Ref. 209].

(U) The US stated in ISO in March 1990 that there are no US user requirements nor any organization in the US willing to provide resources for JTM standards [Ref. 210]. AFNOR has similarly found little interest in industry for JTM and recommended further work be suspended [Ref. 211]. Nevertheless, the reassessment report for JTM Full Class [SC21 N 4679 Revised] recommended completion of the International Standard texts, given the advanced state of the work. The recommendation was approved by SC21 in June 1990 [Ref. 212].

(U) SC21 also agreed in June 1990 to prepare a formal tutorial/usage guide that includes JTM scenarios and shows how JTM fits with other ASEs [SC21 N 4679].

### 9.3 Profiles of OSI Standards

(U) The following sections provide examples of the profiles of standards being considered for migration toward open information system environments.

#### 9.3.1 NATO Functional Profiles

(U) A number of profiles have been developed in TSGCEE SG9. These include (see Appendix H) the *Military Message Handling System* (draft STANAG 4257), R.131(M)--*Relay for Connecting PSDNs using X.75*, TC 111(M)--*Permanent Access to a PSDN*, and TA 51(M)--*COTS over CLNS and CSMA/CD LAN*. Profiles identified in the *NTIS Transition Strategy* are described in Tables 2, 3, and 4 of Section 4.3.1 and more fully in Appendix B.

#### 9.3.2 International Standardized Profiles (ISPs)

(U) ISO/IEC JTC1 has set up a Special Group on Functional Standardization (SGFS) to develop standards for International Standardized Profiles (ISPs). An ISP is somewhat more general than the common use of the term "profile" in that a profile is a stack of protocols to be used in combination, whereas an ISP is a document in which one or more profiles are published. The procedures adopted for specifying ISPs are unique because international harmonization is intended to be achieved

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<sup>35</sup> (U) ISO 8832/DAM 1, *Extension to Specification of the Full Protocol*, 28 May 1990 [SC21 N 5224]. Merged text of ISO 8832 1989 with revised text of DAM1 is provided in SC21 N 5225 dated 28 May 1990.

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before candidate ISPs are submitted to ISO. Proposals for ISPs are expected to be accepted by the regional workshops EWOS, NIST OSI Implementor's Workshop, and the Promoting Conference for OSI (POSI) before becoming proposed draft ISPs (PDISPs). As noted in Section 4.3.3.2, the SGFS has developed a three-part draft ISP for FTAM.

(U) Table 13 shows the overall organization and labels (taxonomy) used to identify and distinguish ISPs. It shows the distinctions created by the choice of connection-oriented (CO) or connectionless (CL) modes (see Section 3.7.3).

Table 13. (U) Overview of Taxonomy for International Standardized Profiles

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|      |  |
|------|--|
| A    | Application profiles using CO-mode transport service (TS)  |
| B    | Application profiles using CL-mode TS  |
| F    | Interchange format and representation profiles   |
| T    | Transport profiles providing CO-mode TS  |
| - TA | CO-TS over CL network service (CLNS) using Transport Protocol (TP) Class 4 as defined in ISO 8073/DAD2 |
| - TB | CO-TS over CO network service (CONS) with provision of TP Classes 0, 2, and 4                          |
| - TC | CO-TS over CONS with provision of TP Classes 0 and 2   |
| - TD | CO-TS over CONS with provision of TP Class 0   |
| - TE | CO-TS over CONS with provision of TP Class 2   |
| U    | Transport profiles providing CL-mode transport service (TS)  |
| - UA | CL-TS over CLNS  |
| - UB | CL-TS over CONS  |
| R    | Relay profiles between T- or U-profiles  |

(U) An important element of functional standardization, as well as for the Directory (ISO 9594), is the development of an international standard for taxonomy. TR 10000, *Taxonomy Framework*, contains a classification and identification scheme for candidate profiles. This taxonomy is being adopted by TSGCEE SG9 and will be used in forthcoming editions of the *NTIS Transition Strategy*.

(U) There are four classes of ISPs in the taxonomy of TR 10000: application profiles (*AXX nn* for those requiring the COTS and *BXX nn* for those requiring CLTS); interchange format and presentation profiles (*FXX nn*); transport profiles (*TX nnnn* and *UX nnnn* for CO and CL profiles, respectively); and relay profiles (*RX p,q*).

9.3.2.1 Interchange Format and Presentation Profiles. (U)

These profiles are coded by information type (three letters), document structure (first digit),

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and architecture (second digit). The information types are (the last two have no two-digit extensions):

- Office document: *FOD nn*
- Computer graphics: *FCG nn*
- SGML document: *FSG*
- Directory data definitions: *FDI*.

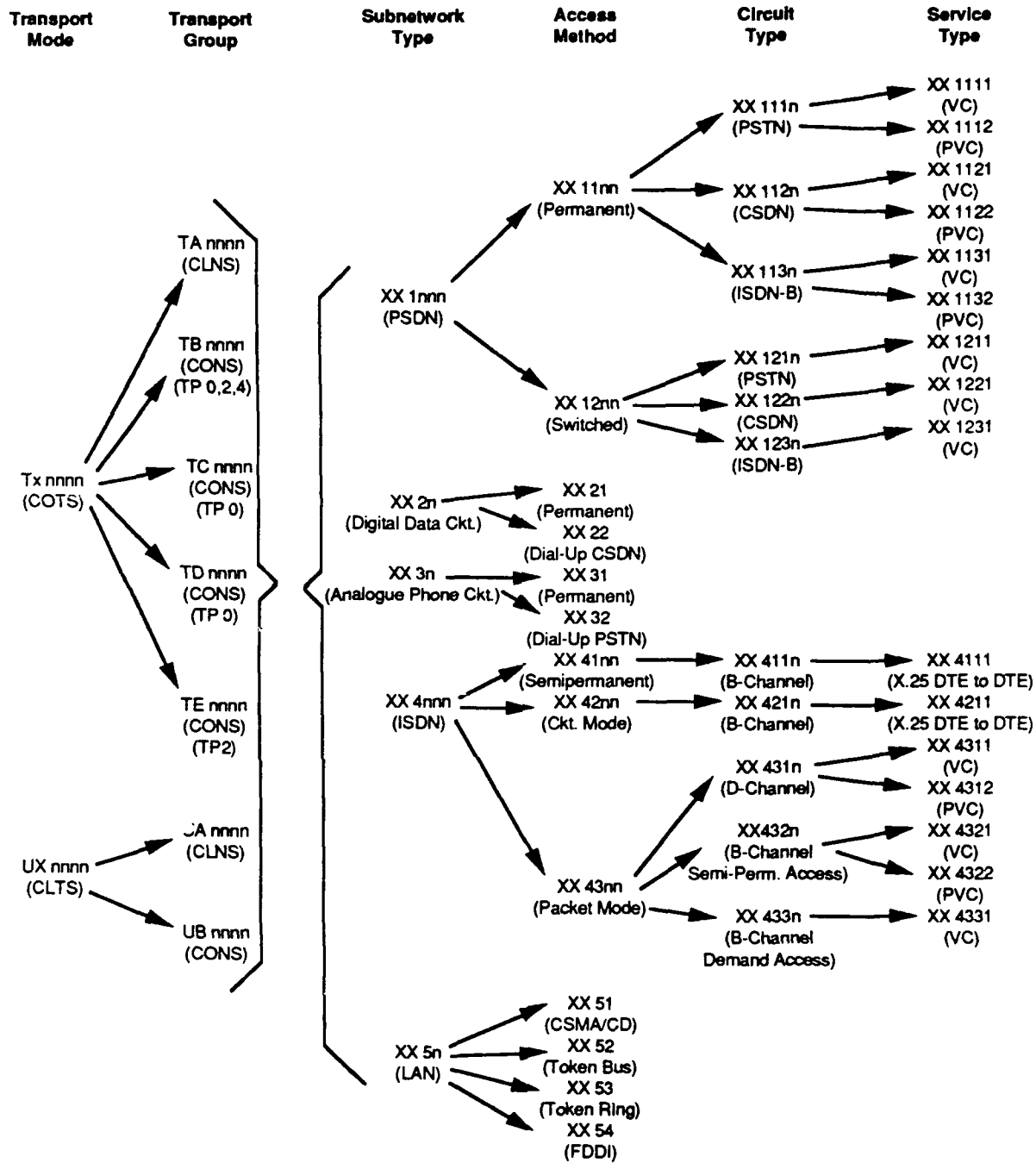
**9.3.2.2 Application Profiles.** (U) These profiles are coded by application supported and transport mode required (three letters, where the first letter is "A" if requiring COTS and "B" if requiring CLTS--no *BXX nn* profiles have yet been identified), service type (first digit), and functional association (second digit). The applications are :

- FTAM: *AFT nn*
- MHS: *AMH nn*
- VT: *AVT nn*
- TP: *ATP*
- RDA: *ARD*
- OSI Management: *AOM*
- Directory: *ADI n*.

**9.3.2.3 Transport Profiles.** (U) These profiles (Figure 11) are coded by transport mode (first letter "T" for COTS and "U" for CLTS), transport group (second letter), subnetwork type (first digit), access method (second digit), circuit type (third digit), and service type (fourth digit). The transport groups are CLNS (*TA* or *UA*), TP 0/2/4 over CONS (*TB* or *UB*), TP 0/2 over CONS (*TC*), TP0 over CONS (*TD*), and TP2 over CONS (*TE*). The subnetwork types are PSDN ("1"), digital data circuit ("2"), analogue telephone circuit ("3"), ISDN ("4"), and LAN ("5"). The access methods differ for circuits and LANs:

- Circuit access methods: permanent ("1"), switched ("2"), and packet mode ("3").
- LAN access methods: CSMA/CD ("1"), token bus ("2"), token ring ("3"), and FDDI ("4").

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Source: *Functional Profiles for Opens Systems Interconnection*, Joseph R. Onufer, Chairman, TSGCEE SG9 WG1, U. S. Army CECOM ISD, Military OSI Symposium, Symposium Proceedings SP-8, Volume 1, 5-8 June 1990, NATO UNCLASSIFIED.

UNCLASSIFIED

Figure 11. (U) Taxonomy for International Standard Transport Profiles



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**9.3.2.4 Relay Profiles.** (U) These profiles are coded by relay type:

- CLNS: *RA p,q*
- CONS: *RB p,q*
- X.25: *RC p,q*
- MAC using transport bridging: *RD p,q*
- MAC using source routing: *RE p,q*
- CLNS to CONS: *RZ p,q*.

The four-digit numbers p and q each use the four-digit numerical classification of the transport profiles. They thereby identify the subnetwork types between which the relay occurs.

**9.3.2.5 ISPs.** (U) The following ISPs are planned to be developed by the SGFS (Special Group on Functional Standardization, JTC1) [Ref. 213]:

- *AFT 12, FTAM, Positional File Transfer*, Source: EWOS, 1990
- *AFT 22, FTAM, Positional File Access*, Source: EWOS, 1990
- *AFT 3, FTAM, File Management*, Source: EWOS, 1990
- *AMH 11, MHS, Common Transfer Facilities: MTA to MTA (P1)*, Source: EWOS, 1991
- *AMH 12, MHS, Common Transfer Facilities: UA to MS (P7)*, Source: EWOS, 1991
- *FOD, ODA, "Core 11,"* Source: AOW, 1990
- *FOD, ODA, "Core 26,"* Source: EWOS, 1990
- *FOD, ODA, "Core 36,"* Source: NOIW, 1990
- *TA 52, LAN, Token Bus: CLNS*, Source: NOIW
- *TA 53, LAN, Token Ring: CLNS*, Source: NOIW
- *Tx 41, WAN, ISDN: CS Services*, Source: EWOS [x=B,C,D,(E)], 1991
- *Tx 42, WAN, ISDN: PS Services*, Source: AOW [x=B,C,D,(E)], 1991
- *Tx 1231, WAN, PSDN: Access via ISDN*, Source: EWOS [x=B,C,D, (E)], 1991
- *RD 51.51, Relay, MAC Layer Relay: CSMA/CD to CSMA/CD*, Source: EWOS, 1991
- *RD 51.53, Relay, MAC Layer Relay: CSMA/CD to Token Ring*, Source: EWOS, 1991

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- *RA 5x.5y, Relay, Relay at CLNS Level: LAN to LAN, Source: TBD [x,y=1,2,3]*
- *RC 51.111, Relay, Relay at X.25 PLP Level: CSMA/CD to PSDN, Source: TBD [x,y=1,2,3].*

### 9.3.3 UK and US GOSIP

(U) This section discusses UK GOSIP and US GOSIP. Documentation for UK GOSIP was originally issued in March 1988 for mandatory use in 1990. Figure 12 shows the standards recommended for UK GOSIP. Documents for the current (1990) version of UK GOSIP, *UK Government OSI Profile, Version 3.1*, are [Ref. 214-216]:

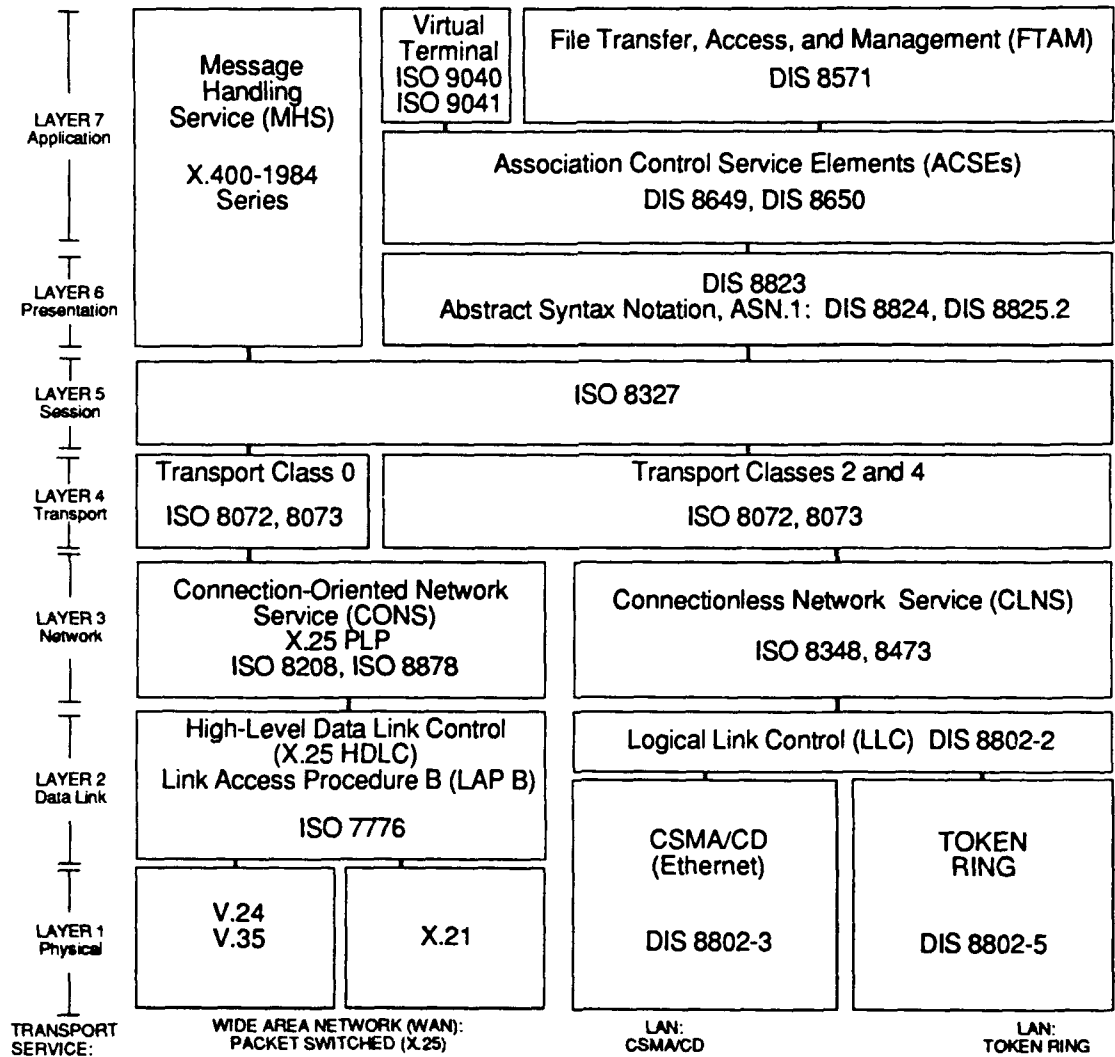
- Volume I, *Introduction*
- Volume II, *Specification*
- Volume III, *Procurement Handbook*.

(U) On the facing page, Figure 13 shows the standards and options recommended for US GOSIP [Ref. 93]. These are based on the December 1988 *Stable Implementation Agreements for Open Systems Interconnection Protocols, Version 2, Edition 1*, of the regional NIST OSI Implementor's Workshop [Ref. 31].

(U) Note that only the CL-mode network layer protocols are recommended for packet switched wide area networks (WANs) in US GOSIP, whereas the UK GOSIP recommends a connection-oriented network layer for packet switching. UK GOSIP has been endorsed by representatives from both France and Germany. TSGCEE SG9 recognizes the differences between the recommendations and plans to allow for both implementations to be valid. A technical issue [Ref. 217] may be whether a component may need to be developed with the capability to interconnect a connectionless and a connection-oriented network layer. In June 1990, NIST presented a paper [Ref. 218] to the Military OSI Symposium at the SHAPE Technical Centre. This paper outlined an approach to extending the GOSIPs of both the US and the UK in which the additional standards could be used to achieve interoperability between systems based on those GOSIPs. Neither the US nor the UK has adopted a plan to converge or extend their respective GOSIPs to achieve interoperability.

UK GOSIP

APPLICATION SERVICES:

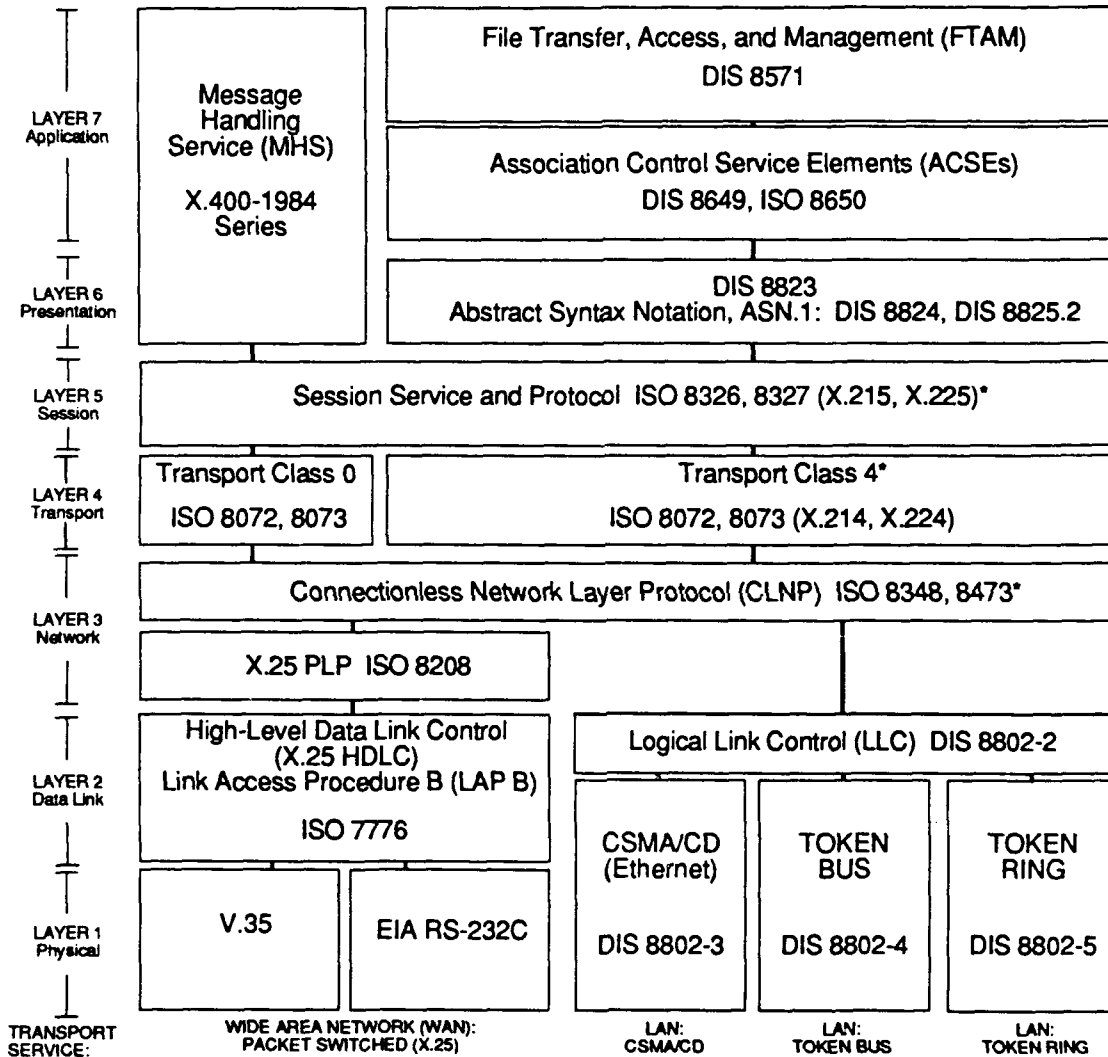


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Figure 12. (U) Stacks of Standards Recommended for UK GOSIP

US GOSIP

APPLICATION SERVICES:



\*Required for all conformant systems.

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Figure 13. (U) Stacks of Standards Recommended for US GOSIP

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(U) In the next (1991) version of US GOSIP, the following protocols are scheduled to be included: VT (TELNET and Transparent Profiles), end-system to intermediate system (ES-IS) network layer protocols, connection-oriented network service, and ODA/ODIF. These protocols would be added in 1992: directory services (CCITT X.500), interim network management, ISDN, VT (page, scroll, and forms), connectionless transport, 1988 CCITT extensions to MHS, FTAM extensions, and Fiber Distributed Data Interface (FDDI). Future versions of US GOSIP will continue to be based on the agreements reached in the regional NIST Implementor's OSI Workshop. GOSIP 2.0 will be based on *Stable Implementation Agreements for Open Systems Interconnection Protocols*, Version 3, Edition 1 [Ref. 219]. Working agreements in that workshop that have not reached final form are found in the *Working Implementation Agreements for Open Systems Interconnection Protocols: Continuing Agreements*. Reference 220 (February 1990) is the most recent version of the *Continuing Agreements*, based on the Proceedings of December 1989 NIST OSI Implementor's Workshop. These agreements provide the basis for projections of US GOSIP for 1992 and beyond.

(U) A detailed description of the plans, based on US GOSIP, to introduce OSI protocols into the US DoD is provided in *The Department of Defense Open Systems Interconnection (OSI) Implementation Strategy* [Ref. 222]. The baseline for US tactical implementation of OSI standards and protocols will be based on the work of TSGCEE SG9, the *NTIS Transition Strategy*, and associated STANAGs. Tactical networks may use GOSIP-specified lower-level protocols until NTIS protocols are developed and commercially available. When the NATO standards are complete, approved, and available, those required for DoD use will be introduced as GOSIP Advanced (post-1989) Requirements [Ref. 221].

### 9.3.4 European Procurement Handbook for Open Systems (EPHOS)

(U) Decision 87/95 from the European Community (EC) requires the specification of OSI standards for public procurements. A document is being developed by France, Germany, and the UK to provide guidance for such procurements. The document is called the European Procurement Handbook for Open Systems (EPHOS) and is based on base profiles of the UK GOSIP specification. Where possible, EPHOS will cite European standards and ISPs.

### 9.3.5 International Versions of GOSIP

(U) Initiatives have been taken to develop an international version of GOSIP. The initial meeting in October 1988 was sponsored by the United Kingdom, with participation from France, Germany, Canada, Japan, Sweden, and the United States. The next meeting in Japan will highlight attempts to gain support from other Pacific nations.

### 9.3.6 Workshops Promoting OSI

(U) Three regional international workshops have been established to promote OSI. These are the EWOS, POSI--the Asia/Oceania Workshop, and, for North America, the NIST OSI Implementor's Workshop. A Regional Workshop Coordinating Committee has also been established to promote dialog and harmonization among the regional workshops. The goal of the workshops is to define standards profiles that will ensure interoperability of products from different vendors. As indicated in Section 9.3.3, the *Stable Implementation Agreements* [Ref. 31, 219] from the NIST OSI Implementor's Workshop form the basis of US GOSIP. A companion document, *Continuing Agreements* [Ref. 32, 220], provides the basis for enhancements and future revisions to US GOSIP.

## 9.4 Standards for Applications Portability

(U) This section identifies the major organizations active in achieving increased applications portability. It also discusses the standards recommended as profiles for applications portability. Each of the major recommendations is based on POSIX. The areas addressed are X/Open (Common Applications Environment), NIST (Applications Portability Profile), Open Software Foundation (OSF), and the Technical and Office Protocol (TOP).

### 9.4.1 Example Model for the Open Systems Environment

(U) Figure 14 provides an example of a model for the open systems environment developed by the UK MOD [Ref. 222].

### 9.4.2 Interfaces for Applications Portability (IAP)

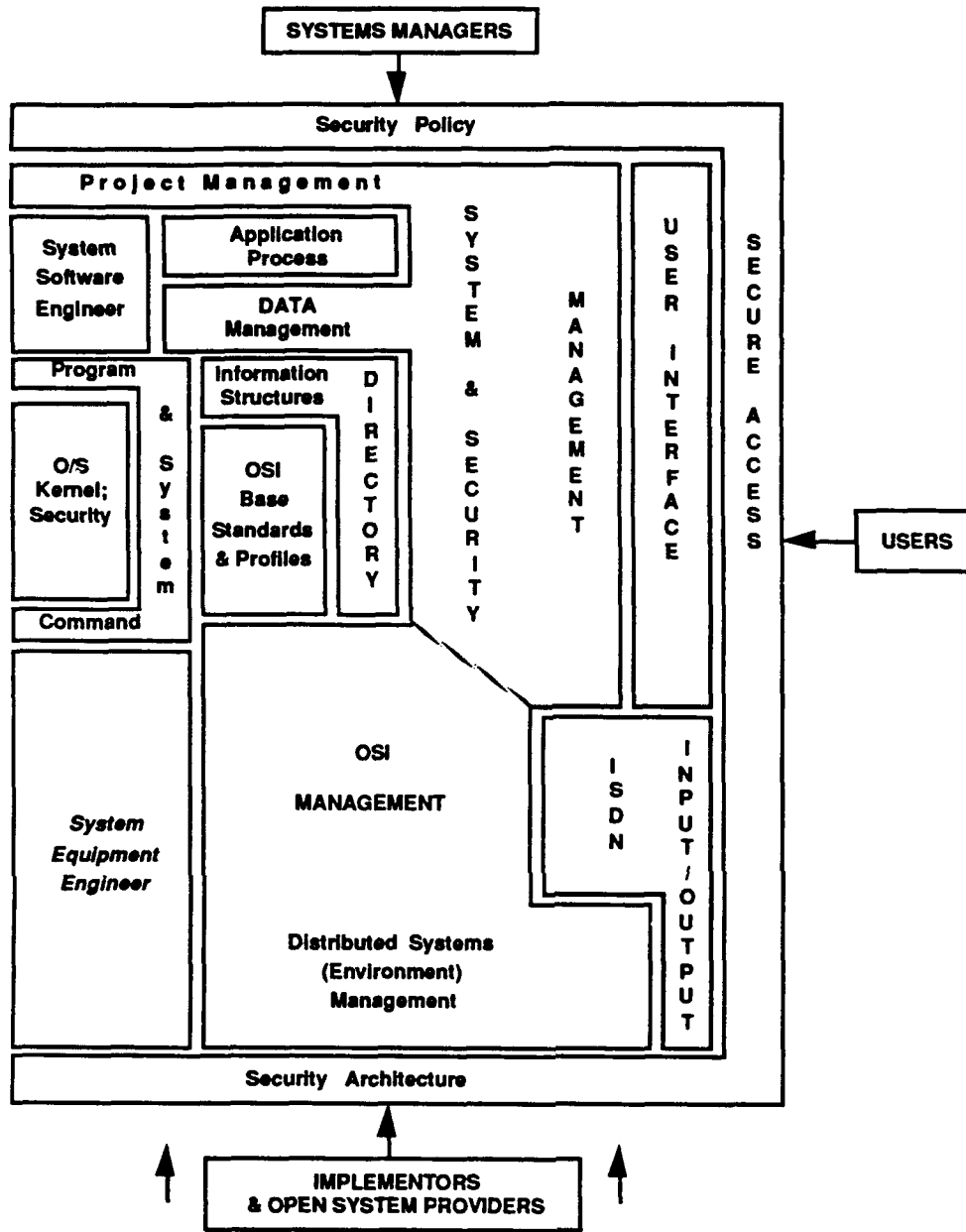
(U) JTC1/TSG-1 is conducting a study into the interfaces that need to be standardized in order to facilitate portability of applications. TSG-1 is identifying areas where standards are needed to facilitate application portability and will recommend priorities for the standardization of those interfaces [Ref. 223].

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(U) IAPs can be language-independent, operating system independent, or both. Proposed work in SC21 will be for IAPs that are both language and operating system independent. Language-specific constructs could be developed in SC22, as the mapping of abstract data types to language-specific constructs is primarily the work of defining language bindings.

(U) Specification of an API would include definition of data types of the interfaces and may include rules for describing behaviour and sequencing of functions within an interface (e.g., blocking or non-blocking procedure calls) and levels of enforcement of these rules. A model of APIs is needed and should be related to or possibly included in the models for XALS and ODP. It has been proposed that the API model, as well as the XALS and ODP models, should include a means to extend the interface to include user- or application-specific extensions or abstractions. For example, it should be possible to invoke a procedure to store application data type within the X.500 Directory Service without changing the interface definition [Ref. 224].

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Source: *Scope for MOD Information Technology (IT) Standardization and Responsibilities*, UK MOD Information Technology Standards Board, 11 August 1989, UNCLASSIFIED.

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Figure 14. (U) A Model for the Open Systems Environment

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### 9.4.3 X/Open Common Applications Environment (CAE)

(U) This section discusses the CAE developed by the X/Open international consortium and specified in the X/Open Portability Guide [Ref. 59-61, 225, 226]. The Portability Guide recommends standards and options within standards to achieve an open environment in which new applications can be ported without modification. Several international consortiums have endorsed the X/Open CAE as a basis for developing open environments. The JTC1 has formed a special study group for CAE (and the Applications Portability Profile discussed in the next section) extensions to OSI. Guidance for US GOSIP now recommends [Ref. 227] that the CAE be included in all OSI transition strategy plans being developed by the Services and Agencies.

(U) The foundations of the X/Open CAE are the interfaces of the UNIX System V operating system, as defined in the AT&T System V Interface Definition (SVID), and the C language. The X/Open CAE consists of features grouped in five functional areas: operating system, languages, data management, hardware, and networking. The Third Edition of the Portability Guide (XPG3), published in 1989, defined the CAE in seven volumes:

- (1) System V specification commands and utilities
- (2) System V specification interface and headers
- (3) System V specification supplementary definitions
- (4) Programming languages (revised from earlier version; the COBOL definition is aligned with ANSI COBOL 85)
- (5) Data management (revised)
- (6) Window management (completely new)
- (7) Networking surfaces (completely new).

The next phase of the X/Open CAE will complete the convergence with the current POSIX standard (IEEE P 1003.1).

(U) The primary feature of the operating system is the X/Open System V Specification (XVS) that defines the applications interfaces to be provided by the underlying operating system. Another feature of the operating system functional area is the X/Open Native Language System, which is a set of interfaces designed to facilitate the

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development of applications that can operate in different languages and cultural environments. These two features are defined in the following ways:

- XVS mandates the entire SVID base definition with the exception of the mathematics group.
- XVS has extended the SVID, including extended use of symbolic names to replace numeric constants.
- Some of the SVID kernel extensions are optional in XVS (use of these options could restrict portability).
- The Native Language System is supported by a message catalogue system (messages in the appropriate language are retrieved at run time); a mechanism whereby native language, local custom, and code-set requirements can be identified to applications at run time; enhanced interface definitions of standard C library functions to provide language-dependent character-type classification and special conversions; and a set of standard commands and library functions that will operate correctly with 8-bit characters.

(U) The C language is the primary feature of the language functional area. The X/Open Portability Guide provides guidelines for writing program designed to be portable and to avoid problems that arise between the AT&T System V C language standard (used for the initial X/Open standards) and the draft standard issued by ANSI X3J11. X/Open has also established definitions for COBOL (based on ANSI X3.23-1974), FORTRAN (based on FORTRAN 77, ANSI X3.9-1978), and Pascal (based on ISO 7185-1983 Level 1).

(U) Data management includes Indexed Sequential Access Method (ISAM) interfaces that are defined for creating, managing, and manipulating indexed files, and SQL for access to relational database management systems. The ISAM definition is based on Version 2.10 of C-ISAM by the Informix Corporation. SQL is based on ISO 9075 (ANSI X3.135-1986) but contains extensions and deviations (see Section 6.2.2.2).

(U) Hardware includes media and formats defined for transferring source code in machine-readable form. The features include 40- and 80-track 5 1/4-inch floppy disks, 1/2-inch magnetic tape, and utilities for transferring files. The primary magnetic tape format is 9-track, phase-encoded at 1,600 bits per inch.

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(U) Networking is based on ISO standards and interim standards recommended by the Standards Promotion and Applications Group (SPAG). X/OPEN is working to develop definitions in three areas where there are not yet standards:

- Generalized inter-process communications, with detailed definitions for message passing between processes, shared memory, and semaphores
- Distributed file system
- Distributed transaction processing.

(U) XPG3 was offered to CEN/CENELEC as a standard in 1989. Balloting on prENV 40002 was unsuccessful [Ref. 228]. XPG3 consists of 12 components (listed with reference to other standards work as applicable):

- (1) X/Open System Interfaces (XSI) Commands and Utilities (DP 9945-2, IEEE P1003.2)
- (2) XSI System Interfaces and Headers (ISO 9945-1; IEEE P1003.1)
- (3) XSI Internationalization
- (4) XSI Curses Interface
- (5) Source Code Transfer
- (6) C Language (DP 9899; ANSI X3.159; SC22/WG14 work)
- (7) COBOL (ISO 1989; SC22/WG4 work)
- (8) Index Sequential Access Method (ISAM) (ANSI X3.23 work)
- (9) SQL (ISO 9075)
- (10) Window Management Library Interface
- (11) Transport Interface (IEEE P1103.8)
- (12) Personal Computer Interworking.

(U) The following summarizes some of the comments provided to CEN and EWOS regarding the adoption of the Portability Guide as an ENV [Ref. 228]:

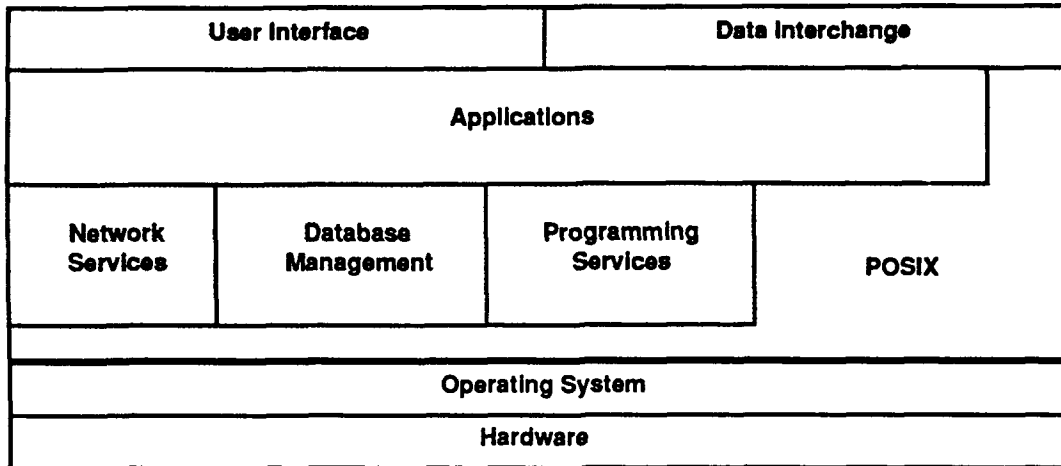
- XPG3 depends totally on UNIX, which needs an AT&T license, and the AT&T version of Programming Language C, which differs from ongoing work in SC22/WG14 (Denmark).
- The X/Open COBOL does not agree with ISO 1989 COBOL; the X/Open recommendations appear to match only one existing product (the MicroFocus compiler). X/Open COBOL excludes some features and specifies some extensions to ISO 1989. There is no real coordination between X/Open recommendations and SC22/WG4 (France).
- The X-Windows standard differs from the one developed at MIT and currently being used to progress such work in ANSI for possible submission to JTC1 (UK).

#### 9.4.4 NIST Applications Portability Profile

(U) This section discusses the Applications Portability Profile developed by the NIST. The NIST approach to applications portability is based on recognition of the need for an architectural approach that provides interfaces for functionality to accommodate a broad range of applications requirements. The functional components of the architecture are viewed as a "tool box" of standard elements that can be used to develop and maintain portable applications. These tools are based on an open systems concept and are required to be developed as an integrated collection of nonproprietary standards.

**9.4.4.1 Architectural Approach.** (U) Figure 15 provides a high-level view of the architectural approach that underlies the Applications Portability Profile. The shaded area in Figure 15 identifies the primary elements of the profile: an operating system interface (POSIX), database management, data interchange, network services, user interface, and programming services. The network services contain elements to support an open systems interconnection for data communications and to support file management. Database management services include both database languages and support for developing and maintaining data dictionaries. Programming services include programming languages. POSIX is shown as the operating system interface that enables the other elements of the profile to be essentially isolated from a specific operating system and specific hardware. The user interface provides support for windowing and menus, and the data interchange functions support business graphics, engineering graphics, and document processing. Applications make use of standard, nonproprietary interfaces to the functions provided by the profile. Figure 15 does not represent all possible interfaces among the elements of the profile, nor does it show all the ways a user can access these elements. For example, a user would normally execute applications via the user interface or the data interchange functions, but clearly some applications require no special interface. Further, users can be expected to need direct access to the data management service.

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Figure 15. (U) An Example View of the Architecture for the Applications Portability Profile

(U) Table 14 identifies the elements (tools) and the associated interface specifications of the recommended standards for the Applications Portability Profile. The key elements are: OSI for data communications; (extended) POSIX for the operating system interface; SQL and IRDS for database management; and X-Windows for the user interface.

(U) An extended version of POSIX is recommended for the operating system interface (see Section 5.2.1). SQL Standard Database Language (see Section 6.2.2.2) and the IRDS data dictionary standard [Ref. 229] (see Section 6.2.4) are recommended for database management. Recommended for data interchange are:

- GKS and CGM (see Section 9.2.3)
- Initial Graphics Exchange Specification (IGES), used for engineering graphics
- Product Data Exchange Specification (PDES)
- SGML (see Section 9.2.5.3)
- ODA/ODIF (see Section 9.2.5.2).

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*Table 14. (U) Standards for the Applications Portability Profile*

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| <b>Function</b>      | <b>Element</b>                         | <b>Reference for Standards</b>   |
|----------------------|--|--|
| Operating System     | Extended POSIX                         | IEEE P 1003.1+Extensions (FIPS 151)  |
| Database Mgmt        | SQL<br>IRDS                            | IS 9075 (FIPS 127)<br>ANSI X3.138 (proposed FIPS)  |
| Data Interchange     |  |  |
| Business Graphics    | GKS<br>CGM                             | ISO 7942, ISO 8651, ISO 8805<br>ISO 8632   |
| Engineering Graphics | IGES, PDES                             | NBSIR 86-3359, NBSIR 88-3813   |
| Document Processing  | SGML<br>ODA/ODIF                       | ISO 8879, ISO 9069, ISO 9070, TR 9573<br>ISO 8613  |
| Network Services     |  |  |
| Data Communications  | OSI                                    | GOSIP (FIPS 146)   |
| File Management      | NFS                                    | IEEE P1003.8/x   |
| User Interface       | X-Windows                              | ANSI X3H3.6 (Version 11, Release 3)  |
| Programming Services | C<br>COBOL<br>FORTRAN<br>Ada<br>Pascal | ANSI X3J11/86-151-Oct 1986, X3.159<br>ANSI X3.23-1974,85, FIPS 021-2<br>ANSI X3.9-1978, FIPS 069-1<br>FIPS 119<br>ISO 7185-1983 (FIPS 109) |

(U) Standards and options identified in US GOSIP (see Section 9.3.3) are recommended for the open systems data communications, and Network File Service (NFS) is recommended for file management. X-Windows is recommended for the user interface, providing a non-proprietary windowing capability. Five standard programming languages are recommended (C, COBOL, FORTRAN, Ada, and Pascal), but standard bindings to POSIX for these languages are still being defined [Ref. 58,62, 230].

**9.4.4.2 NIST Approach to IAPs.** (U) The IEEE Computer Society's Technical Committee on Operating Systems (TCOS) has formed a number of working groups to progress POSIX and other standards that are required to facilitate applications portability. Table 15 identifies the documents (and working groups known by the same name) being prepared by IEEE on areas other than POSIX for application portability [Ref. 57]. The scope and status of POSIX standards work is discussed in Section 5.2.1.

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Table 15. (U) Applications Portability Standards Being Developed by IEEE for Submission to ISO Through ANSI

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- P1003.0, *Applications Portability Guide*--addresses the broad applications portability issues, such as: benefits and risks of open system architecture, architectural framework for portability, applications portability concepts, operating systems services, data management and interchange services, data interchange services, graphics services, network services, user interface services, and languages/application development environment services
- P1201.1, *Interfaces for User Portability*--defines a formal standard for programming interfaces for the portability of application software that employs Graphical User Interfaces (GUIs) based on the X11 Intrinsic and Xlib programming interfaces defined by the X-Window System
- P1201.2, *Drivability*--defines a recommended practice for those elements and characteristics of user interfaces that must be consistent to permit users to easily transfer from one look-and-feel or application to another
- P1201.3, *User Interface Management System (UIMS)*--defines a language-independent dialogue applications programming interface to develop applications systems that are independent of user interface concerns and can be more easily ported across a wide range of user interface styles and technologies; would address such features as: separation of presentation-dependent and presentation-independent aspects, and mechanisms for data and control exchange between application and dialogue layers (not yet approved by TCOS)
- P1201.4, *Xlib*--submits for direct ballot, without any changes to semantics or syntax, the MIT X Consortium's X-Window System specification X11 (Release 4) of the Xlib functional specifications with integrated C language binding (direct ballot planned for early 1991)
- P1224, *X.400 Mail Services Applications Programming Interface (API)*--defines an API to X.400 mail services for gateways ... supports transfer of mail through an X.400 message transfer system (status is uncertain due to lack of support)
- P1237, *Remote Call Procedure (RPC) Interface Language*--defines an interface description language and a very limited set of procedure interfaces to allow applications to use an underlying RPC mechanism layered on an OSI stack (balloting planned for mid-1992 and approval early in 1993)
- P1238.1, *OSI Application Program Interfaces, Part 1: Common Connection Management and Supporting Functions*--defines an API model for connection-oriented OSI Application Layer services (ballot in early 1992 with P1238.2)
- P1238.2, *OSI Application Program Interfaces, Part 2: File Transfer, Access, and Management (FTAM)*--provides an application program interface to the detailed OSI FTAM services and higher-level user-oriented FTAM-based services (ballot in early 1992 with P1238.1)

Source: *Briefing on POSIX*, NIST, 12 June 1990, UNCLASSIFIED.

(U) A review of the interface specifications for the Applications Portability Profile shows that there are not yet international standards for many of the elements of the recommended architecture. Some are being considered by ANSI, IEEE, and other standards defining bodies, and others are US standards. For example, X-Windows, originally developed by the "X" Consortium at the Massachusetts Institute of Technology, is being considered by the X3H3.6 ANSI working group, and the C language bindings are being considered by the X3J11 ANSI working group. NIST is developing interim standards for file management and is recommending NFS to IEEE P1003 as the best starting point for these interfaces [Ref. 62].

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### 9.4.5 Open Software Foundation (OSF) Profiles

(U) The OSF has identified a Level 0 portability profile that is based on the following elements:

- POSIX and the Third Edition of the X/OPEN Portability Guide
- Programming language bindings for ANSI C, COBOL, Pascal, Ada, BASIC, and LISP
- X/Windows
- GKS and PHIGS for graphics
- OSI protocols for networking
- Database Language SQL.

(U) The Level 1 OSF profile standards are still being defined through a request for technology (RFT) process. The base standard for the operating system will be the IBM AIX Version 3 of UNIX. This will be compatible to UNIX System V Releases 2.0 and 3.0 and conformant to POSIX [Ref. 231]. The graphical user interface will be a combination of the Microsoft OS2 Presentation Manager, the Hewlett-Packard window manager, and the DEC toolkit.

(U) OSF is planning to develop a Distributed Computing Environment that includes such "technologies" as Architectures, RPC, Naming and Directory, Authentication and Authorization services, Time Management services, Distributed File services, and others [Ref. 232].

### 9.4.6 Technical and Office Protocol (TOP)

(U) The TOP is part of a combined industrial and government effort on the part of users to specify a profile of standard protocols that can be used in commercial applications to provide connectivity and interoperability. TOP is associated with another effort, Manufacturing Automation Profile (MAP).

(U) The TOP specification [Ref. 233] defines a functional network for distributed information processing for technical and business functions. TOP Version 1.0 (November 1985) is summarized in Table 16. It provides for Carrier Sense Multiple Access/Collision Detection (CSMA/CD) and Token Bus LANs using the connectionless X.25 Internet Protocol and the Class 4 transport protocol. FTAM is supported at Layer 7.

(U) TOP Version 3.0 was released in 1989, and it is expected to have a 6-year stability period before release of another version. It provides not only FTAM but also VT, Directory services, network management, and MHS at Layer 7. It further includes the ODIF (ISO 8613), Computer Graphics Metafile Interchange Format



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(DIS 8632), Product Definition Interchange Format (PDIF), and the GKS interface (ISO 7492). IGES Version 3.0 from ANSI [ANSI DP ANS Y14.26M-1986, Ref. 234] is included. At the lower layers, TOP Version 3.0 provides for Token Ring LANs and for X.25 packet switching via X.21 and X.21 bis at Layer 1. TOP Version 3.0 is summarized in Table 17.

Table 16. (U) Standards for TOP Version 1.0

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| Layer                           | References for Standards  |
|---------------------------------|---|
| 7. Application                  | ISO 8571 (FTAM)   |
| 6. Presentation<br>(Null Layer) | (ASCII and binary encoding)   |
| 5. Session                      | ISO 8327  |
| 4. Transport                    | ISO 8073 (Transport Class 4)  |
| 3. Network                      | ISO 8473 (Connectionless and for X.25--Subnetwork<br>Dependent Convergence Protocol, SNDCP) |
| 2. Data Link                    | ISO 8802/2 (Type 1, Class 1 Logical Link Control)   |
| 1. Physical                     | ISO 8802.3 (CSMA/CD Media Access Control)<br>ISO 8802.4 (Token Bus Media Access Control)    |

(U) The international organization, Open Systems Interconnection for Technical and Office Protocol (OSITOP), has been examining architectural issues and has produced a position paper on a solution for connection-oriented network service (CONS) and connectionless-oriented network service (CLNS) internetworking. This paper concludes that:

- It is not realistic to sidestep this issue by expecting that one of the two incompatible sets of protocols (CONS or CLNS) be abandoned or by accepting the existence of two non-communicating OSI islands.
- Three solutions are valid, although not architecturally correct according to OSI principles:
  - The "265" internetworking function (based on TP4 over CONS)
  - A Distributed System Gateway (DSG)
  - A Multi-System Distributed System Gateway (MSDSG).
- OSITOP recommends the MSDSG solution.

SC21/WG6 is reportedly preparing a technical report that is based on the definition of an MSDSG [Ref. 235].

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*Table 17. (U) Standards for TOP Version 3.0*

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| <b>Layer</b>    | <b>References for Standards</b>  |
|-----------------|--|
| 7. Application  | ISO 8571 (FTAM)<br>CCITT X.400-1984 (MHS)<br>ISO 9041 (VT, subset VT-B)<br>ISO 8613 (ODIF)<br>ISO 8632 (CGM)<br>ISO 7492 (GKS)<br>ISO 9594 (Directory)<br>ISO 9595 and 9596 (Network Management)<br>ISO 8649 and 8650 (ACSE) |
| 6. Presentation | ISO 8823   |
| 5. Session      | ISO 8327   |
| 4. Transport    | ISO 8073 (Transport Class 4)   |
| 3. Network      | ISO 8473 (CLNP, SNDCP)<br>CCITT X.25 PLP   |
| 2. Data Link    | ISO 8802/2 (Type 1, Class 1 Logical Link Control)<br>CCITT X.25 HDLC (LAPB)  |
| 1. Physical     | ISO 8802.3 (CSMA/CD)<br>ISO 8802.4 (Token Bus)<br>ISO 8802.5 (Token Ring)<br>CCITT X.21 and X.21 bis (Packet Switching)  |

**9.5 Other Profiles and Transition Strategies**

(U) This section is intended to be expanded to address additional activities and options to support transition from existing military and other standards to standards for open environments. Examples are application gateways, test systems, and test methodologies. Efforts to highlight functional standards, select stacks of mature standards and options within standards, and harmonize implementations would be examined. One example is the *Guide to the Use of Standards* [Ref. 236] developed by SPAG in Europe. Functional standards based on OSI standards are being developed by the Interoperability Technology Association for Information Processing, Japan (INTAP), specifically towards an interoperable distributed database system [Ref. 237]. Recommendations for functional standards and cooperation with European and US organizations and companies are also provided in Japan by POSI.

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(U) Initial profiles for Cooperation for Open Systems Interconnection in Europe (COSINE) have been released. These profiles are summarized in Table 18. In addition to those standards cited in the table, COSINE is evaluating:

- Virtual Terminal, ISO 9041 (with AD2 screen mode)
- EWOS Profile A/122 for file access
- Additional message handling services (CCITT X.400-1988)
- Job Transfer and Manipulation (JTM), ISO 8832 and ISO 8833.

*Table 18. (U) Standards for COSINE Profiles*

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| <b>Layer</b>    | <b>References for Standards</b>  |
|-----------------|--|
| 7. Application  | ENV 41204 (FTAM)<br>ENV 41910 (Remote Terminal Access)<br>EWOS Profile A/111 (File Access)<br>RARE MHS and CCITT X.400-1884 MHS Services<br>Remote Job Entry (to be defined in EWOS) |
| 6. Presentation | (Null Layer)   |
| 5. Session      | (Null Layer)   |
| 4. Transport    | (Connection-Oriented)  |
| 3. Network      | (Connection-Oriented)  |
| 2. Data Link    | CCITT X.25-1984  |
| 1. Physical     | Local Area Networks (not specified)  |

## 10. STATUS OF NATO OSI DATA COMMUNICATIONS STANDARDS

### 10.1 Introduction

(U) This chapter and the next examine NATO efforts to specify and implement open system standards and architectures to achieve interoperability. The purpose is to (1) assess the progress being made in NATO to incorporate military requirements in international standards and to define, where necessary, extensions to those standards, and (2) identify the NATO standards and profiles that may be applicable to ATCCIS.

(U) This section is followed by a discussion of the eight military requirements defined by TSGCEE SG9 (Section 10.2) and an overview of SG9's organization and the plans and activities of the working groups (WGs) within SG9 (Section 10.3). Section 10.4 provides an assessment of the status of draft OSI STANAGs, with particular attention to the way in which each draft STANAG addresses the military features. The chapter concludes with a summary of related standards work in NATO bodies (Section 10.5) and the findings (Section 10.6).

### 10.2 Military Requirements for NATO OSI

(U) This section summarizes the requirements associated with incorporating military enhancements into open systems interconnection (OSI) standards. Within NATO, this work has been assigned to TSGCEE SG9. General information on NATO and international standards bodies concerned with OSI standards is provided in Appendix F.

(U) Beginning in February 1983, a number of military requirements have been identified in NATO that are not adequately covered by existing OSI standards. Eight military features were identified in the NATO Interoperability Management Plan (NIMP) [Ref. 101], and TSGCEE SG9 has recommended that the OSI Reference Model (STANAG 4250) be extended to provide support for these features:

- Multihomed, mobile host systems
- Multi-endpoint connection
- Internetworking
- Network/system management functions
- Security
- Robustness and quality of service
- Precedence and preemption
- Real-time and tactical communications.

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(U) Table 19 gives the description of the eight military features as provided in *Use of OSI Standards in NATO--Strategic and Technical Issues*, March 1988 [Ref. 238].

Table 19. (U) Eight Military Features for Enhancing OSI in NATO

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- (1) Multihomed and mobile host systems. Multihoming is a mechanism for attaching an end system to two or more network access points without the need for a system setting up a call to it to be aware of the extra connectivity. In addition to enhancing survivability, this facility may be extended to support "mobile hosts" such as aircraft and ships.
- (2) Multi-endpoint connections [multi-addressing; multipeer data transmission (MPDT)].<sup>36</sup> In order to transmit data to a number of recipients, it is usually necessary to establish several connections and send separate copies of the data across each connection in turn. More efficient use is made of the communications resources if the sender has to transmit only one copy of the data. The network then takes care of routing, control, and distribution of the data.
- (3) Internetworking. Mechanisms are required to facilitate the interconnection of various NATO systems at the boundary point between subnetworks.
- (4) Network or system management functions. Management functions are required that may be of greater sophistication than those considered satisfactory for civilian networks. Management of broken networks in which layers of protocols are inoperable and fast responses to changes in network topology are essential to maintain important connections.
- (5) Security. Protection measures are required to prevent unauthorized access to information, preserve the integrity of data, and to mitigate against denial of service. [Note: Security includes access control, authentication, integrity, and confidentiality.]
- (6) Robustness (resilience) and quality of service. The range of quality of service parameters required for military systems exceeds that currently permitted within commercial OSI networks. In particular, in order to maximize the survivability of a network, the NATO aim is to maintain an adequate quality of service to the users (or at least to users operating above a given priority level) in the face of a severely damaged or partitioned network.
- (7) Precedence and preemption. In order to minimize congestion, particularly in a damaged network where resources are at a premium, it is desirable to be able to allocate resources on the basis of priority levels assigned to the connections being routed through the congested area. A facility is therefore required to associate a priority level with a connection when it is established.
- (8) Real-time and tactical communications. Certain applications are prepared to sacrifice such aspects of quality of service as sequencing and guaranteed delivery to achieve the minimum possible transit delay.

Source: *Use of OSI Standards in NATO--Strategic and Technical Issues*, Issue 2, TSGCEE SG9, March 1988, NATO RESTRICTED.

(U) A top-level view of how the eight military features identified above could potentially affect the layers of the OSI Reference Model is provided in Table 20. The entries in the table are based on the most recent editions of the draft OSI STANAGs (see Section 10.4).

<sup>36</sup> (U) As indicated in Section 4.2.1, work in ISO on MPDT has been suspended in SC21/WG1. The completed work is planned to be released as a Technical Report. Canada is serving as the point of contact within SG/9 for maintaining interest in MPDT in ISO. Canada has introduced a draft proposal in ISO on Multi-Party Communications that would address MPDT.

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*Table 20. (U) Impact of Military Features on Layers of OSI Reference Model*

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| Military Feature                         | OSI Layer |     |     |     |   |     |     |
|--|-----------|-----|-----|-----|---|-----|-----|
|  | 1         | 2   | 3   | 4   | 5 | 6   | 7   |
| 1. Multihomed, Mobile Host Systems       |           |     | TBD |     |   |     | X   |
| 2. Multi-Endpoint Connection             |           |     | X   |     |   | TBD | X   |
| 3. Internetworking                       |           |     | TBD |     |   |     |     |
| 4. Network/System Management Functions   | TBD       | TBD | TBD | TBD |   |     | X   |
| 5. Security                              | X         |     | X   |     |   | TBD | X   |
| 6. Robustness and Quality of Service     | TBD       |     | X   | TBD |   | TBD | TBD |
| 7. Precedence and Preemption             |           |     | X   | TBD |   |     | X   |
| 8. Real-Time and Tactical Communications |           |     | TBD | TBD |   | TBD | TBD |

Key: X = A deficiency has been identified in the applicable draft STANAG.

Sources: *Use of OSI Standards in NATO-Strategic and Technical Issues, Annex 6, Summary of Impact of Military Feature on Layers of Reference Model*, TSGCEE SG9, 1 March 1988, NATO UNCLASSIFIED; *Commentaries on the STANAGs of WG1*, Contribution by France to TSGCEE SG9/WG1, February 1989, NATO UNCLASSIFIED; the *NATO OSI Security Architecture (NOSA)*, March 1988, NATO UNCLASSIFIED; and recently released draft OSI STANAGs (through July 1990).

(U) TSGCEE SG9 is currently evaluating a proposed revised specification [Ref. 239] of eight military features, in which Robustness and Quality of Service is replaced by Quality of Service and Real-Time and Tactical Communications is replaced by Real-Time Communications. Table 21 provides the new definitions of these features, showing in *italics* the changes in wording from the current definitions (in effect since 1984).

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Table 21. (U) Proposed Revised Military Features

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- (1) Multihomed and mobile host systems. Multihoming is a mechanism for attaching an end system to two or more network access points without the need for a system setting up a call to it to be aware of the extra connectivity. In addition to enhancing survivability, this facility may be extended to support "mobile hosts" such as aircraft, ships, and land vehicles during the move from one node to another.
- (2) Multi-endpoint connections [multi-addressing]. In order to transmit data to a number of recipients (a common occurrence in signal handling), it is usually necessary to establish several connections and send separate copies of the data across each connection in turn. More efficient use is made of the communications resources (in particular improved performance in terms of minimizing delay and conservation of bandwidth) if the sender has to transmit only one copy of the data. The network then takes care of routing, control, and distribution of the data. *Some networks behave this way (e.g., IEEE 802.3, net radio, and broadcast satellites).*
- (3) Internetworking. Mechanisms are required to facilitate the interconnection of various NATO systems at the boundary point between subnetworks.
- (4) Network/system management. Management functions are required that may be of greater sophistication than those considered satisfactory for civilian networks. *Examples are: management of broken networks in which layers of protocols are inoperable; fast responses to changes in network topology essential to maintain important connections; and counterattack management, to recognize and counter the effects of intelligent attack on and physical damage to the network.*
- (5) Security. Protection measures are required to prevent unauthorized access to the system, the confidentiality of the information it carries, and to preserve integrity of data and to mitigate against denial of service.
- (6) Quality of service. The range of quality of service parameters required for military systems exceeds those currently permitted within civilian OSI networks. In particular, in order to maximize the survivability of a network, the NATO aim is to maintain an adequate quality of service to the users (or at least to users operating above a given priority level) in the face of a severely damaged or partitioned network. *There is a perceived requirement for an ultimate delivery capability, whereby important communications are sustained, even at very low data rates.*
- (7) Precedence and preemption. In order to minimize congestion, particularly in a damaged network where resources are at a premium, it is desirable to be able to allocate resources on the basis of priority levels assigned to the messages being routed through the congested area. A facility is therefore required to associate a priority level with a message. *This requirement is needed for both connection-oriented and connectionless communications.*
- (8) Real-time and tactical communications. Certain applications (often tactical in nature) require communications with specified time outs, which can be in the range of milliseconds to seconds, and accurate sequencing is essential. *Real time may also include high demands on sequencing accuracy.*

Note: Text shown in italics was added to the previous version shown in Table 19 (March 1988).

Source: *Use of OSI Standards in NATO--Strategic and Technical Issues*, Draft for Issue 3, Contribution by the UK to TSGCEE SG9, 4 May 1990, NATO UNCLASSIFIED.

### 10.3 Organizational Responsibilities--TSGCEE Subgroup 9

(U) TSGCEE SG9 has the primary responsibility in NATO for reviewing the military requirements, identifying the potential impact on the OSI standards planned for use in each of the seven layers of the ISO and NATO Reference Model, defining the deficiencies and services required to address these requirements at each layer, and

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developing draft STANAGs that conform to the Reference Model and provide for the needed services. SG9 has three permanent WGs, one of which is not permanent, and three ad hoc working groups (AHWGs):

- WG1, responsible for Layers 1-4 and functional profiles, within which the functional profile work is carried out by an AHWG on Functional Profiles.<sup>37</sup>
- WG2, responsible for Layers 5-7, within which the work on the Military Message Handling System (MMHS) is carried out by an AHWG on MMHS.
- WG3, responsible for establishing a memorandum of understanding (MOU) for a multinational programme for Communications Systems Network Interoperability (CSNI)--not a permanent WG; work on the MOU is expected to be completed in December 1990, at which time WG3 would be disbanded.
- AHWG on OSI Management (AHWG-OM).
- AHWG on Integrated Services Digital Network (ISDN).
- AHWG on Security.

TSGCEE SG9 maintains liaison with many NATO bodies and agencies, including ADSIA, TSGCEE SG11 (Tactical Communications), TSGCEE PG6 (Tactical Communications Systems for the Land Combat Zone--Post 2000), NATO Industrial Advisory Group (NIAG) SG6 (Compatibility of Naval Data Handling Equipment), ATCCIS PWG, and Allied Tactical Communications Agency (ATCA).

(U) SG9 has become increasingly concerned that its terms of reference (TOR) [Ref. 240] are too broad in nature and that because of resource limitations within the Nations there is a need to formally restate the TOR to reflect the direction of the work SG9 considers most valuable and within its ability to undertake. The proposal developed by the Chairman of SG9 stated the mission [Ref. 241]:

To promote cooperation among NATO Nations in ensuring the technical interoperability of data processing and distribution systems used for command and control and in the development and procurement of related equipment and software.

Table 22 gives the specific actions for SG9 identified in the proposal (the proposed draft TOR will be discussed at the 11-13 December 1990 meeting of SG9). In a briefing to SG9 in May 1990, the Chairman of SG9 proposed the following strategy for SG9 to carry out the actions of Table 22 [Ref. 242]:

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<sup>37</sup> (U) The AHWG on Functional Profiles has recommended that the content and structure of a NATO functional profile be based on ISO TR 10000. Review of this document shows that TSGCEE SG9 intends to specify recommended standards for multiple layers at the interoperability parameter level.



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In terms of the NIMP, which advocates the use of civilian communications standards (ISO/OSI) for C3 systems (augmented for military features as necessary), TSGCEE is tasked to support this policy by undertaking the following:

- (1) In conjunction with appropriate NATO agencies, determine the range of standards needed by functional name, type, application area, and time required over a forward time frame of 5 years.
- (2) In light of the SG9 list of military features, determine their applicability to each identified need.
- (3) From (2) estimate the resources needed to produce the standard in terms of effort, skills, and time frame.
- (4) Clearly define SG9 contribution planned (e.g., no involvement, consultancy/review, guidance, or provision).
- (5) Develop policy on forms of support to be given (e.g., on Base STANAGs, profiles, or Parts of STANAG 4250).
- (6) Make explicit statements of external work needed.
- (7) Define major work items: define responsible 'agents,' time, resources, and expertise.

*Table 22. (U) Proposed Revised Special Tasking Instructions for TSGCEE SG9*

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Subgroup 9 is required to undertake the following specific tasks:

- Sponsor and develop a Single Architecture of NATO Technical Common Interface Standards (SANTIS) structured in compliance with the ISO Basic Reference Model for OSI and in accordance with the policy approved by the TSGCEE at its meeting held from 13th to 15th December 1983. The architecture will be developed by using civil sector standards developed by ISO and related recommendations of CCITT, but with enhancements as necessary to provide military features.
- In the light of the approved policy and in consultation with ADSIA, review and support the development of the NIMP to include SANTIS.
- Give guidance to the [other] TSGCEE subgroups to ensure that those data transmission standards related to Layers 1 to 3 of the NATO Model, which are the responsibility of those subgroups to develop, conform to SANTIS.
- Review existing communications STANAGs for suitability for the SANTIS and for interoperability with that architecture.
- Identify STANAGs under development that deviate from the Subgroup's policy and, where practicable, influence them to conform to SANTIS.
- In consultation with ADSIA, submit recommendations to the TSGCEE on the role it should play in the formulation of test plans and procedures and in configuration management.
- Influence the further development of NATO digital data links to conform to SANTIS where desirable.
- Observe activities in appropriate research study groups of the Defence Research Group and make use of their results and recommendations in areas relevant to the work of the Subgroup.

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(U) The following working documents and papers have recently been developed to refine the scope of TSGCEE SG9 work on using OSI standards for NATO CCISs:

- *Use of OSI Standards in NATO--Strategic and Technical Issues*, May 1990 [Ref. 243]
- *The TSGCEE Subgroup 9 Support Programme for OSI in Military Communications*, June 1990 [Ref. 244]
- *The Use of OSI in Military Communications*, June 1990 [Ref. 245].

(U) An AHWG has been formed by TSGCEE to review the current organization of TSGCEE and make recommendations for streamlining the organization. The AHWG is expected to complete its work in 1990. At the January 1990 TSGCEE plenary meeting, the TSGCEE directed that ATCCIS Phase III be included in these efforts [Ref. 246]. The recommendations of the AHWG, taken up at the June 1990 TSGCEE plenary meeting, included the formation of six Principal Subordinate Groups (PSGs), each of which could have subgroups, WGs, project groups, and AHWGs. Details of the recommendations are classified [Ref. 247]. However, it is possible that ATCCIS would be taken up by a project group or a subgroup other than SG9. TSGCEE decided in June 1990 to refer the recommendation on reorganization to the CNAD.

(U) The foundation for an assessment of the progress in NATO for adapting to and, where necessary, defining military enhancements for OSI standards is a review of the activity and work plans of SG9. The activity for developing the *NTIS Transition Strategy* is discussed in Section 10.3.1. This is followed by a discussion of the current activity and work plans of the three WGs of SG9: WG1 in Section 10.3.2, WG2 in Section 10.3.3, and WG3 in Section 10.3.4. Status of the current work of the three SG9 AHWGs is discussed next: AHWG-OM in Section 10.3.5, AHWG-ISDN in Section 10.3.6, and AHWG-Security in Section 10.3.7. Because of the scope of its work, the current activity and work plan of WG2's AHWG-MMHS is discussed separately in Section 10.3.8.

### 10.3.1 NTIS Transition Strategy

(U) A major project of TSGCEE SG9, led by the German delegation, is the development and maintenance of the *NTIS Transition Strategy*. The current version is the 1989 or Fifth Edition; it is dated 30 November 1989 [Ref. 4] and was directed to be distributed by SG9 in May 1990. This document is revised annually and promulgated by the CNAD. It provides recommendations for international commercial standards, primarily from ISO and CCITT, and intercept strategies (stacks of standards) that can be used by the nations as part of a transition strategy prior to the promulgation of OSI STANAGs. The *Intercept Profile for Military Message Handling Systems*, based on

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CCITT X.400-MHS(84) (see Section 10.3.8), was included in this edition. The Fifth Edition also incorporates ISDN standards and the 1988 recommendations of CCITT. It describes 4 application, 17 transport, and 11 relay profiles. It also addresses many of the deficiencies identified in the July 1989 release (Version 1.2) of WP 25, including ODA, RDA, and TP. A summary of the standards and profiles contained in the Fifth Edition of the *NTIS Transition Strategy* is provided in Section 4.3.1, especially Tables 2, 3, and 4 and Figure 9. The profiles are illustrated in Appendix B.

(U) A draft of the next edition of the *NTIS Transition Strategy* is expected to be provided to the October 1990 SG9 meeting and distributed in final form after the May 1991 SG9 meeting. The new version will include use of the new ISO TR 10000 taxonomy. The taxonomy of application profiles is expected to be removed from the *NTIS Transition Strategy* and included in the Functional Profile Guidelines document being developed in WG1. Emerging standards not addressed in the Fifth Edition that should be considered for the next edition of the *NTIS Transition Strategy* are ODP, TM, security protocols, X-Protocol (X-Windows), GKS, CGI, PHIGS, CGM, SQL, IRDS, and Remote Call Procedure.

**10.3.2 Status of Activities and Plans for Developing Lower Layer OSI STANAGs**

(U) The two primary tasks of WG1 are developing lower layer STANAGs (the first issues are planned for submission to SG9 in October 1990) and developing guidelines for standardizing NATO functional profiles. The status of these activities is summarized below [Ref. 248-250].

**10.3.2.1 Lower Layer STANAGs.** (U) WG1 has agreed to prepare all the lower layer STANAGs for submission to SG9 by the October 1990 WG1 meeting. If possible, example profiles, Conformance Statements, and NPICS Proforma will be included. At present, the draft STANAGs do not explicitly require Transport Protocol TP4 to support connectionless operations, and they may not include the annex for Layer 3 (Annex F) on the connectionless Internet Protocol (IP). Revised drafts of all STANAGs are planned for the July 1990 meeting of the AHWG-FP. WG1 has determined [Ref. 251] that it is inappropriate for forward error coding (FEC) to be standardized with the OSI framework; therefore, WG1 has relegated FEC as actions to be accomplished on the information bit stream outside the Reference Model. Thus, FEC is not currently being considered in the lower layer STANAGs.

**10.3.2.2 Functional Profiles.** (U) A Functional Profile (FP) Guidelines document is being developed; it is viewed in WG1 as the basis for the lowest

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common denominator of interoperability. This document is being developed in WG1, but WG2 will be requested to provide formal comments and will be invited to participate in future AHWG-FP meetings. The FP Guidelines document is based on ISO TR 10000 (Part 1--*Framework* and Part 2--*Taxonomy*). WG2 has no strong reservations against the FP Guidelines or the ISO TR 10000 taxonomy and structure for standardized profiles. However, WG2 expressed the need to continue their message handling work in the EWOS format in order to maximize their interchange of information with EWOS. WG2 would translate their MMHS STANAG work into the TR 10000 structure at a time when that structure was more stable for the upper layers. WG1 plans to submit the FP Guidelines document to SG9 in October 1990.

**10.3.2.3 Use of OSI in NATO.** (U) WG1 is evaluating a proposal to change the emphasis of WG9 work on military features. The paper, *NATO Approach to OSI--A Review*, says that

With the possible exception of the work on management however, the analysis of the current ISO position indicates that there is relatively little scope remaining for NATO to influence ISO to provide specific military features.<sup>38</sup> Therefore, we need to focus our work on the facilities that are now present and examine how they should be adapted for use. ...there is a need now to develop augmentations to the civil standards.

WG1 agreed that work should be done to adapt present facilities for military use, but that many aspects of the identified military features cannot be satisfied by the present facilities and that additions must be made to the current protocol standards. WG1 further agreed that it is desirable to amend the civilian OSI standards under development to incorporate military features if that it is possible. Finally, WG1 agreed that this represents a shift in emphasis in the WG1 work, but not to the exclusion of having NATO-approved positions presented to ISO. The *NATO Approach to OSI--A Review* paper addresses the military features as shown in Table 23.

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<sup>38</sup> (U) This view is not shared by all of TSGCEE SG9; both the AHWG on Security and the AHWG on OSI Management are continuing to work to influence ISO to provide military features. In security, work is continuing to make the TCS conform to the eventual security protocol agreed by ISO---only the implementation would be unique to NATO.

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Table 23. (U) Proposed New Emphases for TSGCEE SG9 Work on Military Features

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- (1) Multihomed and mobile systems. The routing protocols are deemed likely to meet the military requirements. Further work in NATO is needed to establish exactly how these protocols are to be used. Additionally, further study is needed for use of the Directory service, if adopted by NATO, to meet these requirements by providing a mapping to multiple addressees.
- (2) MPDT. ISO work on multi-endpoint connections is likely to be set aside. Support of this feature for time-critical applications could be considered along with the work on real-time and tactical communications, or it can be considered as a pan-layer topic in its own right. SG9 should therefore assume the responsibility for developing this work as an augmentation to civil standards as a minimum to define a broadcast facility for use when the physical media is inherently of a broadcast nature.
- (3) Internetworking. Work is needed to meet the military requirement for secure internetworking between connection based and connectionless environments.
- (4) Security. NATO is currently further ahead than ISO on security. The work to develop the Trusted Communications Sublayer (TCS) protocols, which are unique to NATO and outside of OSI as a matter of choice, must continue. Further work is required to develop the security functionality at the other layers identified within NOSA... Interaction with the civil standards community is anticipated.
- (5) Robustness and Quality of Service. Little work has been done in ISO on fully supporting QoS. ... Much excellent work to define the military requirements for QoS has already taken place but it needs to be refined and developed as augmentations to layer protocols. ... It is an area, like management, where input to ISO could be made if the topic is pursued there. ... At the sub-network level, robustness may be supported through exploiting facilities within the emerging ISO routing protocols.
- (6) Precedence and Preemption. The ISO protocols to convey precedence and pre-emption need augmentation to define the number of military levels and how they are signalled between the layers in a consistent manner.
- (7) Real-time. Studies are required to examine the protocol overheads associated with current profiles (e.g., MMHS over STAMINA). It may be necessary to cut down the OSI stack for some profiles (e.g., support of wide area networks).
- (8) Management. Work is required to identify, define, and register military objects that need to be managed by means of the emerging OSI management mechanisms.

Source: NATO Approach to OSI--A Review, UK Contribution to WG1, October 1989, NATO UNCLASSIFIED.

**10.3.2.4 Multipeer Data Transmission (MPDT).** (U) Work is progressing in the US Protocol Standards Technical Panel for multicasting; by August 1990, WG1 plans to have a report on how the US GOSIP would accommodate a Combat Net Radio (CNR) profile. Canada is working to keep MPDT alive in ISO and is coordinating other NATO-Nation input with ISO.

**10.3.2.5 Lower Layer Addressing.** (U) WG1 has been reviewing a number of technical papers on lower layer addressing. These include the *EWOS Technical Guide to OSI Layer 1 Through 4 Addressing* and a draft British Standards Institute guide for *The UK Scheme for the Allocation of ISO-DCC Format OSI Network Service Access Point (NSAP) Addresses*, which was used in the EWOS document as a reference for addressing in Layer 3. The US has submitted papers on

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naming and addressing and on the compatibility of STANAG 4214 and US GOSIP Network Layer addressing. The UK has developed a rationale for Annex D of draft STANAG 4263 with the goal of resolving differences with STC in an addressing scheme.

**10.3.2.6 Precedence and Preemption.** (U) Since ISO restricts the Transport Layer levels of precedence to 15 by restricting use of one of the levels, WG1 agreed to reduce from 16 to 15 the number of levels of precedence that would be adequate at the Transport Layer.

**10.3.2.7 Real-Time Programs.** (U) WG1 has specific proposals for incorporating real-time aspects into the Layer 4 STANAGs. There are issues regarding these real-time services as to their conformance to OSI, differences from CCITT real-time work, and the interest of several nations in other efforts [e.g., US Manufacturing Automation Protocol (MAP) real-time work] as closer to OSI.

**10.3.2.8 Glossary of Terms.** (U) WG1 has developed a *Glossary for OSI Layers 1 Through 4*. WG1 is recommending to SG9 that SG9 coordinate a glossary for all OSI layers.

**10.3.2.9 Liaison With Other Groups.** (U) The *NATO Consultation, Command and Control (C3) Master Plan* developed by NACISA is being forwarded to the Military Committee and is expected to be approved. The *NATO C3 Architecture* is still being worked on; in particular, Volume 1 (*Consolidated Architecture*) has not been accepted (see Section 11.1). STC has an ongoing program to implement X.25 for an investigation of preemption functionality. US/EUROCOM wishes to use STANAGs 4262 and 4263 for the revised STANAG 4269 on the tactical digital gateway but reports that the layer STANAGs were not considered stable enough. WG1 has noted that the gateway standard would appropriately be a profile of SG9 lower layer standards, probably a relay profile. WG1 has responsibility for access to ISDN and plans on developing profiles for use of ISDN as a bearer service.

**10.3.2.10 Work Plan.** (U) TSGCEE SG9 WG1 has an 18-month work plan, beginning October 1989, that contains the work areas and planned activities on lower layer STANAGs as shown in Table 24 (the first five are most important areas; the work plan will be updated in October 1990) [Ref. 248, 250].

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*Table 24. (U) Work Plan and Activities on Lower Layer STANAGs by WG1*

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- (1) Develop annexes to Layers 1-4 STANAGs, incorporating the applicable NATO military features; focus on MPDT and the TC 111(M) Profile, Connection-Oriented Transport Protocol (TP0/TP2) over X.25 (complete by September 1990).
- (2) Submit Layer 1-4 STANAGs to SG9 for ratification (October 1990).
- (3) Finalize and submit for ratification the Functional Profile Guidelines document for submission to SG9 in October 1990.
- (4) Finalize ongoing work on the TC 111(M) and R.131(M) functional profiles (drafts for July 1990; refer to SG9 after the September 1990 WG1 meeting).
- (5) Continue development of the TA SI(M) LAN profile (no target dates for completion).
- (6) Develop NATO military scenarios to provide a basis for future functional profiles, for use by all working groups (September 1990).
- (7) Develop addressing protocols.
- (8) Develop broadcast protocols (STANAGs) for tactical radios.
- (9) Develop STANAGs to support real-time communications.
- (10) Study gateways between tactical and strategic networks.
- (11) Study feasibility of ISDN in a NATO military environment (note: WG1 addresses only the requirements to access/interface to ISDN).
- (12) Study aspects such as use of routing protocols (especially with regard to multihomed and mobile host systems), multipeer (multi-endpoint) communications, internetworking, quality of service (including priority and preemption), and military-specific managed objects.
- (13) Maintain liaison with NIAG(SG6) in their development of functional profiles.

Source: NATO SG9 WG1 18-Month Work Plan, TSGCEE SG9 WG1, October 1989, NATO UNCLASSIFIED.

**10.3.3 Status of Activities and Plans for Developing Upper-Layer OSI STANAGs**

(U) The status of WG2 activities is summarized in the following paragraphs [Ref. 251, 252]:

**10.3.3.1 Upper-Layer STANAGs.** (U) The first issues of the STANAGs for the Session Layer, the Presentation Layer, and ASN.1 have been submitted to SG9 without any military enhancements. Some minor changes were made in February 1990. Some additional editorial changes were directed by SG9 in May 1990 and action to begin ratification was deferred. WG2 will make the required changes in October 1990, and the ratification process is expected to be directed to begin by SG9 in December 1990.

**10.3.3.2 Registration Authority.** (U) NATO needs to make provision for an appropriate registration authority to ensure unique addressing of military organizations and users within NATO MMHS domains and to assign object identifiers for MMHS (and other application service element) information objects. Registration authority can be technically independent for Application Layer addressing and information objects and for network addresses, but NATO may wish to consider these two issues concurrently.

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(U) Two principal scenarios are being discussed, one in which NATO is registered as a network addressing authority under the ISO 6523 scheme and allocates Network Service Access Point (NSAP) address space to users, and another in which NATO is *not* so registered and each member nation allocates from its own delegated address space the NSAP address space for NATO use. It has been noted [Ref. 253] that if NATO becomes a network addressing authority, it will not prejudice the ultimate choice of which scenario to pursue and that such authority is needed for reasons other than NSAP addresses.

(U) SG9 has considered recommendations drafted by the AHWG on MMHS (see Section 10.3.8) put forward by WG2, but has decided to postpone action on this issue. SG9 decided to hold a meeting during 8-10 October 1990 with NACISA, national experts, and SG9 experts in attendance to formulate a method of work and joint recommendations for technical and administrative assessments on naming and addressing, and NATO as a registration authority [Ref. 254].

**10.3.3.3 MMHS(88).** (U) Revised working drafts of the MMHS(88) rationale, base standard, and two interoperability profiles have been produced. The current work is not yet stable (see Section 10.3.8). MMHS(84) gateways, directories, protocol implementation conformance statements (PICS), and management requirements still need to be considered. The June 1990 meeting of the AHWG on MMHS (in the US) addressed MMHS profiles.

**10.3.3.4 FTAM.** (U) WG2 has scheduled an initial focus meeting on FTAM for June 1990. The goals are: a statement on the current status of FTAM (including profiles and products); a requirements document outlining requirements for file transfer; determination of base standard and profile enhancements; and a work plan. WG2 plans to maintain close liaison with NACISA, particularly on the development of FTAM profiles, as NACISA has undertaken work in this area. NACISA is attempting to meet a requirement identified by the UK to transfer large unstructured files. Civilian profiles lack security features to support this requirement. NACISA plans to complete an FTAM profile for use over the STAMINA transport profile by September 1990.

**10.3.3.5 Liaison with Other Groups.** (U) WG2 has taken the position that it is premature to consider firm profile structures (WG1 FP Guidelines) at this time. The AHWG on MMHS is attempting to influence civil profile efforts, EWOS in particular, that have not adopted TR 10000, on which the WG1 draft Guidelines are based. WG2 is concerned about the deviation of the Quadrilateral Technical Interface Design Plan (QTIDP) project from the MMHS profile, the possible costs associated with altering



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implementations based on the QTIDP work to be conformant with the MMHS profile, and the potential interoperability problems between systems implementing different profiles.

**10.3.3.6 Work Plan.** (U) WG2 has developed a 12-month work plan for the period February 1990 to February 1991. This plan addresses progress of MMHS and support for ratification of the Session, Presentation, and ASN.1 STANAGs. In addition it identifies: monitoring the status of conformance testing, upper layer security, directories, upper layer management, recommendations on NATO registration issues, and *NATO C3 Architecture*; providing a response to WG1 on Functional Profile Guidelines; developing well-defined requirements for Upper Layer military extensions; and developing a WG2 way forward and program of work for real-time requirements and FTAM. A summary of the elements of this plan is provided in Table 25 (the topics are alphabetical) [Ref. 255].

**10.3.4 Nunn Initiatives and Work Plan of WG3**

(U) An Ad Hoc Group on Nunn Initiatives was formed by TSGCEE SG9 in March 1988 to progress three projects as multinational cooperative efforts. In part, these proposals were aimed to satisfy a request from ADSIA to TSGCEE to investigate the feasibility of a transmission-media-independent data link architecture; such an architecture and the associated technical standards are needed to support stated requirements of the Air Command and Control System (ACCS, see Section 11.3). The three original proposals were to:

- Develop, test, and implement techniques for Communications System/Network Interoperability (CSNI)
- Develop an architecture for future data links based on the NATO Reference Model
- Produce draft STANAGs for the products produced in the other two projects.

NATO funds for the last two proposals have not been found.<sup>39</sup>

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<sup>39</sup> (U) US DoD support for the second and third items was not provided, apparently due to lack of funds.

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Table 25. (U) Work Plan and Activities on Upper-Layer STANAGs by WG2

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- (1) **Abstract Syntax Notations.** Develop STANAGs covering the use of abstract syntax notations (e.g., ASN.1) and their encoding rules. Ratification of STANAGs without military extensions has been recommended to SG9. WG2 will attempt to identify requirements for military extensions. Areas of analysis have been the use of ASN.1 versus NATO Message Text Formatting System (FORMETS), encryption, and compressed encodings.
- (2) **Application Layer STANAG Format.** Develop a STANAG format to deal with Application Layer service and protocol specifications; this format (completed in March 1988) will form the basis for the development of separate service/protocol STANAGs such as for ACSE, FTAM, MHS, and Remote Data Access (RDA). This format will accommodate functional profiles. Functional profiles for an application will be ratified separately and included as annexes to the base STANAG for that application.
- (3) **Conformance Testing.** Establish a framework and methodology for testing the conformance of protocol implementations of a particular standard. Specify test sequences to be used. A proposal by Canada in March 1989 was accepted by SG9 and is awaiting a TSGCEE decision on the allocation of funds and resources. The initial step would be a team of two or three persons developing detailed recommendations regarding the establishment of a permanent NATO testing organization, its structure, responsibilities, and relationship to other NATO bodies, agencies, and member Nations.
- (4) **Connectionless-Mode Data Transfer.** Adopt or develop standards to support connectionless-mode service at both upper and lower layers of the reference model. International standards for the upper layers (e.g., ISO 9548, ISO 8326/AD1, ISO 8822/AD1) are now stable. No schedule for WG2 in this area has been set.
- (5) **Database Requirements.** Determine military requirements for database management systems (DBMSs) and the potential applicability of ISO standards (from ISO SC21/WG3, such as ND, SQL, SQL2, IRDS, and RDA; and from the activity of ISO SC21/WG1 on Distributed Application Processing and Transaction Processing) (see Section 6.2). Possibly develop a new STANAG dealing with database requirements. An issue is the area of responsibility vis-a-vis ADSIA with respect to NATO information architecture. No activity other than an STC presentation in March 1989 on database replication.
- (6) **Directories.** Determine applicability of joint ISO/CCITT Directory standards (see Section 4.3.4) to the NATO communication systems environment. Given need for such standards, develop an Application Layer STANAG for Directory services. An ad hoc meeting was held in June 1988 to assess the impact of Directory standards on military communications networks. Further discussion is required but not scheduled.
- (7) **File Transfer.** Add FTAM, with possible enhancement or modification, to the set of Application Layer STANAGs; determine what military applications FTAM might serve and how it might be adapted to, and used in, a military environment; and specify how required military features, such as security and quality of service, will be incorporated into FTAM for military use (see Section 4.3.3). An initial ad hoc meeting was held in June 1990. The results will be discussed at the October 1990 WG2 plenary meeting.
- (8) **Formal Description Techniques.** Establish a standard within NATO for use of FDTs to describe protocol and service specifications and test sequences. Several different techniques are currently used in the civilian area [SDL by CCITT, ESTELLE and LOTOS by ISO, and Tree and Tabular Combined Notation (TCN) for test sequences in ISO and CCITT] (see Section 8.5). A requirement exists for some uniformity in both FDTs and the automated tools to support them. No activity to date.
- (9) **Graphics.** Determine the need for graphics within the NATO context and the relevance of ISO standards such as GKS and PHIGS (see Sections 9.2.3) or standards such as Videotex and CCITT T.73 (mixed mode); determine the need for including such standards into appropriate segments of Application and Presentation Layer STANAGs. No activity to date.

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Table 25. (U) (Continued)

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- (10) MMHS. Add MOTIS service and protocol specifications and CCITT X.400 MHS-series recommendations, or parts thereof, with possible enhancement or modification; determine what military applications electronic mail might serve and how it might be used in a military environment; and specify how military features, such as security and quality of service, will be incorporated into MOTIS/MHS. See Section 10.3.8 for details of MMHS work areas by WG2.
- (11) Multipeer Data Transmission. Determine military requirements for MPDT and the potential modification or creation of protocols for this task. Intermittent activity, but no resolution for further action. ISO initiated a project on this topic but suspended it due to lack of support. This pan-layer issue may eventually dictate changes to upper layer STANAGs.
- (12) Naming and Addressing. Define a universal scheme for the naming and addressing of layer entities, with particular emphasis on the Application Layer. Such a scheme is necessary for interoperability of application entities that are attached to different subnetworks and may be mobile (i.e., may temporarily detach from and reattach to different subnetwork points of attachment). Examine the need for a registration authority within NATO to ensure globally unique names and addresses. WG2 has made specific recommendations (see Section 10.3.8) to SG9 that NATO become an authority for Application Layer registration.
- (13) NATO C3 Architecture. Monitor the direction and possible impact of activity in this area. Receive informal briefings. Maintain liaison with NACISA.
- (14) Presentation Layer STANAGs. Develop STANAGs to encompass the OSI Presentation Payer services and protocol specifications (ASN.1 is being addressed as a separate STANAG). Ratification of STANAGs 4256 and 4266 without military extensions has been recommended to SG9. The WG2 questionnaire did not identify requirements for military extensions in the short term.
- (15) Quality of Service. Determine special military requirements for quality of service; these could be general (e.g., performance requirements) or layer specific. Monitor work by the AHWG on OSI Management. This is a pan-layer issue that may dictate changes to upper layer STANAGs.
- (16) Real-Time Performance. Determine special military requirements. No activity other than a presentation in October 1989.
- (17) Session Layer STANAGs. Develop STANAGs that encompass the OSI Session Layer service and protocol. Ratification of STANAGs 4255 and 4265 without military extensions has been recommended to SG9. The WG2 questionnaire did not identify requirements for military extensions in the short term.
- (18) Upper Layer Architecture. Determine functionality required for NATO systems with respect to Upper Layer Architecture. This activity is designed to ensure maximum uniformity between different OSI application service elements (e.g., FTAM, MHS). No activity other than one report.
- (19) Upper Layer Management. Determine functionality required for NATO systems. No activity to date. A report on the US Defense Message System management is planned.
- (20) User Requirement Definition. Conduct a questionnaire to survey user requirements for Session and Presentation Layer deficiencies identified in the September 1988 Canadian analysis. Questionnaire was revised and circulated to Nations in May 1989. No requirements for specific changes in upper layers were identified. A recommendation to pursue FTAM was noted (see above).
- (21) Virtual Terminal. Consider the potential use of civil Virtual Terminal work in a military context. No activity to date.

Source: NATO SG9 WG2 18-Month Work Plan, TSGCEE SG9 WG2, May 1990, NATO UNCLASSIFIED.

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**10.3.4.1 WG3 on Communications System/Network Interoperability (CSNI).** (U) WG3 was formed in October 1989 to develop an MOU under a Nunn Initiative for CSNI. Canada, France, and the United States have signed the formal Statement of Intent for participation; the UK, NL, and STC have also expressed interest in participating. WG3 tasking will end with a completed MOU among the participating nations, but the project itself will take about 3 years. The emphasis of this 3-year effort is not on developing standards but rather to demonstrate the operational utility of internetworking using enhanced OSI profiles with military features. While completion of the MOU is planned for December 1990, the Chairman of SG9 has suggested that WG3 be kept as an AHWG within SG9 [Ref. 256].

(U) The CSNI project plans a demonstration in 1993 for linking subnetworks of countries across long haul multimedia supporting multiple modes (voice, data, images). According to the January 1990 draft MOU [Ref. 257], WG3 will (1) ensure that the work will be closely related to the recommendations, standards, and draft STANAGs of all groups under SG9; (2) provide both feedback into the STANAG development process and practical experience on the implementation of OSI protocols on military bearer systems; (3) provide reports on the demonstration results and performance to SG9; and (4) based on demonstration results, recommend to SG9 the adoption of promising system concepts for different operational applications. An outline of the work areas being considered for the CSNI statement of work is given in Table 26.

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Table 26. (U) Proposed Work Areas for CSNI in WG3

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1. System Concepts and Testing
  - a. System demonstration architecture
  - b. Testing program
2. Applications and Services
  - a. Database exchange
  - b. Security
  - c. Voice
  - d. Messaging
3. Multinetwork Management and Protocols
  - a. Multimedia routing
  - b. Enhanced OSI protocols
4. Communications Media and Systems
  - a. Long haul HF
  - b. Satellite communications (SATCOM) SHF
  - c. SATCOM UHF
  - d. MIDS and X.25
  - e. Internet
  - f. VHF
  - g. UHF LOS.

Source: *Draft Proposed Terms of Reference for WG3*, TSGCEE SG9 WG3, 22 January 1990, NATO UNCLASSIFIED.

**10.3.4.2 Media-Independent Data Link Architecture**

(MIDLA). (U) MIDLA was suggested to TSGCEE by ADSIA in 1986 [Ref. 258]. During the period 1987-1989, the Nations attempted to identify Nunn Initiative funding for MIDLA, but these efforts were unsuccessful. At the October 1989 SG9 plenary meeting [Ref. 251], the Nations agreed that development of a data link architecture based on the OSI Reference Model to replace antiquated data links was extremely important. However, it was also agreed that resources were not available within SG9 to address the breadth, complexity, and technical aspects of that subject. SG9 agreed to send a letter to TSGCEE stating the importance and magnitude of this project. In addition, the Nations were asked to assess again the availability of resources relative to the MIDLA project.

(U) Some bilateral work between France and the United Kingdom is being discussed regarding future data link architectures. Further, ADSIA has received an STC study, *An Architecture Based on OSI Principles for NATO Tactical Data Links* [Ref. 259], and has indicated to TSGCEE SG9 that no further work on behalf of ADSIA is required for MIDLA [Ref. 260]. However, tactical data link architecture is being addressed by the TSGCEE AHWG on Restructuring as a potential area of work. SG9 has indicated that if the SG9 terms of reference are amended to include tactical links, guidance from the TSGCEE would be required on providing necessary resources [Ref. 256, 261].

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### 10.3.5 Status of Activities and Plans for Developing Network Management Standards

(U) The lead for NATO initiatives on network management is the AHWG-OM, which addresses such pan-layer areas as fault management (detection, isolation, and correction of abnormal operation); configuration management (exercise control over identities and collect data from and provide data to managed objects in order to assist in providing continuous operation of interconnection services); security management (enable the management of the information necessary for providing security services); accounting management (enable charges to be established, and costs to be identified, for the use of managed objects); and performance management (evaluate the behavior of managed objects and the effectiveness of communication activities). Specifically, the AHWG-OM was established to:

- Define the requirements for management in a military OSI environment.
- Investigate the influence of the military features (see Section 10.2) on the OSI management standards under development by ISO. The AHWG-OM has determined that the eight military features will affect, to varying degrees, all management areas.
- Influence ISO, and other standards bodies as appropriate, to adopt any additional military features identified.
- Develop any additional military management standards for the requirements not met by ISO.
- Assist in the coordination of management work within NATO and provide support for OSI management to SG9 and its working and ad hoc groups.

(U) The work of the AHWG-OM has been focused on influencing ISO work; in addition, work has begun on a draft STANAG covering OSI management. Many members of the AHWG-OM are also members of ISO committees, and the AHWG-OM believes its work is recognized by ISO in SC21/WG4 as a major contribution of the development of standards [Ref. 262].

(U) Many of the ISO network standards have been reorganized and now appear to have a stable framework in ISO (see Section 8.2.3). A new set of functions has been developed, and the model of management information has been significantly modified. The Common Management Information Service (CMIS) and Protocol (CMIP) are now International Standards (ISO 9595 and 9596).

(U) The AHWG-OM has noted that little military influence has yet been brought to bear on Security Management, for which work is progressing very slowly in ISO. The responses to a requirements questionnaire distributed in June 1989 indicated

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that almost all network management practices were manual and procedurally oriented and were not relevant to what ISO is trying to standardize in Network Management. However, the results of the questionnaire confirmed the earlier military analysis document in the Working Document *NATO Requirements for OSI Management* (an evolving record/base document of the AHWG on OSI Management results) [Ref. 263]. Enhancements to this document--specifically in Section 7, "Military Features and Their Impact on OSI Management"--arising from the questionnaire were adding the needs (1) for a broadcast facility, (2) for a capability to apply management in real time, (3) to define and work across management domains, (4) to define access control mechanisms for management information, and (5) to provide for survivability of management information (replication mechanisms). Requirements for performance management, event reporting, and management negotiation were dropped [Ref. 264].

(U) In the February 1990 AHWG-OM meeting a formal contribution, addressed from individual nations to ISO, was drafted requesting adoption of Quality of Service (QoS) as a new work item by SC21/WG1, in response to Question Q62 on QoS. If QoS is accepted, the AHWG-OM will need to concentrate on the management-specific aspects of QoS, especially notifications.

(U) The AHWG-OM has a prioritized 21-month work plan [Ref. 262] from June 1990 through February 1992. Work on military features, broadcast, and the out-of-band Telecommunication Management Network (TMN) for ISDN was conducted at the June 1990 meeting. The remaining 1990 meetings will emphasize Quality of Service and Parts 4 (Management) and 5 (Military Features) of Edition 2 of STANAG 4250, as well as a three-volume *Management Guide*<sup>40</sup> to provide guidelines on the definition of NATO-managed objects. For QoS, an input paper will be developed and provided to the Nations for national input to ISO. Drafts of Part 4 to STANAG 4250 and Volume 1, *Introduction and Overview*, of the *Management Guide* was developed and distributed to other working groups in June 1990; these will be revised and forwarded to SG9 in October 1990. These documents will be finalized for ratification at the February 1991 meeting. Volume 2, *Applying OSI Management*, and Volume 3, *Product Procurement and Considerations*, of the *Management Guide* will be finalized by the October 1991 meeting. Updates of the Working Document will continue, with emphasis on changes made to Section 7.

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<sup>40</sup> (U) The full title of the *Management Guide* is *NATO Systems Guidelines for the Use of OSI Management*.

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**10.3.6 AHWG on ISDN**

(U) An AHWG on ISDN was formed by TSGCEE SG9 in 1989 to review the status of ISDN and the applicability of these standards to NATO. The terms of reference are shown in Table 27. An overview of the eight military features was adopted at the April 1990 meeting. The results are given in Table 28 (note that the suitability of the ISDN protocols for use in the tactical domain was agreed to be outside the scope of the meeting) [Ref. 265].

*Table 27. (U) Initial Approach to Military Features for ISDN*

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- (1) Identify the ISDN domains to be standardized to assist the development of consistent ISDN standards within NATO countries and, in addition, to fulfill interoperability requirements and facilitate the development of a NATO Communications Subsystem.
- (2) Identify ISDN civil standards applicable to the systems involved in a NATO Communications Subsystem.
- (3) Review the capability of ISDN to support relevant military features, interworking requirements from tactical users/networks, and other NATO user service requirements.
- (4) Consider specifying enhancements to ISDN civil standards to meet a minimum military requirement.
- (5) Determine the impact of ISDN on the NTIS defined by SG9 in accordance with the NATO Reference Model, for example, the NTIS on network management and security.
- (6) Submit technical papers to SG9 for candidate profiles and/or STANAGs.
- (7) Submit a report to SG9 at each meeting.

Source: *Terms of Reference for TSGCEE SG9 AHWG on ISDN*, NATO UNCLASSIFIED.



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Table 28. (U) Military Features for ISDN

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- (1) Mobile Hosts and Multihomed Systems. A number of scenarios are being discussed, some outside the ISDN domain (e.g., in the tactical area) and some within the strategic ISDN domain (e.g., as user moving from one PABX to another). Only strategic ISDN domain issues are currently being addressed in the AHWG on ISDN. It was agreed that ISDN Suspend/Resume procedures for moving during a call were not applicable to mobile hosts. Some form of slow mobility is required where a user may, for example, move between extensions on the same access switch or even to a different access switch and still maintain the same user identity. This would require a type of registration and cancellation procedure where a user takes the user identity around a fixed network. Specific NATO procedures may be required to realize this feature--further study is required. Procedures associated with the cellular radio service are issues mainly applicable to the tactical domain.
- (2) Multi-Endpoint Connections. Information needs to be multicast (or broadcast) to several destinations. A central issue is whether a unidirectional service was required for this feature:
  - (a) If the requirement were defined in terms of a conference call (bidirectional), then commercial products are expected to be available.
  - (b) If broadcast facilities were provided at the Application Layer using packet procedures, no specific NATO procedures are required.
  - (c) If broadcasting were required on all bearer services (e.g., voice and data), then the AHWG on ISDN should wait for CCITT/ETSI to define this feature.It was generally agreed that the multi-endpoint feature is for data application rather than voice; further study is required on the requirement for voice.
- (3) Internetworking. The *NATO C3 Architecture* (Volume 4, *Communications Subsystem*) allows both the "T" reference point and the K, M, and N reference points as possibilities for internetworking. If the "T" reference point were chosen, then a number of enhancements would be required for NATO, such as satellite and routing indicators.
- (4) Network and System Management. CCITT is defining a network management structure in both the user-network area (Q.940) and within the network. This work is at the architectural level and has not resulted in a definition of detailed procedures. Of particular interest to SG9 are the management functions of Section 3 of Q.940 for fault, configuration, accounting, performance, and security management--all aligned with OSI management functions. In addition, management reference models have been defined.
- (5) Security. Key issues are the applicability of NOSA to ISDN (for data services), the impact of ISDN on NOSA (e.g., security of voice services, protection of signalling channels), and the definition of new security features using ISDN capabilities (e.g., common channel signalling). The first two issues are for the AHWG on Security. The AHWG on ISDN will propose ISDN security features relevant to the third issue (e.g., supplementary services) for approval by security experts of SG9.
- (6) Robustness and Quality of Service. The only possible special NATO requirement identified is the QoS parameter, should the ISDN network performance figures given in I.350 not prove to be adequate for military applications.
- (7) Precedence and Preemption. This feature is already being addressed (service definition and information).
- (8) Real-Time and Tactical Communications. No special real-time requirements are foreseen for ISDN. Note that the discussion was limited to interworking with a tactical network and to the concept of a strategic ISDN activity either as a transit network or to gain access to an ISDN user.

Note: The suitability of the ISDN protocols for use in the tactical domain was agreed to be outside the scope of the assessment leading to these requirements.

Source: *Report of the 2nd Ad Hoc Meeting on ISDN, Paris, 24-26 April 1990*, TSGCEE SG9 AHWG on ISDN, May 1990, NATO UNCLASSIFIED.

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(U) The AHWG on ISDN is discussing the ISDN Reference Model and has considered papers from France (based on the CCITT Reference Model and the *NATO C3 Architecture*), ETSI, and ECMA. These models describe network-to-network interworking, including CCITT No. 7 and QSIG (an extension of Q.931) protocols.

(U) Discussion of essential bearer services for ISDNs used for NATO communications resulted in a two-page recommendation for the Network Bearer Services [viz., 64-kbps circuit switched (CS) unrestricted as in I.231.1, CS speech as in I.231.2, CS 3.1 kHz audio as in I.231.3, CS access to packet switching node as in I.231.1, B-channel packet switched access as in I.232.1, and D-channel packet switched access on the Basic Rate Interface as in I.232.1] and the Terminal Bearer Services. Further study has been recommended for Frame Relay (I.122), Frame Switching (I.122), user-to-user signalling (I.232.3), 7 kHz audio, 2x64 kbps unrestricted, H0--384 kbps unrestricted, H11--1536 kbps unrestricted, and H12--1920 kbps unrestricted.

(U) One proposal (submitted by the US) suggests the following as the basis for a draft STANAG on ISDN for packet mode services [Ref. 266]:

- Networks shall support a packet-switching capacity in conformance with the 1988 CCITT recommendation on packet-switched data, X.31/I.462, *Support of Packet Mode Terminal Equipment by an ISDN*. At the user interface for the Basic Rate Interface, both B channel and D channel packet switching will be supported. At the Primary Rate Interface, B channel packet switching will be supported. Terminals that support X.25-based packet switching will also conform to X.31.
- Conditional notification shall be supported on switched access connections. On permanent virtual circuits, the option of "no notification" shall be available.

(U) The issues identified in Table 29 have been recommended to be the focus of future efforts in the AHWG on ISDN (but have not been adopted) [Ref. 267].

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*Table 29. (U) Initial Draft Proposed Work Plan and Activities on ISDN*

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- (1) Work on progressing the layer integration of the OSI Transport Service with the ISDN Digital Access Signalling System
- (2) Develop and provide directory capabilities for resource identification and selection, to include an Application Title Directory and a Network Address Directory, based on ISO 9594 (CCITT X.500)
- (3) Add naming and addressing issues with respect to ISDN to the SG9 working group pursuing these issues
- (4) Adopt the CCITT Common Channel Signalling System No. 7 (SS7) internationally
- (5) Study further tactical communications support by ISDN, with special attention to interconnection with digital radio and cellular networks and to the requirements for maintaining radio silence (e.g., unacknowledged data transfer)
- (6) Address (in the appropriate SG9 working groups) security and system management services as they pertain to ISDN and the coordination of ISDN and OSI Registration Authority issues
- (7) Accelerate the cooperation between ISDN and OSI standardization and planning efforts
- (8) Address the capabilities of B-ISDN to meet the minimum military requirement and consider viewing B-ISDN as the focus for future telecommunications services
- (9) Resolve the issue of interconnecting TCS "black boxes" to ISDN (TCS interfacing to ISDN needs further study)
- (10) Pursue the resolution of ISDN and OSI harmonization in NATO through direct involvement in established working groups within each individual nation, making these groups aware of NATO needs to promote military requirements.

Source: *ISDN/OSI Integration: Issues, Trends, and Recommendations*, Contribution from Canada to the Initial Meeting of the AHWG on ISDN, January 1990, NATO UNCLASSIFIED.

### **10.3.7 AHWG on Security**

(U) The AHWG on Security has developed three major references for use in SG9: *NATO OSI Security Architecture (NOSA)* [Ref. 110], *Security Architecture for NATO Information Systems Interconnection (SANISI)* [Ref. 111], and the *NATO Network Security Information Classification Guide* [Ref. 122]. NOSA was developed to give guidance to contractors and procurement managers on the preferred placement of security services within OSI-conformant systems. SANISI provides detailed rationale on the placement of security services and mechanisms within the OSI Reference Model. A key element of SANISI is the requirement in Layer 3 for a Trusted Communications Sublayer (TCS). NOSA and SANISI do not identify a requirement for security protocols for Layer 4.

(U) Two security protocols (SP3 and SP4) have been introduced into ANSI from the US Secure Data Network System (SDNS) [Ref. 251]. SP4 has been accepted as a work item in SC6/WG4 in ISO, and SP3 is expected to be accepted when some additional work on SP3 is completed in 1990. SP3 is the protocol most closely aligned with TCS. Since the distribution of NOSA and SANISI, the AHWG on Security has been addressing questions regarding the security protocols that have been introduced

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for Layer 3, including SP3, Northern Telecom's SPX, and the UK's End-to-End Security Protocol (EESP). SP3 was judged as equivalent to the end-to-end encryption portion of the TCS. SPX adds connection-oriented service to SP3. The EESP adds CO services to SP3 and includes integrity and traffic padding.<sup>41</sup> The AHWG on Security anticipates that SG9 should be able to arrive at a Layer 3 protocol that will satisfy NATO military requirements [Ref. 268].

(U) Discussion of SANISI has included proposed annexes on application and implementation aspects of the TCS and the Denial of Service definition. Agreement has been reached that once an event object is defined, the recovery mechanisms are the same whether the cause was malicious or accidental and so is a management issue. A review is to be conducted of the SANISI annexes to determine if these can be downgraded to NATO UNCLASSIFIED and be permitted to be used as technical input to ISO.

(U) The AHWG on Security is reviewing and maturing concepts of an ISDN security architecture. The AHWG has noted that the *NATO C3 Architecture* (see Section 11.1) underlines the importance of becoming aware of the security problems associated with an architecture that combines circuit switching with packet switching handling real-time voice and high-bandwidth data. A paper has been developed on security management; it will be condensed and included as Annex D in the NOSA document.

(U) The AHWG has expressed strong support for the WG3 program to demonstrate the proof of concept of the security protocols and architecture. The AHWG on Security has noted concerns that have been expressed that SDNS SP4 is not a suitable candidate from a NOSA point of view, as NOSA does not identify a requirement for security services in the Transport Layer. A recommendation was drafted that WG3 consider the concept of a TCS as in NOSA and SANISI. The TCS services definitions and protocol specification are not yet complete, but will be sufficient to provide the required security services within the next 12 months.

(U) The AHWG on Security held a meeting of security experts in June 1990 to discuss the TCS service definition and protocol specification. Progress was made on providing the additional technical work required for a detailed design specification for the TCS. This specification will be provided to the SG9 WGs for consideration and, in the case of WG3, possible implementation.

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<sup>41</sup> (U) EESP was introduced into SC21/WG1 during the May 1990 meeting in Seoul. EESP has been proposed to the JTC1 as a new work item.

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(U) The current 18-month work plan, shown in Table 30, has been focused to allow the AHWG to concentrate on the aspects of the security problem most visible in ISO, namely the Layer 3/Layer 4 security protocol. The AHWG believes that it is in this area where it has the greatest expertise and the best possibility of influencing ISO to adopt a standard suitable for NATO. The goal would be host protection, in addition to link protection. The next step will be application protection.

*Table 30. (U) Work Plan for AHWG on Security*

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| <ol style="list-style-type: none"><li>(1) Prepare glossary of terms</li><li>(2) Consider registration authority issue</li><li>(3) Review ISO activities on security</li><li>(4) Analyse relation of ISDN and TCS</li><li>(5) Review TCS Service and Protocol documents</li><li>(6) Prepare TCS issues document for meeting of experts</li><li>(7) Provide comments on NATO C3 Architecture</li><li>(8) Edit and review classification of NOSA and SANISI texts</li><li>(9) Update document on Security Management managed objects</li><li>(10) Review upper layer security issues</li><li>(11) Develop rationale for TCS placement</li></ol> |
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Source: *Agenda for 10-13 September 1990 Meeting of AHWG on Security*, 24 May 1990, NATO UNCLASSIFIED.

**10.3.8 Status of Activities and Plans for Developing the Military Message Handling System (MMHS) for NATO**

(U) During the last 3 years, an AHWG on MMHS, reporting to TSGCEE SG9 WG2, has been working to have features required by the military incorporated into the MHS defined by international standards bodies. The initial proposals, based on X.400-MHS(84), for an MMHS have been accepted as an Intercept Profile by SG9; it addressed security, confidentiality, integrity, authentication, message stores with access protocols, and directory services. Most of these features have now been incorporated in CCITT X.400-MHS(88). Known as the "Blue Book," MHS(88) was ratified in November 1988.

(U) MMHS will be addressed in a separate Application Layer standard, STANAG 4257; the first working draft of this STANAG was provided to WG2 in February 1990. STANAG 4257 will incorporate four elements that are being developed simultaneously by the AHWG on MMHS: Base Standard [Ref. 269], Rationale [Ref. 270], an Alpha Profile, and a Beta Profile. The Alpha profile is intended to address

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strategic and tactical applications where bandwidth limitations are not severe, and the Beta Profile is intended to address tactical applications where bandwidth is severely limited. For the Beta profile, the AHWG on MMHS assumes that bandwidth will be conserved by eliminating all but the most vital services of MHS. These profiles are being written as a "delta" or change to the MHS profile being developed by the European Workshop for Open Systems (EWOS) [Ref. 271]. Each MMHS profile will be included in STANAG 4257 as a separately ratifiable annex [Ref. 272].

(U) The AHWG-MMHS work has been separated into two sets of functional groups. The first set consist of military messaging services, notification, security, redirection, distribution lists, conversion, ACP 127, and MMHS(84) gateways. The second set will provide directories, message store, physical delivery, management, routing, local services, and PICS. The first draft of the MMHS(88) STANAG [Ref. 269] released in February 1990 addresses the first set of functional groups.

(U) One of the key issues for MMHS is the need for NATO-wide consistency and uniqueness of names and addresses to be in conformance with international standards. WG2 made the following recommendations developed by the AHWG-MMHS to SG9 in May 1990 [Ref. 273]:

- Register NATO as a country name with ISO. If this is not acceptable to ISO/CCITT, then NATO should be registered as an Administrative Management Domain within one country (e.g., Belgium).
- Obtain a number for NATO as an Identified Organization in the object identifier structure detailed in ISO 9834.
- Establish a NATO registration authority to register the addresses of end users within NATO management domains (both domain names and the domain-specific part), to register Application process names and Presentation addresses, and also to manage the allocation of numerical subscripts to objects.

In June 1990 the AHWG on MMHS reviewed these recommendations in light of additional information provided by STC. MMHS has now withdrawn the above recommendations and plans to study the requirements and alternatives in detail at the October 1990 meeting.

(U) The *Intercept Profile for MMHS*, based on MHS(84), has been amended (Issue 2) to include full support for ACP 127 [Ref. 274]. It was completed in February 1990 and is ready for distribution by SG9. Issue 2 has a new annex (Annex C) on implementation options for the military header extensions. Issue 1 of the profile was accepted as an intercept strategy for the 1989 (Fifth) edition of the *NTIS Transition Strategy* [Ref. 4]; however, depending on choices of interoperability parameters, MMHS

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implementations based on MHS(88) may not be backwards compatible with MHS(84) implementations (see Section 4.3.2.3).

(U) One area of MMHS not addressed by MHS(88) is support for trusted functionality. Such support may be covered by standards developed by the SDNS security protocols SP3 and SP4 to carry out services associated with trusted functionality. The May 1989 meeting of the AHWG-MMHS was devoted to security and succeeded in developing two functional groups of security services. One of these does not require use of asymmetric encipherment mechanisms, but precludes direct support of nonrepudiation services. These have both been accepted by EWOS. The AHWG-MMHS is seeking guidance from the AHWG on Security to identify suitable encipherment mechanisms to support these services [Ref. 275]. The AHWG on Security confirms the need for asymmetric cryptographic mechanisms and indicates that such mechanisms must be offered by the Nations for consideration and approval by the appropriate NATO authorities [Ref. 276].

(U) A number of MMHS-related issues are identified in the WG2 12-month work plan. These include editing and publishing the MMHS(88) Base Standard, Alpha Profile, Beta Profile, Rationale, overview statement (planned for September 1990), and statements of requirements for registration, security, management, and directory; specifying conformance requirements (postponed until 1991); specifying implementation guidelines for MMHS and for Directory support of messaging domains including MMHS and ACP (commencing June 1990); defining military extensions and methods for distribution lists; developing an evolutionary strategy; developing an MMHS(88) profile; developing MMHS management issues and requirements to be forwarded to AHWG on OSI Management (February 1991); defining the role of a Message Store in support of mobile hosts, plus extensions of civilian services to access the Message Store (June 90); defining MMHS naming conventions for upper layer OSI information objects such as application processes, abstract systems, transfer syntaxes, and application contexts; and developing a security model, security profile, and T-profile.

(U) Table 31 provides a statement and status summary of the work areas for MMHS being addressed in the 12-month work plan of the AHWG on MMHS for the period March 1990 to February 1991 (order of entries is alphabetical) [Ref. 277].

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Table 31. (U) Work Plan and Activities on MMHS

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- (1) Applications. Develop a guide to applications supported by MMHS. No activity to date.
- (2) Base STANAG (MMHS(88)). Develop an MMHS STANAG based on CCITT X.400-1988, with extensions to meet military requirements. Activity commenced in January 1989 and is expected to be released to the Nations for comment after the June 1991 AHWG-MMHS meeting. The complete STANAG will be written as a "delta" document to the EWOS MHS profile. This means that instead of specifying the complete standard, it will only specify the changes to the EWOS document. It will consist of a Base Standard (which describes all the Elements of Service, rationale, default values, etc.), an Alpha profile for use in normal circumstances, and a Beta profile (which will exclude all but the essential services for message passing) for use in an environment of restricted bandwidth.
- (3) Conformance Requirements. Specify conformance requirements and testing procedures for MMHS products and implementation. Postponed pending completion of the first draft MMHS base STANAG.
- (4) Directory Guidelines. Specify implementation guidelines for Directory support of messaging domains, including MMHS and ACP 127. Begun June 1990.
- (5) Distribution Lists. Define military extensions and methods for Distribution Lists. Main issues have been identified and documented in the working drafts of the base standard and profile.
- (6) Evolution Strategy. Develop a full plan for specifying time frames for interconnecting MMHS, ACP 127, and civilian MHS domains and for including MMHS(88) features. Commenced January 1989, but no activity since.
- (7) Implementation Guidelines. Develop implementation guidelines for MMHS based on MMHS operating procedures; include gateway issues. Discussion but no report to date. (Target for draft document was February 1990.)
- (8) Local Services. Develop guidelines for common local services. Started work in June 1990; draft planned for September 1990.
- (9) Management Issues. Develop MMHS requirements to be forwarded to the AHWG-OM. Started work in June 1990; draft planned for September 1990. Target publication date is February 1991.
- (10) Mapping to Eight Military Features. Map the MMHS requirements to the eight military features. One contribution has been made; further work is pending resolution of the features themselves.
- (11) Message Store. Define role of the Message Store in support of mobile hosts, plus extensions of civilian services to access the Message Store. Started work in June 1990; draft planned for September 1990.
- (12) MMHS Intercept Profile ('84). Maintain an interoperability profile based on MHS(84) for use until the MMHS STANAG is mature. Version 2 was completed in February 1990 and provided to SG9 for publication. It is expected to appear in the next (Sixth) edition of the *NTIS Transition Strategy*.
- (13) Naming and Registration. Define MMHS naming conventions for upper layer OSI information objects such as application processes, abstract syntaxes, transfer syntaxes, and application contexts. Establish registration authority (or authorities) and define registration procedures for names requiring registration. Deferred to SG9 for direction; recommendations forwarded by WG2 to SG9.
- (14) Physical Delivery. Scope and produce guidelines for physical delivery. No activity to date.
- (15) Routing. Define algorithms and constraints. Started work in June 1990; draft planned for September 1990.
- (16) Security Model. Define a general architectural model for MMHS security services and mechanisms. List of outstanding issues created. Security parts of profile identified.
- (17) Security Profile. Develop an MMHS security profile based on MHS(88) security services, plus additional algorithms, support systems, and procedures. Document underdevelopment based on EWOS profile A/3311 plus additional issues. Draft base STANAG [Ref. 269] and profile produced. Guidance of Nations sought on acceptability of security mechanisms.

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Table 31. (U) (Continued)

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- |   |
|---|
| (18) <u>T-Profile</u> . Define a Transport Layer implementation profile for MMHS. Deferred to WG2.  |
| (19) <u>Testing Issues</u> . Identify testing requirements and develop conformance and interoperability tests. Deferred to SG9 for direction.   |
| (20) <u>Transition Guidelines</u> . Define transition strategy from intercept interoperability profile to final MMHS STANAG and functional profiles. Draft MMHS over paper produced that includes migration of ACP 127 and MHS to MMHS. |
| (21) <u>User Requirements</u> . Define user requirements to be met by MMHS functional and interoperability profiles. National inputs received from questionnaire in January 1989. No other activity planned.                            |

Source: MMHS AHWG Input to NATO TSGCEE SG9 WG2--12-Month Work Plan, TSGCEE SG9 WG2 AHWG on MMHS, February 1990, NATO UNCLASSIFIED.

#### 10.4 Status of NATO OSI STANAGs

(U) Table 32 identifies the STANAGs being developed that will specify ISO standards and applicable military options and extensions, if any. Work has begun on all these STANAGs, but only the NATO Reference Model, STANAG 4250, has been ratified. Originally, TSGCEE SG9 planned to issue a single STANAG for all services and a second STANAG for all protocols at each layer, giving a total of 14 STANAGs in addition to STANAG 4250, the NATO Reference Model. In October 1987, TSGCEE SG9 agreed [Ref. 238, Annex 1.2] to work at the Application Layer for single STANAGs for each Application Layer service, such as MMHS (STANAG 4257). Protocol specifications as well as service definitions would be addressed in that STANAG. This approach will require editorial changes in STANAG 4250.

(U) When stacks of standards, options, and interoperability parameters that involve more than one OSI layer are selected for open systems interconnection for NATO data processing and distribution systems, the agreements will be specified in documents that are to be known as functional profiles. NATO functional profiles, initially to be drafted by TSGCEE SG9, will be based on the OSI STANAGs 4250-4259 and 4261-4266. To date, the functional profiles promulgated by TSGCEE SG9 are contained in the *NTIS Transition Strategy* and are all based on commercial international OSI standards and the OSI STANAGs. These profiles (application, transfer, and relay) are identified in Tables 2, 3, and 4 of Section 4.3.1 and illustrated in Appendix B.

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*Table 32. (U) NATO OSI Standards*

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| OSI Layer       | Service Definitions          |  | Protocol Specifications |                 |
|-----------------|------------------------------|--|-------------------------|-----------------|
|                 | STANAG                       | Draft Published                                  | STANAG                  | Draft Published |
| Reference Model | 4250 Ed 1<br>4250 Ed 2 Prt 1 | Apr 86 (Ratified)<br>May 90 (Draft) <sup>a</sup> | -                       | -               |
| 1               | 4251                         | 13 Jul 90  | 4261                    | 6 Jul 90        |
| 2               | 4252                         | Jul 90   | 4262                    | Jul 90          |
| 3               | 4253                         | Jul 90   | 4263                    | Jul 90          |
| 4               | 4254                         | Jul 90   | 4264                    | Jul 90          |
| 5               | 4255                         | 12 April 90                                      | 4265                    | 12 April 90     |
| 6               | 4256                         | 19 Jan 90  | 4266                    | 19 Jan 90       |
|                 | 4258 (ASN.1)                 | 15 Jan 90  | 4259 (ASN.1 BER)        | 19 Jan 90       |
| 7               | 4257(MMHS) <sup>b</sup>      | 16 Feb 90  | 4257(MMHS) <sup>c</sup> | 16 Feb 90       |

<sup>a</sup>The May 1990 draft of STANAG 4250 is being circulated to the Nations for ratification.

<sup>b</sup>Multiple STANAGs are planned for Layer 7; STANAG 4257 will address MMHS.

<sup>c</sup>For Layer 7 there will be a single STANAG for each pair of related Application Layer Service Definitions and Protocol Specifications.

(U) STANAG 4250, *NATO Reference Model for Open Systems Interconnection*, is being revised and the new draft developed in the May 1990 TSGCEE SG9 plenary meeting is being circulated to the Nations. The new STANAG will be in five parts, only the first of which is ready for ratification. The first four parts conform to the current structure of the OSI Basic Reference Model, ISO 7498.

- Part 1--*General Description*
- Part 2--*Security*
- Part 3--*Naming and Addressing*
- Part 4--*Management*
- Part 5--*Military Features*.

Two additional parts (*NATO Functional Profile Guidelines* and *Conformance Testing*) were separated from STANAG 4250 and will be drafted and ratified separately. In May 1990, SG9 agreed to reissue Edition 2 of STANAG 4250 as described above without going through a formal ratification process [Ref. 256]. Thus, STANAG 4250 has been forwarded to the TSGCEE for promulgation.

(U) During its meetings in February 1989, TSGCEE SG9 WG2 addressed the impact of the eight military features on the Session and Presentation Layers, especially for

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security, quality of service, and multipeer data transmission. WG2 determined that for both the Session and Presentation Layers there are no military features that have been defined, that are needed in the near term, and that are not supported by the OSI standards. WG2 has therefore forwarded the draft STANAGs for the Session and Presentation Layer (STANAGs 4255, 4256, 4265, and 4266) and ASN.1 (STANAGs 4258 and 4259) to TSGCEE SG9 for ratification; TSGCEE SG9 decided in March 1989 to distribute these drafts to the nations to begin the ratification process. These drafts were modified by WG2 in February 1990 and provided to SG9 in May 1990. SG9 identified a number of editorial problems with the draft STANAGs, requested these be addressed by WG2, and asked for revised drafts at the December 1990 SG9 plenary meeting.

(U) The remaining paragraphs in this section summarize the scope of the current drafts of these STANAGs. The STANAGs are discussed layer by layer beginning with Layer 1, the Physical Layer. The discussion emphasizes the portions of the STANAGs addressing deficiencies and enhancements for the military features.

### 10.4.1 Physical Layer STANAGs

(U) Draft STANAG 4251 (July 1990) identifies for the Physical Layer all eight areas for potential military enhancements and summarizes the services provided by and the deficiencies of current civil standards. All but three of the areas are identified as "not envisioned to affect the Physical Layer." The three areas in which enhancements are expected are:

- Network/system management functions. ISO 9595 (*Management Information Service Definition*) is cited for relevance, but military enhancements to those standards are left for further study (the July 1990 draft cites several parts to ISO 9595 that were dropped by ISO in 1989 when DIS 9595-2 was adopted as ISO 9595).
- Security. ISO 9595-7 (*Management Information Service Definition--Part 7: Security Management Service Definition*) is cited for relevance, but military enhancements are left for further study, to be provided as Annex B.
- Robustness and quality of service. ISO 9595-6 (*Management Information Service Definition--Part 6: Performance Management Service Definition*) is cited for relevance, but military enhancements are left for further study.

(U) Draft STANAG 4261 (July 1990) also identifies for the Physical Layer all eight areas for military enhancements, summarizes the protocols provided by and the deficiencies of current civil standards, but leaves specific military enhancements for further study. All but three of the areas are identified as "not envisioned to affect the

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Physical Layer." The three areas in which enhancements are expected are the same as for STANAG 4251:

- Network/system management functions. ISO 9596 (*Management Information Protocol Specification*) is cited for relevance, but military enhancements are left for further study in Annex H (the July 1990 draft cites several parts to ISO 9596 that were dropped in 1989 by ISO when DIS 9596-2 was adopted as ISO 9596). The following statements are cited in Annex H as military "enhancements to CCITT Physical Layer protocols":
  - (1) Unbalanced and balanced interchange circuits for use on general telephone systems in the tactical, sustaining base, and long-haul environments monitoring circuit fault conditions shall do so as indicated in V.24.
  - (2) Data interchange circuits in the tactical, sustaining base, and long-haul environments monitoring circuit fault conditions shall do so as indicated in X.24.
  - (3) In the tactical and sustaining base environment, all unbalanced interchange circuits shall detect circuit failure and interpret a fault condition as a type 3 circuit on which the receiver or load provides a special indication as stated in V.10. This is to be implemented as a service provided by the Physical Layer management entity and sent to the fault management application entity as a system management data unit.
- Security. ISO 9595-7 (*Management Information Protocol Specification--Part 7: Security Management Protocol Specification*) is cited for relevance, but military enhancements are left for further study, to be provided as Annex B.
- Robustness and quality of service. ISO 9595-6 (*Management Information Protocol Specification-Part 6: Performance Management Protocol Specification*) is cited for relevance, but military enhancements are left for further study in Annex H.

(U) Requirements for Mechanical Aspects (Annex D) are provided by STANAG 4261 in the areas of connectors, pin outs, cabling, and shielding and dielectric. Requirements for Functional Aspects are provided for data and control (timing and grounds are left for further study). Requirements for Electrical Aspects are provided for interchange circuits and cabling. Requirements for Procedural Aspects are provided in connection establishment (connection completion, connection maintenance, and data transfer are left for further study). Requirements for fault management, configuration management, performance management, and security management are briefly discussed under Management Aspects. Annex I will address military requirements for the X.21 "permanent" protocol and Annex J will address the tactical "K" protocol.

### 10.4.2 Data Link Layer STANAGs

(U) STANAG 4252 will address, as does ISO 8886 upon which it is based, both CO and CL modes of service. None of the security aspects (Annex B) have

## UNCLASSIFIED

yet been identified for the Data Link Layer. STANAG 4252 identifies deficiencies only in one of the eight areas for enhancements:

- Network/system management. The definition of the Data Link Management Objects and their manipulation are not covered in the existing ISO standards, but are the subjects of on-going work and are expected to be completed in the near future. After completion it will be verified if military enhancements are requisite. Data Link Management Objects are required for DIS 10164, DIS 10165, and ISO 9595.

(U) The current draft STANAG 4262 indicates that "no need for enhancement was identified" for all but one of the eight areas of potential military features. The remaining area is addressed as follows, without specifying the protocols needing enhancement:

- Network/system management. Enhancements are needed, but these may be provided as a result of the on-going ISO standardization work. If this is not the case, further work would be needed to provide the missing military enhancements. Note: The specification of Data Link Layer Management Objects is the subject of the work item JTC 1.06.04 in ISO.

(U) Annex D of the current draft STANAG 4262 addresses the Balanced Link Access Procedure B (LAP B), based on ISO 7776 and provides for the CO-mode data link service used by packet level protocols (PLPs) such as CCITT X.25 PLP and ISO 8208. Annex E addresses LAP D based CCITT I.440 and I.441. Annex F addresses the Logical Link Control (LLC) and the Media Access Control (MAC) protocols, based on ISO 8802-2 (LLC), 8802-3 (CSMA/CD LAN), 8802-4 (Token Bus LAN), and 8802-5 (Token Ring LAN). The LLC, when used with the appropriate MAC data link sublayer protocol, provides CO and CL-oriented data link service in a LAN environment. Annex G addresses the data link protocol Balanced Class of Procedures (BAC) based on the HDLC standards ISO 7809, 4335, 3309, and 8885 and provides CO- and CL-mode services. Options explicitly include Exchange Identification (XID), UI frames for CL-mode data transfer, selective reject, extended sequence numbering, test, and extended frame check sequence capability (32-bit frame check sequence).

### 10.4.3 Network Layer STANAGs

(U) STANAG 4253 is based on ISO 8348 (*Network Service Definition*), including the three addenda, and thus provides for both connection-mode and connectionless data transmission. The Security Annex is classified; as provided in the NOSA document (see Section 8.1.3.2), it addresses services such as peer entity authentication, data origin authentication, access control, connection confidentiality,

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connectionless confidentiality, traffic flow confidentiality, connection integrity without recovery, and connectionless integrity. STANAG 4253 addresses the areas of deficiencies of the civil standards shown in Table 33 for providing military feature enhancements.

Table 33. (U) Areas of Deficiencies for STANAG 4253

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- (1) **Multihoming.** In the interest of survivability, an end system, identified by a single "logical" network address, may need to be connected at several Subnetwork Points of Attachment (SNPAs) either with more than one link into the same subnetwork or with links into several subnetworks. Routing management functions will be needed in order to determine the SNPA to be used; enhancements for routing management (if any) are for further study.
- (2) **Mobile Hosts.** This requirement is for end systems identified by a single logical address to be able to connect to different SNPAs, although only one connection may be in use at any one time. In this case it may not be possible to determine in advance which subnetwork links will be involved in establishing connections associated with a particular subscriber address. The Network Layer addressing is extended in this STANAG to support logical network addresses that may identify more than one NSAP. Enhancements for routing management (if any) are for further study.
- (3) **Multiaddressing.** To economize on network bandwidth and increase speed of delivery, an application that involves sending the same data to a number of destinations will require a multi-addressing service (multipeer data transmission) within the Network Layer, which provides either selective addressing or broadcast facilities. The Network Layer addressing is extended in this STANAG to support multicast addresses that may identify more than one NSAP. Enhancements for multipeer data transmission are for further study.
- (4) **Management.** Additional management facilities may be required to support the other military enhancements. Military enhancements of the ISO Network Layer management objects are for further study.
- (5) **Security.** The ability is required to signal the security label of each network connection and each connectionless service data unit. The security classification will remain constant throughout the life of a connection. The security label for a network connection or a connectionless service data unit may be signalled as a protection QoS parameter.
- (6) **Robustness.** The ability to survive physical damage and denial of service attacks and to route around damaged or partitioned networks is required for military systems. Military enhancements to Network Layer management functions for robustness are for further study.
- (7) **Precedence and Preemption.** No requirement for military enhancement has been identified beyond the priority QoS parameter defined in ISO 8348.
- (8) **Real-Time Communications.** Enhancements for real-time communications are for further study.

Source: Draft STANAG 4253, July 1990, NATO UNCLASSIFIED.

(U) Annex D to STANAG 4253 discusses the two types of addresses used in the Network Layer: (1) subnetwork addresses, which identify a point of attachment to a subnetwork (e.g., an X.25 network) and (2) network address, which is (ISO 7498-3) a name, unambiguous within the OSI environment, that is used to identify a set of NSAPs. An NSAP-address is a network address that is used to identify a single NSAP. The subnetwork address must be derivable from the network address, either directly using a field of the network address or indirectly using table lookup/directory service functions. An NSAP may have two or more NSAP-addresses, such as where a

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system performs two roles (e.g., National and NATO) or where a system is multihomed. Annex D provides technical detail on:

- Addressing schemes, including the Initial Domain Part (IDP) and the Domain Specific Part (DSP) of an NSAP-address, the Authority and Format Identifier (AFI) and Initial Domain Identifier (IDI) that make up the IDP, and the four basic schemes recognized by ISO 8348/AD2.
  - (1) CCITT numbering schemes for public networks--the IDI is X.121 for packet switched networks, F.69 for Telex, E.163 for circuit switched networks, or E.165 for ISDNs.
  - (2) Schemes with an address allocated under a national registration authority, in which the IDI is an ISO Data Country Code (DCC) according to ISO 3166.
  - (3) Schemes with an address allocated under an international registration authority, in which the IDI is an ISO International Code Designator (ICD) allocated according to ISO 6523.
  - (4) Local schemes that would only be recognizable amongst a restricted network of systems.
- The NATO-ICD scheme, in which NATO, as an international authority, allocates addresses. The AFI is 46 for ICD decimal addresses and 47 for binary addresses. Currently there is one NATO addressing sub-schema defined, the scheme "X" that uses AFI=46 and NATO Format Identifier=10. This scheme is for use with decimal coded addresses using NATO domain identifiers allocated under STANAG 4214.
- Multicast addressing, which can be used in the Network Layer to identify a set of NSAPs. Multicast addresses are defined as extensions to the network addressing scheme and so can operate only between NSAPs supporting the same scheme. Multicast addressing across national boundaries is not supported by the DCC scheme.

(U) STANAG 4263 provides for three types of CO-mode Network Layer protocols: (1) DTE-to-DTE, based on the 2nd Edition of ISO 8208 (*X.25 Packet Level Protocol for DTE*, 1990); (2) DTE-to-DCE, based on ISO 8878 (*Use of X.25 to Provide the OSI CO Network Service*) and the 2nd Edition of ISO 8208 for end systems and on CCITT X.25(1988), Sections 3, 4, 5, 6, 7, and Annexes A-I, for subnetworks; and (3) STE-STE, based on the X.75 Packet Level Protocol (Sections 3 through 5 and Annexes A through E) for the interconnection of two packet-switched data networks. These all provide the connection-oriented network service (CONS). The use of the X.25 PLP to provide the CONS over an ISO 8802 LAN is not currently addressed in STANAG 4263.

(U) Annex B on security for STANAG 4263 has yet to be produced (as of July 1990), but will address--as provided in the NOSA document (see Section 8.1.3.2)--services such as peer entity authentication, data origin authentication,

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access control, connection confidentiality, connectionless confidentiality, traffic flow confidentiality, connection integrity without recovery, and connectionless integrity.

(U) No military enhancements are specified in STANAG 4263 Annex D for the DTE-DTE CONS. The required military enhancements for DTE-DCE CONS (Annex C) are given in Table 34.

*Table 34. (U) Military Enhancements Identified for Annex C of STANAG 4263*

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- (1) **Security.** The use of the network service Protection Quality of Service parameter to associate a security level with a network connection is for further study.
- (2) **Precedence and preemption.** The priority of a network connection shall be indicated, when appropriate, by means of the network service Priority Quality of Service parameter. This parameter is mapped in this protocol to the Priority CCITT-specified DTE facility as defined in ISO 8878 DAD1. The use of this facility is optional in this STANAG, but may be enforced by specific profiles. Absence of the Priority facility from any of the packet types in which it may appear shall be interpreted as indicating the lowest defined priority level, and Priority-aware implementations shall act accordingly. The Priority facility shall be transmitted unchanged between the two network service users; however, this STANAG extends the specification of X.25(1988) in the following way: a subnetwork may inspect the Priority facility in order to record the priority of a connection and may use this information to preempt a lower priority connection under certain (subnetwork-dependent) conditions. In this case, the subnetwork shall clear the connection, with cause "DCE originated" and reason "QoS not available--transient condition," with the result that both network service users receive an N-Disconnect indication with originator "NS provider" and reason "Connection rejection--QoS not available/transient condition." Priority values are integers in the range 0 to 14, with 255 meaning "unspecified."
- (3) **Multihoming.** Multihoming may be achieved through the X.25 Hunt Group optional user facility, provided the SNPAs corresponding to the various "homes" can be defined as members of an X.25(1988) Hunt Group. The use of the Hunt Group facility for multihoming is transparent to the OSI network service user. Three types of Network Layer management facilities are specified in the STANAG to support the use of a Hunt Group: configuration, multihoming subscription options, and multihoming registration.

Source: *Draft STANAG 4263*, July 1990, NATO UNCLASSIFIED.

(U) An enhancement for only one military feature is specified in Annex E for interconnecting two packet-switched networks using X.75:

- **Precedence and preemption.** The priority of a network service connection shall be indicated, when appropriate, by means of the network service Priority Quality of Service parameter as in Annex C. This parameter is mapped by the protocol to the X.25(1988) Priority facility. According to X.75(1988), the Priority facility is relayed unchanged as an X.25 user facility, which may be inspected and whose values are stored, but which does not affect the progress of the virtual call. This STANAG extends the specification of X.75(1988) in the following way: an STE may record the priority of a call and use this value to preempt a lower priority call under certain (implementation-dependent) conditions. In this case, the STE shall clear the call with cause "DCE originated" and reason "QoS not available--transient condition," as though the



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call had been cleared by one of the interconnected subnetworks according to the specifications of Annex C. Priority values are integers in the range 0 to 14, with 255 meaning "unspecified."

(U) Annex E to STANAG 4263 defines an internet protocol (IP) for CL-mode network service and relies on the provision of an underlying CL-mode service directly from a CL-mode real subnetwork or indirectly through the operation of an appropriate Subnetwork-Dependent Convergence Function (SNDCF) or Protocol (SNDCP) over a CO-mode real subnetwork. Annex E is based on ISO 8473 (Sections 3-9 and Annexes A-C) and provides extensions for the following three military features:

- **Security.** A security parameter is provided in every IP Protocol Data Unit (PDU) using the Security Option. The structure of this parameter is for further study.
- **Precedence and preemption.** Priority is realized through selection of a parameter in the options part of the PDU header. The priority option shall be mandatory for end systems and intermediate systems conforming to this standard. Encoding of the precedence and preemption parameter and the error conditions are specified in the STANAG.
- **Multicasting.** It is necessary to allocate and reserve address space for multicasting and broadcasting in IP; extensions to IP to implement and manage multicasting are still to be defined.<sup>42</sup> Concepts for multicast addresses are described in detail in the STANAG.

### 10.4.4 Transport Layer STANAGs

(U) STANAG 4254 provides the transport service definition. Since NOSA (see Section 8.1.3.2) identifies no security services for the Transport Layer, there are no military-specific security services or protocol enhancements. The CO transport service (Annex C) is based on ISO 8072. The CL transport service (Annex D) is based on ISO 8072/AD1 (with the restriction that the note of paragraph 15.2.3 is not retained).

(U) Annex E of STANAG 4254, *Real-Time Transport Service (RTTS)*, has been proposed as fulfilling the real-time military features for NATO military systems. Specifically, RTTS is designed to offer more functionality to such services as connection service and data transfer service and to provide additional services such as synchronization and management. RTTS provides services for broadcasting, selective broadcasting, and concentration. Chapter 2 of Annex E, *Definition of the Real-Time Transport Service (RTTS) Provided by the Transport Layer*, uses concepts, terminology,

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<sup>42</sup> (U) Draft STANAG 4263 identifies US DoD RFC 1054, *Host Extensions for IP (DoD) Multicasting*, as the source for descriptions of the required extensions to ISO IP. See Appendix H.

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and structure similar to ISO 8072 for transport Classes 0, 1, and 2. RTTS appears to impact more than a single layer (Layer 4) and does not appear to fully conform to the Basic Reference Model ISO 7498.

(U) Deficiencies and required enhancements in seven areas are noted in STANAG 4254 for both CO-mode and CL-mode transport services as shown in Table 35 (internetworking is not applicable).

*Table 35. (U) Deficiencies and Enhancements Identified for STANAG 4254*

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- (1) Multihomed and mobile host systems. No requirement as the transport service is not affected by either the multiple attachment of a host to two or more nodes or subnetworks nor the change at any time by a host of network or subnetwork attachment.
- (2) Multiaddressing. The transport service does not provide any service or function related to multiaddressing. To specify the addresses of participants in a multipeer connection, the Group Address can be resolved into a number of ordinary addresses or the address parameters in the service definition can be redefined to permit the use of a list of addresses rather than just one.
- (3) Network/system management functions. Transport management service primitives are required to satisfy this requirement, and the primitives defined in ISO 9595 (CMIS) are satisfactory for the communication of information related to the Transport Layer managed objects. Specific management objects and functions need to be defined.
- (4) Security. According to the NOSA, no security services are specified for the Transport Layer and no security enhancements are required.
- (5) Robustness and Quality of Service (QoS). No enhancements required. QoS parameters are provided for data transfer service enabling the user to control and check the QoS. These parameters are negotiated during the connection establishment phase.
- (6) Precedence and preemption. No enhancements required. A QoS parameter is provided to express the priority of a transport connection. This parameter is negotiated during the connection establishment phase.
- (7) Real-time and tactical communications. In real-time communications, the requirement to have short transit delay for the transfer of data is more important than the requirement to have data delivered without sequence errors. There is also a requirement for such services as sampling process data transmission, periodic data transmission, and synchronization service, which are not provided by the ISO transport service. For real-time communications, the definition of services is for further study. For tactical communications, ISO transport services are suitable.

Source: *Draft STANAG 4254*, July 1990, NATO UNCLASSIFIED.

(U) STANAG 4264 provides the transport protocol specification. The connection-oriented transport protocol (Annex C) is based on ISO 8073. End systems must implement transport protocol Classes 0 and 2; other classes may be implemented in addition. The deficiencies and enhancements to seven of the military features (internetworking does not apply) are given in Table 36.

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Table 36. (U) Deficiencies and Enhancements Identified for Annex C of STANAG 4264

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- (1) Multihomed and mobile host systems. The protocol shall have the recovery mechanism of Classes 1, 3, or 4 in the case where the Network Service Provider releases the network connection each time the host system changes SNPA and the QoS requirement specifies low probability of unexpected connection release. If the classes 0 or 2 are used, the recovery of the connection shall be provided either in the Network Layer or in the Application Layer.
- (2) Multiaddressing. Savings in time and bandwidth can only be achieved if mechanisms are introduced into layers that inherently possess the ability to support communications to multiple destinations simultaneously (Layers 2 and 3).
- (3) Network/system management. Specific military managed objects for the Transport Layer will be specified when they are identified. They will be specified as extensions/modifications to the civilian managed objects.
- (4) Security. There are no specific security functions and no required enhancements.
- (5) Robustness and Quality of Service (QoS). Transport Layer specifications of the mechanisms needed to respect the QoS requirements are for further study.
- (6) Precedence and preemption. Transport Layer specifications of the mechanisms involved by the management of the priority are for further study.
- (7) Real-time and tactical communications. To be defined.

Source: Draft STANAG 4264, July 1990, NATO UNCLASSIFIED.

(U) Annex D specifies the connectionless transport protocol, based on ISO 8602. Enhancements are the same as in Annex C with the following exception:

- Multihomed and Mobile Host Systems. Since no data acknowledgement is provided by the service, the protocol is not affected when a remote host system changes its SNPA and is not reachable temporarily.

(U) Annex E specifies the connection-mode transport protocol over CONS, based on ISO 8073 and ISO 8073/AD2 (*Class Four Operation Over Connectionless Network Service*) using TP4. Enhancements are the same as in Annex C with the following exceptions:

- Multihomed and Mobile Host Systems. Since no network connection is released when a remote host system changes its SNPA and since TP4 offers error detection and recovery mechanisms, this protocol is not affected by this military feature.

(U) Annex F of STANAG 4264, *Real-Time Transfer Protocol Over Connectionless Network Service*, is still to be defined.

#### 10.4.5 Session Layer STANAGs

(U) The two Session Layer STANAGs (4255 and 4265) have been developed by WG2 with the US serving as editor. Both these STANAGs have been recommended by WG2 to be distributed by SG9 for ratification without military features.

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(U) STANAG 4255 is based on ISO 8326, *Basic Connection-Oriented Session Service Definition*. Annex D is reserved for connectionless session services. The only military deficiency areas identified in the draft STANAG are for security and multi-endpoint connection:

- Security. A mechanism for providing graceful closure may be required by NATO in the long term. At present, this requirement is insufficiently refined to allow a service realization. Therefore, no enhancement of ISO security measures can be provided at this time
- Multi-endpoint connection. ISO is currently considering multipeer data transmission requirements for the Session Layer. This activity will be monitored by the developer of this STANAG, and this paragraph will be updated as developments warrant. An enhancement requirement is contingent upon ongoing developments within ISO.

(U) STANAG 4265 is based on ISO 8327, *Basic Connection-Oriented Session Protocol Specification*. An annex (Annex D) is reserved for information regarding the Connectionless Session Protocol Specification. The deficiencies and enhancements for STANAG 4265 are the same as for STANAG 4255.

### 10.4.6 Presentation Layer STANAGs

(U) The two Presentation Layer STANAGs (4256 and 4266) have been developed by WG2. In addition, STANAGs have been drafted for ASN.1 (STANAG 4258) and the Basic Encoding Rules for ASN.1 (STANAG 4259). All four Layer 6 STANAGs have been recommended by WG2 to be distributed by SG9 for ratification without military features.

(U) STANAG 4256 will initially be based on ISO 8822, *Connection-Oriented Presentation Service Definition*. An annex (Annex D) is reserved for connectionless presentation services. Potential deficiencies have been noted in three areas:

- Security (Annex B). NOSA has placed additional security-related services in the Presentation Layer, but these are not yet defined in detail. Modifications are anticipated in the ISO standards following ISO 7498-2, which may meet the emerging military requirements. No security enhancement to the ISO Presentation Layer is currently available. However, as solutions are available this STANAG will be amended.
- Mobile hosts and multihomed systems. No deficiencies noted (subject to change dependent upon the ability of the lower layers to support this feature).
- Multi-endpoint connection. Modifications will be needed to the Presentation Layer if multi-endpoint connections are required in an implementation, but no specific requirements have yet been identified. Modifications will be made to

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the ISO standard once the multipeer data transmission work in ISO has been progressed.

(U) STANAG 4266 is based on ISO 8823, *Connection-Oriented Presentation Protocol Specification*. Annex D is reserved for the connectionless presentation protocol specification. The military deficiencies and enhancements for STANAG 4266 are the same as for STANAG 4256.

(U) Separate NATO agreements will address ASN.1 (STANAG 4258) and the ASN.1 basic encoding rules (STANAG 4259). These are based on ISO 8824 and ISO 8825. No deficiencies were found in these based standards and no enhancements are recommended.

(U) STANAG 4259 observes that additional sets of encoding rules for ASN.1 may be required for specific applications giving either compressed (minimum volume) or encrypted encodings. No specific requirements in this area have yet been identified. Following work in these areas by ISO, additional ASN.1 encoding rule STANAGs may be developed. A remark provided at the end of STANAG 4258 observes that ISO 8824/1 includes a note that makes reference to the encodings for the Real Type by the *Basic Encoding Rules for ASN.1* (ISO 8825)--this note is not relevant if alternative encoding rules are to be employed.

### 10.4.7 Application Layer STANAGs

(U) The only Application Layer STANAG that has been produced in draft form is the draft MMHS STANAG 4257. The status of the MMHS work is discussed in Section 10.3.8. An initial focus meeting on FTAM was planned for June 1990 (see Section 10.3.3.4).

(U) The February 1990 draft MMHS STANAG identifies the STANAG as the Military Base Standard. The draft states that other STANAGs will define related MMHS profiles that will define additional requirements related to particular environments, but the May 1990 report of WG2 to SG9 states that the profiles will be included as separately ratifiable annexes to STANAG 4257. The draft STANAG has four annexes:

- Annex A, *Scenarios and Rationale*, provides detailed specification of the scenario of application and rationales behind the major decisions. It also discusses support of the subset of the eight military features that are applicable to a store-and-forward messaging environment.

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- Annex B, *Military Message Handling System Extensions*, provides the set of extensions to civilian MHSs for Interpersonal Message Service required for military messaging.
- Annex C, *Security Aspects of MMHS*, identifies the service, protocol, and operational requirements related to security. This annex would be classified NATO SECRET.
- Annex D, *Gateway Translations*, provides detailed specification of the interface between MMHS and other messaging systems, including ACP systems [e.g., ACP 121 (*Communications Instructions-General*), ACP 126 (*Communication Instructions--Teletypewriter/Teleprinter Procedures*), and ACP 127 (*Communication Instructions--Tape Relay Procedures*)].

(U) Table 37 identifies the military features as they affect MMHS.

### 10.5 Development of Other Technical STANAGs

(U) This section will identify non-OSI STANAGs that appear to be relevant to ATCCIS technical standards. Media-dependent STANAGs (e.g., on tactical data links) are not addressed.

#### 10.5.1 Network Independent Interface (NIIF)

(U) NIAG SG6 is developing a draft specification of a Network Independent Interface (NIIF). This was briefed to the TSGCEE SG9 AHWG-OM in February 1989. NIIF is a concept for a combat system data distribution interface that could be used by the NATO Frigate Replacement for the 1990s (NFR90), a programme currently in a project definition phase.

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Table 37. (U) Status of X.400(MHS)-1988 Relative to the Eight Military Features

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- (1) Multihomed/Mobile Host
  - (a) Multihoming applies to MMHS applications in two ways: multihoming UAs and multihoming MTAs. In the first case, the MHS must allow a single user to have more than one Originator/Recipient (O/R) name. The second case requires MTAs that answer to more than one name. In both cases, the capability in question is outside the scope of the communications standards, but is permitted as an implementation option. Capabilities for multihoming would have no direct impact on either MHS services or protocols, but are instead more focused on the lower layers.
  - (b) Similarly, mobile hosting can also be applied to either the MTA or UA. In either case, the key requirement to support mobile hosting is the capability for the functional object in question to disconnect from the network for a period of time without serious consequence. In MMHS there are two mechanisms to support mobile hosting of the UA. One such mechanism is the use of a message store (MS) to act on the UA's behalf while the UA is off line. The second mechanism is use of the Hold for Delivery element of service, in which the service element instructs the MTS to defer delivery of a UA's messages until a later time. No such mechanisms are available to the MTA, however.
- (2) Multiplex Data Transmission (MPDT)

Since MHS applications are store and forward (i.e., connectionless) in nature, no end-to-end connections are provided or required by MMHS. However, the MMHS does provide a connectionless MPDT capability in the form of multi-addressed messages. This feature allows a single message to be sent to several recipients with a single submission to the MTS. The MTS is then responsible for performing traffic splitting at the appropriate time. Note that traffic splitting could be substantially more efficient if supported by a lower layer MPDT function.
- (3) Internetworking

Internetworking is addressed by the provision of MMHS/ACP 127 and MMHS/civilian gateway definitions. Gateways could also be created to other systems that perform similar message handling functions, but such gateways are at present beyond the scope of MMHS.
- (4) Network and System Management

Network management is a pan-layer issue that falls under the auspices of the AHWG-OM in SG9. The AHWG-MMHS will continue to identify MHS-related topics to be considered by AHWG-OM.
- (5) Security

Security is a pan-layer issue that falls under the auspices of the AHWG on Security in SG9. The AHWG-MMHS will continue to identify MHS-related topics to be considered by the Security AHWG.
- (6) Robustness and Quality of Service (QoS)

Most aspects normally associated with robustness and QoS have no meaning in the Application Layer. Three MHS characteristics have been identified as significant in terms of robustness and QoS: loss of messages, end-to-end delivery time requirements, and selection of security services. QoS aspects relating to link quality, hop-by-hop transmission delay, and throughput are primarily lower layer issues, and in any case have little meaning for a store-and-forward Application Layer process.

  - (a) Loss of message is addressed by the MMHS expansion of X.400's redirection capability. This provides a dead letter box at each MTA so that messages will always be delivered rather than discarded. MMHS also provides both delivery and nondelivery receipt capability to provide additional assurance of delivery.
  - (b) MMHS has specified end-to-end delivery time requirements consistent with those used by ACP 127. The hop-by-hop transmission delay and throughput necessary to achieve those end-to-end times are lower layer issues.
  - (c) Selection of appropriate security services is largely dependent on the security policy in force. This policy will determine what services will be enabled during the origination of a message based on its classification or other factors. This selection could be done either technically or procedurally, however, and thus is purely an implementation issue. Whatever solution is used will impact only the originator and will not require changes to the communication protocols.

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Table 37. (U) (Continued)

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(7) Precedence and Preemption

The established requirement for military priority in message handling is four levels based on ACP 127. The MMHS base standard provides six priority levels in all protocols necessary to support the use of precedence and preemption in any implementation. However, it is the intent of the AHWG-MMHS to develop functional profiles that support six levels of priority in the UA-to-UA protocols but only three levels in the corresponding MTA-to-MTA protocols. Use of these provided information elements to support precedence and preemption in either the UA or MTA is an implementation issue.

(8) Tactical and Real-Time Communications

MMHS has specified end-to-end delivery time requirements that are purported to represent the tactical environment. In addition, the AHWG-MMHS plans the development of a *Beta Profile* tailored to low bandwidth tactical applications.

Source: *Draft STANAG on Military Message Handling System*, 16 February 1990, NATO UNCLASSIFIED.

(U) In a subsequent joint meeting with the NIAG SG6 and TSGCEE SG9 WG1 in June 1989 [Ref. 278], the NIIF was identified as a project to (1) put NACISA in the lead to resolve interface problems and provide management structure for such projects; (2) provide near- and mid-term standards specification for ACCIS interoperability; (3) initially develop interface specifications to pass character-oriented messages between existing systems; and (4) evolve the specification so that it will be suitable for other services (e.g., file transfer, virtual terminal). The specifications were to be based on ISO OSI standards and on functional profiles of SPAG and CEN/CENELEC that are adopted in the *NTIS Transition Strategy*: T.21 Permanent Circuit (telephonic), T.22 Switched Circuit (telephonic), and T.31 Permanent Access to a PSDN. BID-1000 and KG-84 were identified for communications security. The message handling area was based on A/3211 from the EWOS.

(U) As early as September 1987, NIAG SG6 proposed a draft STANAG for *NATO Naval Intra-Ship Tactical Control and Data Handling Open Systems Interconnection, Network Independent Interface, Transport Service Definition for Connection-Mode Transmission* [Ref. 279]. This proposal was based on ISO 8072 with "additions and deletions, where necessary, to reflect a unique Naval, intra-ship, interpretation to it." The NIIF is identified in this proposal as a collection of standards that provide the complete definition of an interface between the User and the Data Transfer System, based on unique requirements for real-time, fault tolerant information exchange between peer systems. Reference 280 provides a statement of the programme of work planned by NIAG SG6 for 1990-1992.

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### 10.5.2 Lightweight Protocols

(U) The TSGCEE AHWG on Restructuring has noted that the work of NIAG SG6 is closely related to the work of TSGCEE SG9 on OSI standards. Both groups are interested in the area of lightweight LAN profiles for multi-Service use. The basis for the intraship LAN profile being developed by NIAG SG6 is based on France's GAM-T-103, as is the US SAFENET profile and the more general Express Transfer Protocol (XTP) profiles [Ref. 281].

(U) The Xpress Transfer Protocol (XTP) is a lightweight (providing simplicity and low overhead) transfer protocol with unified internetwork services associated with OSI Layers 3 and 4. XTP conforms to the architecture of the Transfer Layer in RTTS developed in France for use in LANs (see Section 10.4.4) [Ref. 282]. XTP is designed to support 100 Mbps sustained transfer rates between application programs with growth to 1 Gbps. XTP is designed to provide services for distributed systems not available in ISO TP4 and US DoD TCP; the requirements include supporting remote procedure calls and rapid request/response operations, coordinating multiple processes, and providing transaction-based file access. XTP supports traditional stream services, bulk transport, real-time reliable datagram service, real-time internet gateways, flow/error/rate control, message delivery confirmation, selective retransmission, message boundary preservation, multiple addressing plans, out-of-band signalling, reliable multicast mechanism, maintenance packets, and multipath capability [Refs. 283, 284].

(U) XTP has been submitted to ANSI X3.S3 for standardization of its services. Its standardization is also being progressed in the US Navy SAFENET Committee.

### 10.5.3 EUROCOM and US/EUROCOM

**10.5.3.1 EUROCOM.** (U) EUROCOM is a technical working group composed of representatives from the NATO European nations whose aim is to achieve better coordination and interoperability in tactical communications systems between European Allied armies. EUROCOM is a subgroup of the EUROGROUP, an informal grouping of European governments within the framework of NATO. Rather than trying to agree on a single system, it is EUROCOM's plan to introduce communications systems in accordance with agreed operational requirements and basic system parameters in such a way that there is complete interoperability among systems built to EUROCOM standards. EUROCOM standards are frequently offered as the basis for NATO STANAGs on tactical communications [Ref. 285].

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(U) The documents (D) currently promulgated by EUROCOM include:

- EUROCOM D/0: *System Concept*, CONFIDENTIAL (date of last revision unknown)
- EUROCOM D/1: *Tactical Communications Systems Basic Parameters*, 1986 (Revised September 1988), RESTRICTED
- EUROCOM D/2: (title and date unknown) subject is testing.

**10.5.3.2 US/EUROCOM** (U) US/EUROCOM is an informal tactical communications technical working group comprising the EUROCOM nations and the United States, Canada, and France. The purpose of US/EUROCOM is to work toward better and less cumbersome interface arrangements, to monitor the implementation agreements on communications characteristics, and to promote cooperation in the procurement of equipment conforming to these characteristics. Much of the preliminary technical work leading to ratified standardization agreements is accomplished by this group.

(U) With respect to work in OSI, the principal interest in US/EUROCOM is with the lower three layers. Currently, US/EUROCOM is in the process of modifying STANAG 4249, *The NATO Multi-Channel Tactical Digital Gateway--Data Transmission Standards (Packet Switching Service)*, to reflect the 1988 version of CCITT Recommendation X.75. US/EUROCOM is also investigating the application of the protocol implementation conformance statement (PICS)-type proformas to the NATO multi-channel tactical digital gateway STANAGs [Ref. 285].

(U) On many occasions US/EUROCOM has accepted invitations from TSGCEE to work on the NATO STANAGs for tactical communications (not just gateways) and interoperability issues. US/EUROCOM has made major contributions to STANAGs 4206-4211 and 4350. Both EUROCOM and US military standards are being considered for drafts of STANAG 4290, *Fiber Optics*. In each case the technical recommendations from US/EUROCOM are provided to TSGCEE SG11 WG1 for further work, coordination, and distribution as draft STANAGs.

(U) The work of US/EUROCOM in developing a profile for a tactical gateway for packet switching (STANAG 4249) was briefed the TSGCEE SG9 WG1 in the October 1989 meetings in Brussels. In addition, Norway provided a paper<sup>43</sup> that suggested US/EUROCOM could undertake several tasks of interest to SG9. These include proposing protocol implementation conformance statement (PICS) proformas for the

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<sup>43</sup> (U) *US/EUROCOM's Role in Developing Profiles for NATO*, AC302/SG9/WG1-8910/15(NO), 2 October 1989, NATO UNCLASSIFIED.

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STANAG 4206-4214 series (and possibly others, such as STANAGs 4290 and 5040); proposing tactical parts of the STANAG 4250 series; identifying profiles required by the tactical communities in NATO; and proposing NATO functional profiles for tactical applications. However, US/EUROCOM's role in developing profiles for NATO is still under consideration and has not been fully accepted by US/EUROCOM.

### 10.5.4 Other Efforts

(U) STANAG 4214, *International Routing and Directory for Tactical Communications*, may be applicable to ATCCIS technical standards; this standard is the responsibility of TSGCEE SG11. TSGCEE SG9 WG1 is looking at naming and addressing requirements and the applicability of STANAG 4214. STANAG 4249, *The NATO Multichannel Tactical Digital Gateway--Data Transmission Standards (Packet Switching Service)*, also the responsibility of SG11, addresses packet switching using a form of CCITT X.25; as such, this STANAG may also be applicable to ATCCIS technical standards. The Eurogroup on Cooperation of Tactical Communications Systems (EUROCOM) is reported to be preparing a revised draft for STANAG 4249 based on CCITT X.25 and the draft TSGCEE SG9 Functional Profile Guidelines document; such a draft would be submitted to SG11 as a contribution and developed into a STANAG.

### 10.6 Findings

(U) TSGCEE has identified and assessed eight military features that need to be incorporated in civil OSI standards, but little detail has yet been released (e.g., in drafts of STANAGs 4251-4266) to show how these features can actually be addressed in military versions of OSI standards. TSGCEE SG9 has an ambitious 18-month plan for progressing the NATO OSI data communications standards, but there is a need to reassess and revalidate the military features--clearly the deficiencies of 1990 civil standards are different from those identified in 1983. TSGCEE SG9 has been successful in many areas (such as security and OSI management) for introducing military work into the civil standards bodies and affecting the capabilities of the civil standards. One of the new approaches being taken by SG9 is the development of functional profiles, which individually address specific military scenarios and groups of requirements and are essential to ensure interoperability of implementations by the Nations; this work needs to be supported and expanded. Finally, there is also a need to identify additional resources and possibly new approaches to expedite the completion of these STANAGs.

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**11. NEAR-TERM APPROACHES FOR ACHIEVING INTEROPERABILITY IN NATO**

(U) Existing and emerging ACCISs are designed to provide command and control information support for NATO and national systems. The ACE ACCIS will provide the higher-echelon support (i.e., at echelons above corps) for the military forces operating in the European region of NATO. ATCCIS will provide support for land combat tactical units, and the Air Command and Control System (ACCS) will support the air operations. The NATO Maritime Operational Intelligence Support (NMOS) and the Battlefield Information Collection and Exploitation System (BICES) will provide intelligence support. Other ACE ACCIS-related projects include the Standard Automated Message Interface for NATO's ACCISs (STAMINA), JRMS, the Status Control Alerting and Reporting System II (SCARS II), and the Nuclear Planning System (NPS).<sup>44</sup>

(U) This chapter begins by reviewing the standards associated with the *NATO C3 Master Plan and Architecture* (Section 11.1). It further examines the standards specified by near-term NATO and multilateral interoperability demonstration and development efforts in addition to ATCCIS, namely the ACE ACCIS (Section 11.2), ACCS (Section 11.3), BICES (Section 11.4), NMOS (Section 11.5), the Quadrilateral Interoperability Program (Section 11.6), and STAMINA (Section 11.7). Military features required by NATO are addressed. In addition, this chapter addresses some of the issues associated with evolving from near-term systems to ATCCIS through the use of standards. Profiles of standards that are to be used in transition implementations for several NATO projects are also presented.<sup>45</sup>

(U) The objective of this review is to ensure that the methodology used for the ATCCIS effort is comprehensive and that no classes of relevant standards have been overlooked. Some national initiatives to adopt and extend OSI standards for tactical employment are reviewed in Appendix C.

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<sup>44</sup> (U) ACCS, ATCCIS, BICES, JRMS, NMOS, NPS, and SCARS II are the seven ACE CCIS-related projects identified in the *ACE Inventory of Key Tasks*, December 1988, NATO CONFIDENTIAL.

<sup>45</sup> (U) Profiles differ from stacks in that a profile usually consists of several stacks of standards and further that profiles are usually recommended for a certain transition strategy or a specific implementation. In some cases, profiles specify options to be used.

### 11.1 NATO C3 Master Plan and Architecture

(U) This section reviews the status of the *NATO Consultation, Command and Control (C3) Master Plan* and identifies its relationship to the assessment of standards for ATCCIS. The Master Plan consists of four documents: the Master Plan Overview [Ref. 286], *TRI-Major NATO Commanders' Command and Control (C2) Plan* [Ref. 287], *Political Consultation and NATO Civil Emergency Planning (PCNCEP) CIS Plan* [Ref. 288], and the *NATO C3 Architecture* [Ref. 289-293]. The *NATO C3 Architecture* consists of five volumes. The two most relevant to the ATCCIS Architecture are Volume 3, *Information System Subsystem*, and Volume 4, *Communications Subsystem*. Much of the material of Volume 3 was drawn from the ATCCIS architecture. The standards annex to Volume 3 is an early draft of WP 25.

(U) The *NATO C3 Master Plan* was formally considered at the January 1990 plenary of TSGCEE. TSGCEE prepared a statement, to be submitted in February 1990, to the Conference of National Armaments Directors (CNAD) that endorsed the *NATO C3 Master Plan* with the following caveats [Ref. 246]:

- The *NATO C3 Master Plan* presents a significant first step towards development of a sound investment strategy for major improvements in NATO C3.
- However, the TSGCEE does not consider the *NATO C3 Architecture* to be sufficiently mature to warrant its endorsement as part of the overall Plan and requests that the CNAD invite the NACISC to decouple the *Consolidated Architecture* (Volume 1) when submitting the Plan for approval to the North Atlantic Council Defence Planning Committee.
- Nations agreed to pursue and resolve many minor issues in the appropriate forums.

### 11.2 ACE ACCIS

(U) The initial phase of development of a standardized and interoperable ACE ACCIS was the Architectural Design Study. The next phase is System Design and Integration, for which a major support contract has been awarded by the NATO Communications and Information Systems Agency (NACISA). Work on the System Design and Integration Contract (SD&IC) began in early 1989 and is expected to be completed in 1991.

(U) ACE ACCIS will provide automation support for NATO headquarters at echelons above corps (e.g., PSCs). The SD&IC will provide about 450 person-months of effort from January 1989 to April 1991. Among the SD&IC objectives are the ACE-wide

## UNCLASSIFIED

issues of interoperability and standards, and the contractor will be identifying the functions to be supported at each interface. NACISA intends to ensure that the project complies with NATO standards and the *NTIS Transition Strategy*. STAMINA has been mandated for the SD&IC effort. The planned products include [Ref. 294]:

- Logical models of the existing system and a new system
- Generic description of the new system, together with a complete functional design that "embodies technical standards"
- Recommended implementation options and transition plan
- Procurement specifications to support procurements in the Central Region and the Southern Region in the 1990s
- Automated support for configuration management.

NACISA expects that the products of the SD&IC effort will become standards for NATO.

### 11.3 Air Command and Control System (ACCS)

(U) The Air Command and Control System (ACCS) is a system to support air operations planning, tasking, and execution throughout ACE from Major NATO Command (MNC) level to combat unit level.<sup>46</sup> ACCS will interface with the ACE ACCIS at the Primary Subordinate Command (PSC) and will concentrate new development at the PSC and below. ACCS will progressively replace a current federation of individual systems that support ACCS functions to varying degrees.<sup>47</sup> At the PSC level and above, ACCS functions will be performed by the ACCIS of each Command.

(U) Development of ACCS, which integrates offensive and defensive air command and control functions, has been underway for several years. Implementation is planned to begin in the early 1990s. In April 1989, the ACCS team completed the *ACCS Master Plan*. The ACCS team was replaced by the ACCS Interim Management Agency, and the new group will conduct a system definition phase. The goal is preparation of system specifications and technical estimates for a Type B cost specification for and procurement by Slice 42 (1991).

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<sup>46</sup> (U) The seven ACCS major functional areas are: Force Management (FM), C2 Resource Management (C2RM), Airspace Management (AM), Surveillance (S), Air Mission Control (AMC), Air Traffic Control (ATC), and Information Exchange.

<sup>47</sup> (U) The systems include Improved United Kingdom Air Defense Ground Environment (IUKADGE), Systeme de Traitement et de Representation des Informations de Defense Aeriene (STRIDA), German Air Defense Ground Environment (GEADGE), and NATO Airborne Early Warning (NAEW).

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(U) The interoperability concept for ACCS is discussed in Volume IV, *Generic Portion of the Overall ACCS Design*, of the *ACCS Master Plan*, [Ref. 295], and in the *Supporting Document on Organization Components* [Ref. 296]. ACCS interoperability is planned through exchange of information through commonly agreed to information definitions, formats, and technical standards. Where possible, the standards to be used are those developed by the Military Agency for Standardization (MAS), ADSIA, and TSGCEE SG9. Specifically, ACCS will be based on the OSI Reference Model as specified in STANAG 4250 (NATO Interoperability Model), the OSI services for Layers 1 through 7 as specified in STANAGs 4251-4257, and the OSI protocols for Layers 1 through 7 as specified in STANAGs 4161-4267. In addition to the ISO Reference Model standards, the NATO Common Interface Standards will be used. TSGCEE SG9 is responsible for the OSI technical standards, and ADSIA is responsible for the procedural standards. Operational interoperability standards will be based, in part, on Allied Tactical Publications (ATPs). In addition, the CCITT ISDN network architecture is being evaluated for full integration of communication services in ACCS.

(U) The ACCS communications concept is to integrate the various NATO and national dedicated communications systems currently used to support air operations into a common user data and voice network. ACCS would be hosted on the existing and planned communications without ACCS-unique communications means. Initially a packet switched data communication overlay would be added to the circuit-switched voice system. This would evolve into common user area ISDNs within each NATO region. Continued support for both character-oriented and bit-oriented messages is required. Specifically, use of tactical data link standards such as Link 4, Link 6, Link 11, Interim JTIDS Message Standard (IJMS), and Link 16 would continue through the foreseeable future.

(U) ACCS has been reviewing technical information exchange standards and requirements, including the need to replace Link 1 for data exchange<sup>48</sup> in the ground environment. The current approach is to base a new standard on STANAG 5516 (J-Series messages) and to develop (within ADSIA WG4) new or modified messages to fulfill specific ACCS Information Exchange Requirements. ACCS plans to use a military version of X.25 for packet-switched systems and for transfer over dedicated circuits and through circuit switches. Variable packet lengths are desired. CSMA/CD and token ring LANs are being considered for ADP systems. As in ATCCIS, the ACCS database concept is partitioned and partially replicated (see Sections 2.1.3 and 6.1.1). An ACCS-wide data dictionary is planned. Analysis has included an STC investigation on the applicability of

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<sup>48</sup> (U) ADSIA WG4 has been given a Priority One task to develop a Link 1 replacement; ADSIA WG4 has asked TSGCEE(SG9) to look at media-independent protocols for such a concept.

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ASN.1 and its relation to the syntax of STANAG 5500 (FORMETS). There is a concern as to whether use of FORMETS would permit achieving the full benefit of the OSI model.

(U) The following considerations in ACCS indicate some elements of the technical approach for achieving interoperability:

- ACCS interfaces will be required to the following generic external agencies/systems:
  - NATO intelligence systems (e.g., BICES, NMOS)
  - NATO army headquarters
  - NATO land-based maritime headquarters
  - NATO maritime forces afloat
  - National headquarters, intelligence, army headquarters, maritime headquarters, territorial commands, meteorological services, civilian air traffic control, and local authorities.
- Requirements have been identified for free text traffic (electronic mail), graphics, and facsimile transmission services. Video transmission is a potential long-term requirement for ACCS, but it has been excluded from consideration for the current ACCS planning time frame (1990s).
- Two ADSIA standardization documents have been considered important for ACCS in the area of formatted messages:
  - ADatP-3/STANAG 5500, containing a catalogue of character-oriented formatted messages
  - Common Information Exchange Glossary (CIEG), containing terms and definitions applicable to the development of both bit- and character-oriented procedural standards.
- ACCS requires an electronic mail service. The planned standard is the Military Message Handling System, based on CCITT X.400 (see Section 10.3.8).
- ACCS further requires automated interactions between databases (e.g., updates) that could be event driven. The FTAM standard has been recommended for consideration for ACCS use, particularly for bulk update of databases.
- The functions (e.g., syntax and formatting rules) of ASN.1 and the associated Basic Encoding Rules (BER) were recognized by the ACCS Team as potentially richer and offering greater scope than NATO Message Text Formatting System (FORMETS) functions of ADatP-3/STANAG 5500. Large investments in FORMETS are being made in operational systems, and NATO interoperability continues to be based on FORMETS and ADatP-3. Eventually, however, FORMETS could be replaced by ISO standards for automated data exchange to make better use of the functionality of the OSI model and the richness of ISO standards. There are potential problems in ensuring interoperability between systems using FORMETS and systems using ISO standards. Investigation is needed on whether the use of an information



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structure based on ADatP-3 message contents is a sufficient basis for achieving backwards interoperability with FORMETS systems.

- ACCS anticipates the use of gateways for data forwarding (message standard translation), trusted secure interfaces between cooperating ADP systems to control access to data, and physical interconnection of different communication systems.
- A connection-oriented virtual call protocol has been proposed for ACCS, rather than a connectionless (or datagram) protocol, as the basis for packet switched services. Virtual call services are widely used in civil networks; they can result in more efficient transmission because of significantly lower packet overheads, and they can simplify network management. An issue is whether virtual call would provide adequate flow control under stress conditions. Limited use of a connectionless service may also be required.

### 11.4 Battlefield Information Collection and Exploitation Systems (BICES)

(U) The Battlefield Information Collection and Exploitation Systems (BICES) will provide intelligence support for the ACE ACCIS, including the land-surface picture for NATO. BICES is a project under the direction of TSGCEE PG7. BICES will consist of three segments, which will utilize either national or NATO intelligence capabilities [Ref. 297]:

- Higher national segment includes national capabilities at the MOD-DoD and Theatre Level
- Lower national segment includes national capabilities below NATO PSCs
- The NATO segment of BICES, as the hub of the interconnected systems, will include the NATO capability at the NATO command level (a portion of ACE ACCIS).

(U) The BICES concept will involve integration of national and NATO systems, initial processing, processing/fusion, and user exploitation. The BICES capability will be integrated into the ACE ACCIS. Specifically, the ACE portion of BICES (and NMOS) will go under the SD&IC activity of the ACE ACCIS. Configuration management for BICES will fall under configuration management of ACE ACCIS. User requirements for the ACE segment of BICES are completed [Ref. 298], but the majority of the national annexes have not yet been provided. One national operational capability has been designated as part of BICES, namely the Limited Operational Capability-Europe (LOCE) system developed by the US.

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(U) Among the approaches being considered for BICES are a common database and a data dictionary, whose scope and content are to be determined. NATO OSI standards from ISO and CCITT will be used unless they cannot meet the BICES requirements.

### 11.5 NATO Maritime Operational Intelligence Support (NMOS)

(U) The NATO Maritime Operational Intelligence Support (NMOS) will also provide intelligence support for the ACE ACCIS. NMOS provides the naval surface and subsurface picture for NATO. NMOS is a joint project under SACLANT, SHAPE, and CINC-CHAN. The only standards identified for NMOS that are not part of the NATO Common Interface Standards are additional STANAG 5500 (ADatP-3) messages [Ref. 299]. The Military Committee approved the Tri-MNC concept for NMOS early in 1987 [Ref. 300].

### 11.6 Quadrilateral Interoperability Programme

(U) The Quadrilateral Interoperability Programme is an initiative of four nations--France, Germany, United Kingdom, and United States--to develop and implement, for the short term, an interface through which the four national ACCISs [respectively Systeme Informatique de Commandement des Forces Terrestres<sup>49</sup> (SICF), Heeres-Fuehrungsinformationssystem fur die rechnergestuetzte Operations-fuehrung in Staeben<sup>50</sup> (HEROS), WAVELL, and Maneuver Control System (MCS)] can interoperate. Software development for the national systems has been completed, and an interoperability demonstration was successfully conducted in May 1990 near Ingostadt, Germany [Ref. 301]. Meetings were held in June and July of 1990 to explore options for fielding initiatives based on the Quadrilateral Interoperability Programme standards.

(U) The Quadrilateral Tactical Interface Requirements (QTIR) document [Ref. 302] expresses the basic requirements. The Quadrilateral Technical Interface Design Plan (QTIDP) [Ref. 303] specifies, for the gateway, the technical interface based on the ISO/CCITT OSI Reference Model. The operational requirements specify for information representation the use of formatted messages as described in STANAG 5621 Edition 2 and in accordance with ADatP-3 (STANAG 5500) specifications. The specifications for the common international interface between national gateways are provided in the QTIDP by annexes describing each of the seven layers with options and parameters derived from

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<sup>49</sup> (U) Information System For Command of Ground Forces (SICF).

<sup>50</sup> (U) Army Command and Control Information System for the Computer Assisted Conduct of Operations within Staffs (HEROS).

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ISO/CCITT standards in order to meet the specific military requirements (e.g., naming, addressing, priority, sensitivity, size of messages, and segmenting).

(U) Standards specified in the QTIDP are identified in Table 38. Specifications of Layers 1 through 5 are closely related to ISO standards. Layer 6 (presentation) is a null layer. Layer 7 specifies message handling functionality based on the CCITT X.400 standards for the subset of service elements provided by the P1 and P2 protocols and the service elements provided by Reliable Transfer Service (RTS), as defined by ISO 9066-2, and integrated with the Association Control Service Element (ACSE, ISO 8649 and ISO 8650) that provide support for other application entities. The Quadrilateral Test and Demonstration Management Plan (QTDMP) [Ref. 304] specifies a plan for interface testing and interoperability testing before performing the 1990 demonstration. Most of the interoperability parameters are specified by the options, classes, and system parameters selected from ISO/CCITT standards; some of the other interoperability parameters are defined in accordance with military requirements defined for messages in the QTIR.

(U) A preliminary review has shown that all standards, stacks, and options for the Quadrilateral Interoperability Programme that are also relevant to ATCCIS have been identified in earlier chapters of this working paper. In addition, a separate analysis [Ref. 305] has been performed that identifies a large number of interoperability parameters and provides their values.

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*Table 38. (U) Standards for Quadrilateral Interoperability Programme*

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| <b>Layer</b>                    | <b>References for Standards</b>  |
|---------------------------------|--|
| 7. Application                  | ISO 8649-1986 (ACSE)<br>ISO 8650-1986 (ACSE)<br>CCITT X.400, X.401, X.408, X.409, X.411, X.420<br>DIS 9066.1, 9066.2 (Reliable Transfer)<br>D:3 8824 (ASN.1)<br>DIS 8825 (ASN.1 Basic Encoding Rules)<br>IS 646, IS 6937 (Coded Character Sets)                        |
| 6. Presentation<br>(Null Layer) | DIS 8822-1985<br>DIS 8823-1985   |
| 5. Session                      | DIS 8326-1984<br>DIS 8327-1984   |
| 4. Transport                    | DIS 8072-1984<br>DIS 8073-1984   |
| 3. Network                      | ISO 8208-1985 (X.25 PLP)<br>DP 8348 (CONS)<br>DP 8472 (Network Convergence Protocol)<br>DIS 8648-1985 (Internal Organization Network Layer)<br>DP 8878-1984 (X.25 CONS)<br>CCITT X.25-1984<br>STANAG 4214 (Internal Routing)<br>STANAG 5046 (Communications Directory) |
| 2. Data Link                    | ISO 7776-1985 (HDLC LAPB)<br>DIS 8886-1985<br>ISO 3309 (HDLC Frame Structure)<br>ISO 4335 (HDLC Procedures)  |
| 1. Physical                     | ISO TR 7477-1985<br>DIS 8481-1985<br>ISO/TC97/SC6 N3473 (DP 10022)<br>ISO 4903<br>CCITT V.3, V.10, V.11, V.28<br>CCITT X.21, X.24, X.25<br>CCITT X.27 (EIA/RS-422-A)   |

Note: The table shows the status of standards at the time the QTIDP was specified.

**11.7 Standard Automated Message Interface for NATO's ACCISs (STAMINA)**

(U) This summarizes the results of a review of the specifications for STAMINA [Ref. 306]. STAMINA is being developed by an Interface Working Group of NATO

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Communications and Information Systems Agency (NACISA) to be used as a standard interface for passing information among ACCISs. Initial demonstrations are planned for the Central Region ACCIS and three target systems: the Allied Command Baltic Approaches Command and Control Information System (ACBA CCIS), the Central Region Alternate War Headquarters CCIS (CR AWHQ CCIS), and the Allied Tactical Operations Centre CCIS (ATOC CCIS, also known as the EIFEL Follow-On). STAMINA is planned to be used for such interfaces as [Ref. 307]:

- Central Region (CR) ACCIS to UKAIR ACCIS and to EIFEL (ATOC)
- SHAPE and CR Primary War Headquarters (HQ) to SHAPE and CR Mobile Alternative HQ
- ACBA (Baltic Approaches) ACCIS to CR ACCIS and to EIFEL (ATOC).
- Various interfaces at SHAPE HQ.

(U) STAMINA consists of two separate transport profiles and an X.400-oriented application profile. The transport profiles support (1) X.25 packet switched networks for use in CR ACE and (2) permanent analogue circuits for point-to-point interfaces using dedicated analog circuits. A third transport profile, switched analog circuits for use with the NATO IVSN analog voice network, has recently been deleted, as there have been no interest shown in implementing this aspect of STAMINA.

(U) The entire STAMINA profile has been adopted by TSGCEE SG9 an intercept profile for the *NTIS Transition Strategy* [Ref. 308]. In the future STAMINA could be considered as several NATO standardized profiles.

(U) Requirements for the Quadrilateral Interoperability Programme and STAMINA overlap, but it is not clear at this time if they will converge. Generally, STAMINA attempts to provide military features (e.g., four levels of precedence and NATO classifications) as "extensions" in Layer 7.<sup>51</sup> Further, STAMINA provides three transport protocols (using Class 0 and Class 2), whereas the QTIDP provides just one (using Class 2) [Ref. 309].

### 11.7.1 STAMINA Application Profile

(U) The STAMINA application profile for message handling is a modification of CCITT X.400(MHS)-1984 18 military features were added. These features are identified in Table 39. STAMINA messages are free text and text formatted according to the ADatP-3 specification [Ref. 310].

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<sup>51</sup> (U) STAMINA leaves the commercial P1 and P2 sublayers unmodified and defines new service elements as extensions to P2; the QTIDP redefines both P1 and P2.

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Table 39. (U) Military Features Added to the STAMINA Specification

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| <u>Military Feature</u>        | <u>Description</u>   |
|--------------------------------|--|
| 1. Extended Authorization Info | Date and time officially authorized  |
| 2. Subject Indicator Code      | Eight subject codes for distribution information   |
| 3. Primary Precedence          | Grades of delivery (e.g., urgent, normal) for primary recipient  |
| 4. Copy Precedence             | Grades of delivery for copy recipient  |
| 5. Security Classification     | Five classifications (e.g., NATO UNCLASSIFIED)   |
| 6. Security Category           | E.g., ATOMAL, EYES ONLY  |
| 7. Originator Identifier       | Originating organizational unit message reference  |
| 8. Address List Indication     | Address list type and identifier; on origination conveys multi-destination delivery; on receipt, forwarding action |
| 9. Clear Indication            | Transmitted without any security classification  |
| 10. Codress Message Indicator  | Indicates a codress encrypted message  |
| 11. Corrections                | Corrections are required in body of text   |
| 12. Exempted Address           | Exempted name(s) from accompanying address list  |
| 13. Handling Instructions      | Handling instructions accompany the message  |
| 14. Message Instructions       | Message instructions accompany the message   |
| 15. Message Type               | Distinguish between normal and exercise traffic  |
| 16. Other Recipient Indicator  | Identifies other recipient(s) also intended to receive message   |
| 17. Pilot Forwarded            | Used in forwarding a message   |
| 18. Security Policy Identifier | Identifies a security policy   |

(U) The application profile has two types of user access:

- Private Message Handling Service (MHS) Access: UA and MTA, PRMD to PRMD, A/3211 (based<sup>52</sup> on CCITT X.400-1984 and ISO 8327)
- Military Private MHS Access: UA and MTA, PRMD to PRMD, A/3211(M) (based on CCITT X.400-1984, ISO 8327, ACP 117, and ACP 127).

The A/3211 application profile is the X.400 MHS, in which the Application Layer (Layer 7) has three sublayers: User Agent Layer defined by X.420, Message Transfer Layer defined by X.411, and Reliable Transfer Server defined by X.410. The A/3211 Presentation Layer (Layer 6) is defined by ISO 8823 (based on X.410), and the Session Layer (Layer 5) is defined by ISO 8327 (based on X.410).

(U) STAMINA applications profile and the Quadrilateral Profile (QP) are both military versions of CCITT X.400(MHS)-1984. The QP is being developed and used by four command and control system programs in FR, GE, UK and US. The QP has a single transport profile based on X.25. To understand some of the essential differences

<sup>52</sup> (U) STAMINA Version 3.0 [Ref. 27] also cites "ISO 8322" for T/3211 and T/3211(M), but this standard does not exist.

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between STAMINA and QP, note that Layer 7 of X.400-1984 consists of the User Agent (UA), the Message Transfer Agent (MTA), and the Reliable Transfer Agent (RTA). The RTA serves as the liaison with the Session Layer protocols (in X.400-1984, the Presentation Layer is a null layer; i.e., there is no layer 6, so Layer 7 liaises directly with Layer 5). Both the UA and MTA use peer (e.g., UA-to-UA) protocols to communicate to distant UAs and MTAs. The peer protocol for the UA is the Interpersonal Messaging Protocol (P2), while the peer protocol for MTA-to-MTA communication is the Message Transfer Protocol (P1). Thus, P1 defines the relaying of messages among MTAs, while P2 defines the service elements of the interpersonal messages exchanged by UAs. The STAMINA profile provides military features by extending P2 (using a "superset" approach), permitting these features to be mapping into similar commercial features in the P1 protocol without affecting lower layer protocols, whereas the QP changed both P1 and P2 in such a way that the changes affected services in lower protocol layers as well.

### 11.7.2 STAMINA Transport Profiles

(U) STAMINA includes selection of CCITT and ISO standards--along with allowable options and parameters--necessary to attain interoperability among the end systems. STAMINA is based profiles defined in the SPAG User's Guide [Ref. 236]. The STAMINA transport profiles are:

- Permanent Telephonic Circuit Providing Connection-Oriented Network Service, T/21(M)
- Telephonic Switched Circuits Providing Connection-Oriented Network Service, T/22(M)
- Permanent Access to Packet Switched Data Network (PSDN), OSI Connection-Mode Services, T/312(M)

Table 40 identifies the standards specified for the STAMINA transport profiles. The current standard for STAMINA is Version 4.0, April 1990 [Ref. 311].

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*Table 40. (U) Standards for STAMINA Transport Profiles*

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| Layer        | T/21(M)               | Transport Profiles    |                       |
|--------------|-----------------------|-----------------------|-----------------------|
|              |                       | T/22(M)               | T/312,<br>T/312(M)    |
| 4. Transport | ISO 8072              | ISO 8072              | ISO 8072              |
|              | ISO 8073 <sup>a</sup> | ISO 8073 <sup>a</sup> | ISO 8073 <sup>a</sup> |
| 3. Network   | ISO 8348              | ISO 8348              | ISO 8348              |
|              | ISO 8208              | ISO 8208              | ISO 8208              |
|              | ISO 8878              | ISO 8878              | ISO 8878              |
|              | STANAG 4214           | STANAG 4214           | STANAG 4214           |
|              | STANAG 5046           | STANAG 5046           | STANAG 5046           |
| 2. Data Link | ISO 7776 <sup>b</sup> | CCITT V.25            | ISO 7776 <sup>b</sup> |
|              |                       | CCITT V.25bis         |                       |
| 1. Physical  | CCITT V.24            | CCITT V.24            | CCITT X.21            |
|              | CCITT V.11            | CCITT V.11            | CCITT V.11            |
|              | ISO 2110              | ISO 2110              | ISO 2110              |
|              | ISO 4902              | CCITT V.25            | ISO 4902              |
|              | MIL-STD-188C          | CCITT V.25bis         | ISO 4903              |
|              |                       | MIL-STD-188C          | MIL-STD-188C          |
|              |                       |                       | CCITT X.21bis         |

<sup>a</sup> Class 0 (Simple) and Class 2 (Multiplexing) are mandatory; Class 4 (Error Detection and Recovery) is optional.

<sup>b</sup> Options 2 and 8 of ISO 7809 (Balanced Asynchronous Class) are mandatory; Option 10 may be included under bilateral agreement.

**11.7.3 STAMINA Development Activities**

(U) One current activity is addressing the need to add functionality required to support relays between X.400 and ACP-127 message domains, as recommended by TSGCEE and recommended by the *NATO C3 Architecture* and the *NATO C3 Master Plan*. In addition, STAMINA is building a database of the interoperability parameters (e.g., speeds for communications lines) chosen by implementors of STAMINA specifications. Some parameters must be identical for interoperability and others must fall within certain ranges. The database will also track some parameters that others not affect interoperability. STAMINA is also planning to develop a conformance test suite and a file transfer functional profile (based on FTAM). A



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new transport profile is being developed for digital circuit switch connections for communications supporting the SHAPE and CR Mobile Alternate War HQ. The current STAMINA application profile will be implemented in the STC testbed. Finally, STAMINA has an initiative, not yet under contract, for an Automated Message Processing System (AMPS), intended to automate message processing at various ACE commands.

(U) The Configuration Management Board (CMB) for STAMINA has agreed [Ref. 312] to add the additional military features to the X.400 specification, making it identical to MMHS(84). The new Version 4.0 of STAMINA should be reviewed for such compliance. The CMB has decided to omit one part of STAMINA, the Transport Profile for Analog Circuit Switch, which was seen as high risk and for which no interest has been expressed from implementors. A consultant contract is planned to develop a conformance test suite for STAMINA, to be delivered at the end of 1990. An FTAM application profile is to be developed; the effort is now in a pre-contract award stage and a product is expected at the end of 1990. There are plans to develop another transport profile for STAMINA for digital circuit switched communications. NACISA is interested in studying the compatibility of STAMINA with the 1988 standards, with an orientation to migrate toward a 1988 base or, alternatively, define an interface module between the 1984- and 1988-based systems.

(U) Some STAMINA parameters are left to be determined by the implementors of an interface, and some of these must be the same on both ends of the interface. NACISA has developed a database in which to record the parameters used on all STAMINA implementations. NACISA has begun to develop a new project called the Automatic Message Processing System (AMPS). It appears at this early stage that it will have two aims [Ref. 313]:

- To provide individual ACE HQs with automated processing capability internal to each HQ for generation of outgoing messages and to provide the processing of incoming messages. Initially, the messages will be transmitted via the existing TARE system using TARE-unique protocols. Where possible, the internal processing will be based on X.400 oriented systems.
- To use the AMPS at each HQ as the platform for the eventual replacement of the TARE with an X.400 oriented network.

AMPS is expected to be based on X.400(88) rather than on STAMINA or MMHS(84), and NACISA plans to work closely with SG9 for the standards.

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(U) An ACE ACCIS Integrated Testbed is planned for the SD&IC efforts and the BICES Pilot Study (BPS) efforts, with NACISA serving as the host nation and STC providing scientific expertise and the home of one of the testbed nodes. SHAPE will provide personnel to implement STAMINA on this testbed, as well as other protocols that may emerge from the SD&IC or BPS.

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12. CONCLUSIONS AND RECOMMENDATIONS

(U) This section summarizes the gaps in current and planned standards coverage and identifies possible courses of action for addressing these deficiencies. Figure 16 identifies standards applicable to ATCCIS in five groups: management, user interface, systems and applications interface, information and data services, and communications services. The initial letters of these groups form the word MUSIC and the groupings are patterned after proposals from the CCTA in the UK. In addition to the four Basic Facilities, Figure 16 depicts other elements of the ATCCIS architecture and shows their relation to the five groups of standards:

- Application-level facilities (ALFs)--provide automation support for command and control key tasks.
- Man-machine interface (MMI) service facility (MSF)--provides the functionality for a generalized interface between ALFs and users, irrespective of the particular devices used to interact with users and the human-computer interface they implement.
- Input-output facilities (IOFs)--provide an interface between an ATCCIS-conformant system and a particular class of non-ATCCIS-conformant systems. Example profiles for an IOF are the STAMINA profile and the Quadrilateral Interoperability Programme profile, both discussed in Chapter 11.

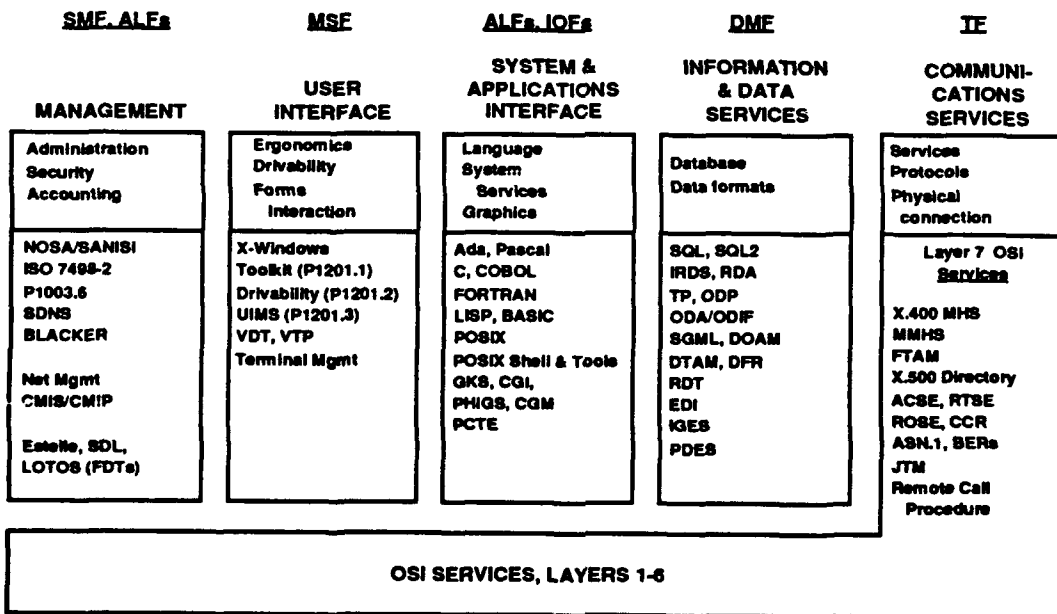


Figure 16. (U) Overview of Standards Applicable to the ATCCIS Architecture

### 12.1 OSI Technical Standards

(U) While TSGCEE has identified and assessed eight military features that need to be incorporated in commercial OSI standards for use in military systems, little detail has yet been released (e.g., in drafts of STANAGs 4251-4266) to show how these features can actually be addressed in military versions of OSI standards. WG1 and WG2 of TSGCEE SG9 are continuing to progress drafts of such standards, but it is too early to assess the degree to which the military features will be provided. TSGCEE SG9 has an ambitious 18-month plan for progressing the NATO OSI data communications standards, but without increased support from the Nations it does not appear that all the stated objectives will be reached. It appears unlikely that a stable set of NATO OSI standards addressing the full range of OSI options will be approved before the mid-1990s. Also, efforts to incorporate military requirements in civil standards and initiatives to obtain commercial products with the desired military features may not be successful until the late 1990s. Clearly, with limited resources, an evolutionary plan is needed that reflects carefully analysed priorities for progressing NATO technical standards for OSI and other open systems capabilities.

(U) There is a need to reassess and revalidate the military features that are the basis for the work by TSGCEE and the Nations to ensure military requirements will be met by the standards to be adopted. The initial views on the required military features developed in the early 1980s were based, to some degree, on concepts to support manual communications centers. Experience since that time with automated communications facilities could lead the reassessment to different results on what military features are not yet supported by civil standards. As an example, fewer levels of precedence might be acceptable than were previously determined, and different measures of quality of service might be defined.

(U) There is a need to identify additional resources and possibly new approaches to expedite the completion of the initial OSI data communications STANAGs. The scope and diversity of the applicable OSI and OSI-related standards activities in the civil sector is expanding rapidly. Some features needed by the military are already being addressed by existing and emerging international standards. Initial OSI data communications STANAGs are needed as soon as possible to provide a concrete step in the transition strategies for the NATO nations and agencies. The work plans by TSGCEE SG9 WG1 and WG2 address many of the important technical areas, but these groups are having difficulty in maturing the full set of draft STANAGs in a timely fashion.

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(U) A significant issue regarding military features for OSI technical standards is whether these features can be specified as extensions or options to the commercial standards or, alternatively, whether some of the features mandate deviations and hence noncompliance with the base commercial standards. Whenever military features can be provided through extensions or new options to existing commercial standards, the specifications for the services and protocols could be offered to the international standards bodies and the nations could seek to have these changes made part of the standard. In such cases, commercial implementations of the military features could be expected at a much lower cost than if military-unique deviations had to be supported.

(U) If NATO and the nations are not successful in defining the military features or if they are not fully addressed by the international commercial standards, as either extensions or options, then the following actions should be considered, presumably by TSGCEE:

- Assess the functionality of the ISO/CCITT standards against the proposed military requirement
- Assess the operational impact of not meeting the requirement in CCISs for data communications
- Identify cost(s) associated with implementing a nonconformant, military-unique standard
- Refer the results back to an operational body within NATO to determine if the added functionality is cost-justified in accordance with memorandum of agreement procedures.

### 12.2 Other Technical Standards

(U) Data standardization is needed to support the development of ATCCIS. Since data standardization addresses the representation of data as well as data management, data element standardization, and naming conventions, it requires not only technical but also procedural and operational standards. Data standardization issues and recommendations are addressed in WP 7L, *Operational and Procedural Requirements for Data Management and Standardization*.

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**12.3 Recommendations**

(U) The following recommendations are made in the area of progressing the technical standards:

- a. TSGCEE SG9 should continue the current efforts to reassess and revalidate the military features that do not appear to be provided by existing and emerging civil standards.
- b. TSGCEE should identify additional resources and possibly new approaches to expedite the completion of the initial OSI data communications STANAGs. As examples, the nations could increase the resources provided to TSGCEE SG9 and more active participation by civil agencies and contractors could be considered.
- c. The nations should seek wherever possible to influence the international and national standards bodies to incorporate the military features identified by TSGCEE SG9 into the civil standards. Specifically, the nations should support initiatives in ISO to expand work in areas of interest to the military. Examples are the ISO questions on whether to continue architectural work on multipeer data transmission and on quality of service.
- d. The military organizations of the nations should actively participate in international and national civil standards bodies to ensure that military requirements are addressed by the emerging open systems standards.
- e. TSGCEE should adopt International Standardized Profiles whenever possible and should seek international recognition of additional profiles where they are needed for military systems.
- f. TSGCEE should develop and adopt a plan to ensure that a set of NATO OSI STANAGs is available in the mid-1990s, even if adopting this plan means postponing the incorporation of some low priority requirements. This plan, including a schedule for the release of the OSI STANAGs, should be included in the next draft of the *NTIS Transition Plan* developed by TSGCEE SG9.
- g. The *NTIS Transition Plan* should be expanded to include additional standards and specific profiles of standards recommended for use by ACCS, ACE CCIS, ATCCIS, BICES, and other major NATO projects until a complete set of NATO OSI STANAGs have been promulgated.
  - (1) The profiles should include support for the exchange of information through database-to-database transfers as well as for STANAG 5500 messages and the data link to replace Link 1 (as required by ACCS).
  - (2) The profiles should include support for ISDN.
  - (3) The standards should include those for graphics interfaces and language bindings, document and picture interchange, remote data access, the reference model for data management, transaction processing, and open distributed processing.

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**APPENDIX A**

**THE USE OF INTEROPERABILITY PARAMETERS TO  
ENSURE STANDARDS COVERAGE**

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## THE USE OF INTEROPERABILITY PARAMETERS TO ENSURE STANDARDS COVERAGE

### 1. INTEROPERABILITY PARAMETER METHODOLOGY

#### 1.1 General

(U) This section describes a methodology for ensuring adequate standards coverage through detailed analysis of the parameters that are required to achieve interoperability against specific standards that control these parameters.

#### 1.2 Description of the Methodology

(U) An Interoperability Parameter (IP) is a system or design parameter whose control is required to achieve interoperability. These parameters are identified in system specifications, interface control documents, and other requirements documents prior to or very early in the system development process. In many cases, the interoperability parameters are controlled through the specification of a range of standards. The assembled parameters act as a checklist for interoperability, since each IP must be controlled by a suitable standard. The purpose of an analysis using IPs is to recognize and examine all relevant quantities and characteristics in a direct manner, instead of assuming that existing or draft standards will provide adequate coverage of the quantities.

(U) One of the underlying principles for the ATCCIS concept is that specifying standards is essential to ensuring interoperability. However, it cannot be emphasized too strongly that specifying standards alone will not guarantee interoperability. Indeed, every standard has a number of design parameters or IPs whose values may need to be fixed in the design phase of implementation. To ensure interoperability, each of these IPs must also be specified and controlled. Some IPs are very general and may be used to specify a class of options or mode of operation. Other IPs may be very detailed, such as restrictions on timing, format size, or bandwidth.

(U) IPs can be identified and appropriately controlled in any stage of system development, from initial concepts and requirements to detailed design and as-built specifications. Parameters may simply be the identity of governing specifications (e.g., standards) for interface or other requirements. They could be the identity of options or specification of limits on performance requirements. They could include lists of services or routines that are mandated or that are denied for use. IPs may include logical or physical layouts that show such elements as sequences, relationships, interconnections, and logical block diagrams. IPs may include waveforms. They may include operating procedures, such as dial settings. In short, IPs include any information item that needs to be controlled at any stage of development to ensure interoperability.

(U) Because each standard is a reflection of the degree to which agreement can be reached in a service area, many important attributes (i.e., IPs) are often left unspecified or unaddressed. As agreements are reached over time, the standards will improve by addressing more functionality and harmonizing conflicting approaches. In cases where standards identify extensions and other types of options, great care must be taken in standards specification and IP control to ensure that, whenever an extension or option is permitted, every implementation of the related service also supports this extension or option. This principle is especially important in achieving not only interoperability but also portability of applications from one implementation or environment to another, such as is needed when operating systems, data management systems, interface packages, and hardware are upgraded.

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**1.3 Examples of Interoperability Parameters**

(U) This section provides a brief introduction to interoperability parameters by examining portions of three sets of standards:

- Physical standards for 25-pin connectors (i.e., EIA RS-232D interface)
- Electrical characteristics of digital interface circuits (i.e., EIA RS-423A and QSTAG 594)
- Transmission characteristics for single channel radio (i.e., STANAG 4202).

**1.3.1 Physical Standards for 25-pin Connectors**

(U) Table A-1 identifies a number of electrical and mechanical interoperability parameters controlled by EIA RS-232D for 25-pin connectors. The first two columns provide the definition of the interoperability parameter; the values specified in the standard, if any, are given in the third column.

*Table A-1. (U) Example Interoperability Parameters Based on Characteristics of Unbalanced Load Digital Interface Circuits, 25-Pin Interface Connectors*

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| Description of Interoperability Parameter                             |  | Example Value of IP |
|---|--|---------------------|
| <b>EXAMPLE ELECTRICAL CHARACTERISTICS:</b>                            |  |                     |
| Undefined condition   | Minimum voltage                              | -3 volts            |
|   | Maximum voltage                              | +3 volts            |
| Marking condition (binary ONE)  | Interface Voltage Maximum                    | -3 volts            |
| Spacing condition (binary ZERO)                                       | Interface Voltage Minimum                    | +3 volts            |
| Restriction on use of hysteresis techniques to enhance noise immunity |  | None                |
| Load impedance of the receiver side                                   | Minimum for applied voltage ≤ 25 volts       | 3,000 ohms          |
|   | Maximum for applied voltage of 3 to 25 volts | 7,000 ohms          |
| Effective shunt capacitance of receiver                               | Maximum                                      | 2,500 picofarads    |
| <b>EXAMPLE MECHANICAL CHARACTERISTICS:</b>                            |  |                     |
| Number of Pins  |  | 25                  |
| Cable length  | Maximum                                      | Not specified       |
| Connector length (male contacts, female shell)                        | Minimum                                      | 38.84 mm            |
|   | Maximum                                      | 39.09 mm            |
| Connector width (male contacts, female shell)                         | Minimum                                      | 8.23 mm             |
|   | Maximum                                      | 8.48 mm             |
| Contact spacing, Pin #1   | Longitudinal offset                          | +16.56 mm           |
|   | Lateral offset                               | +1.42 mm            |
| Contact spacing, Pin #2   | Longitudinal offset                          | +15.19 mm           |
|   | Lateral offset                               | -1.42 mm            |
| Contact spacing, Pin #25  | Longitudinal offset                          | -16.56 mm           |
|   | Lateral offset                               | +1.42 mm            |

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Table A-1. (U) (Continued)

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| Description of Interoperability Parameter    |         | Example Value of IP   |
|--|---------|-----------------------|
| Pin diameter                                 | Minimum | 0.98 mm               |
|  | Maximum | 1.06 mm               |
| Pin length, overall with mounting            | Minimum | 9.77 mm               |
|  | Maximum | 10.03 mm              |
| Pin mounting length                          | Minimum | 1.57 mm               |
|  | Maximum | 1.76 mm               |
| Female contact length, overall with mounting | Minimum | 9.27 mm               |
|  | Maximum | 9.63 mm               |
| Female contact socket depth                  | Minimum | 7.37 mm               |
|  | Maximum | 7.37 mm               |
| Pin assignment                               | Pin #1  | Shield                |
|  | Pin #2  | Transmitted Data (BA) |
|  | Pin #5  | Clear to Send (CA)    |
|  | Pin #25 | Test Mode (TM)        |
| Female contact socket depth                  | Minimum | 7.37 mm               |
|  | Maximum | 7.37 mm               |

Sources:

- (1) DIS 2110, *25-Pin DTE/DCE Interface Connector and Pin Assignments* (related to EIA RS-232C), November 1985.
- (2) EIA RS-232D, *Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, 1986.
- (3) EIA RS-449, *General Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, November 1977.
- (4) EIA Industrial Electronics Bulletin IEB-12, *Application Notes on Interconnection Between Interface Circuits Using RS-449 and RS-232C*, November 1977.

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**1.3.2 Electrical Characteristics of Digital Interface Circuits**

(U) Table A-2 identifies interoperability parameters of digital interface circuits that are controlled by QSTAG 594. These are all electrical characteristics.

*Table A-2. (U) Example Interoperability Parameters Based on Electrical Characteristics of Unbalanced Load Digital Interface Circuits*

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| Description of Interoperability Parameter  |  | Example Value of IP                   |
|--|--|---------------------------------------|
| Open circuit voltage, generator            | Minimum magnitude  | 4 volts                               |
|  | Maximum magnitude  | 6 volts                               |
| Test termination voltage, generator        | 450 ohm $\pm$ 1% test load min                                       | 90% magnitude of open circuit voltage |
| Short circuit current, generator           | Maximum magnitude  | 150 mA                                |
| Output leakage current, current, generator | Maximum magnitude with applied voltage from -6 V to +6 V             | 100 $\mu$ A                           |
| Output signal waveform voltage             | Minimum magnitude  | 3.6 volts                             |
|  | Maximum magnitude  | 6 volts                               |
|  | Variance between transitions   | Within 10% steady state               |
| Output signal waveshaping                  | Rise time to 90% steady state at maximum signaling rate              |                                       |
|  | Minimum  | 0.1 unit interval                     |
|  | Maximum  | 0.3 unit interval                     |
|  | Rise time to 90% steady state at signaling rates below 1 kb/s        |                                       |
|  | Minimum  | 100 $\mu$ sec                         |
|  | Maximum  | 300 $\mu$ sec                         |
| High impedance state                       | Requirement  | Optional                              |
|  | Output voltage at high imped and 450 ohm $\pm$ 1% test load          | Zero (nominal)                        |
| Wire or cable                              | Characteristics  | Not addressed                         |
| Signaling rates                            |  | Not specified                         |
| Total load                                 | Resistance minimum   | 400 ohms                              |
|  | Required differential input voltage to achieve intended binary state | 200 mV                                |
|  |  |                                       |
| Fail safe                                  | Requirement  | Optional                              |

Sources:

- (1) QSTAG 594, *Electrical Characteristics of Digital Interface Circuits*, 25 March 1981 (adopts MIL-STD-188-114).
- (2) MIL-STD-188-114A, *Electrical Characteristics of Digital Interface Circuits*, 30 September 1985 (Revision of MIL-STD-188-114 dated 24 March 1976).
- (3) CCITT V.10/X.26, *Electrical Characteristics for Unbalanced Double-Current Interchange Circuits for General Use With Integrated Circuit Equipment in the Field of Data Communications*, 1985 (related to EIA RS-423A, which is compatible with MIL-STD-188-114A).
- (4) EIA RS-423A, *Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits*, December 1978.

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**1.3.3 Transmission Characteristics for Single Channel Radio**

(U) Table A-3 presents a nearly complete summary of the interoperability parameters controlled by STANAG 4202 for single channel radios. This standard is in use in NATO as the basis of interoperability for digital data transmission on combat net radio.

*Table A-3. (U) Example Interoperability Parameters Based on Single Channel Radio Standards (STANAG 4202)*

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| <b>Description of Interoperability Parameter</b>              |   | <b>Example Value of IP</b>  |
|---|---|---|
| Frequency band  | Minimum frequency                           | Not specified   |
|   | Maximum frequency                           | Not specified   |
|   | Channel spacing                             | Not specified   |
| Transmission rates (1)  | Preferred rate                              | 600 b/s   |
|   | Other required rates                        | 300, 1,200 (and 150 for HF)   |
| Modulation  | Type  | FSK   |
| Data  | Character coding type                       | NATO 7-bit  |
| FSK modulation  | Mark (or 1) frequency                       | 1575 Hz   |
|   | Space (or 0) frequency                      | 2425 Hz   |
|   | Audio tone frequency accuracy, transmit     | ± 5 Hz (± 1 Hz desired)   |
|   | Receiver accuracy                           | ± 20 Hz   |
| FSK transition between mark & space                           | Maximum phase discontinuity                 | 5 degrees   |
| FSK timing  | Minimum clock accuracy for synchronous data | ± 1 part in 10 <sup>5</sup>   |
| Keytime delay   | Required                                    | 0.53333, 2.026676 sec   |
|   | Options                                     | Multiples of 0.10667 sec (2)  |
|   | Modulation applied                          | Reversals ending in a zero  |
| Bit synchronization preamble                                  | Length                                      | 33 bits   |
|   | Modulation                                  | Reversals ending in a "1"   |
| Character synchronization preamble                            | Length                                      | 63 bits   |
|   | Modulation                                  | Pseudo-random sequence generated by a (6,1) shift register starting with "111111" |
| Message preparation for transmission                          | Initial character                           | "SI" or "NUL" (clear, respectively, encrypted text follows)                       |
|   | Message structure                           | 7-bit bytes   |
|   | Message padding                             | Up to 6 "1" bits  |
| Cyclic redundancy check (applied to the entire input message) | CRC type                                    | Polynomial  |
|   | Generator (mod 2)                           | $x^{16}+x^{12}+x^5+1$   |
|   | Conversion to 8-bit byte                    | 0 in most significant bit   |
|   | Size of check                               | Three 7-bit bytes   |
|   | CRC padding                                 | NATO 7-bit end-of-text chars as required (up to 15) (3)                           |
| Envelope termination  | Size  | Four 7-bit characters<br>NATO 7-bit end-of-text chars                             |

**Notes:**

- (1) STANAG 4202 (Appendix B) provides guidelines for interim use of 16,000 b/s channels that are not shown in this table.
- (2) 0.10667 sec is the time to send 128 bits at 1,200 b/s or 64 bits at 600 b/s.
- (3) The minimum message is 16x7 or 112 bits and requires 0.19 sec at 600 b/s.

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Table A-3. (U) (Continued)

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| Description of Interoperability Parameter                      |   | Example Value of IP   |
|--|---|---|
| Error detection and correction coding (applied to 7-bit bytes) | ED&C type                                     | Hamming (12,7), produces 12-bit coding for every 7-bit byte |
| Time dispersal coding  | TDC interleaving array size                   | 16x12, with sixteen 12-bit Hamming codes                    |
| Errors   | Number of acceptable but uncorrectable errors | None (stop processing and send no NACK)                     |

Source: STANAG 4202 EL (Edition 2), *Transmission Envelope Characteristics for High Reliability Data Exchange Between Land Tactical Data Processing Equipment Over Single Channel Radio Links*, Military Agency for Standardization, NATO, 25 May 1988.

1.3.3 Interoperability Parameters for X.25 Packet Switching

(U) Table A-4 provides the interoperability parameters for the Implementor's Agreements on the X.25 packet switching protocol as defined in the 1989 NIST Workshop stable agreements that apply to US GOSIP Version 1.0.<sup>1</sup> The NIST Workshop understands that agreement to these interoperability parameters will ensure interoperability of implementations of the X.25 protocols.<sup>2</sup>

2. USING INTEROPERABILITY PARAMETERS TO CHARACTERIZE MILITARY FEATURES IN OSI-RELATED TACTICAL STANDARDS

(U) This section is intended to be expanded to demonstrate the use of interoperability parameters to describe how some fielded tactical data systems are implementing military versions of OSI standards to achieve interoperability. The descriptions here extend the tables provided in Chapter 9 to describe the Quadrilateral Interoperability Program and STAMINA. Examples will also be taken from Appendix C, National Initiatives for Military Use of OSI Standards.

<sup>1</sup> (U) *Stable Implementation Agreements for Open Systems Interconnection Protocols, Version 2, Edition 1*, NIST Special Publication 500-16, National Institute of Standards and Technology, December 1988, UNCLASSIFIED.

<sup>2</sup> (U) Private communication with Director, Systems and Network Architecture Division, NIST, 25 May 1989.

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*Table A-4. (U) Interoperability Parameters for X.25 Packet Switching*

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|   | ISO Layer & Function | Standards Cited                        | Notes on Interoperability Parameters  |
|---|----------------------|--|---|
| - | General              | CCITT X.25                             | <ul style="list-style-type: none"> <li>• Defines procedures required to describe the DTE side of a CTE/DCE interface for systems attached to subnetworks providing an X.25 interface shall be as defined in ISO 7776 and ISO 8208 as indicated below.</li> <li>• These procedures shall also apply to a DTE operating on a DTE/DTE interface.</li> </ul>  |
| 3 | Network Layer        | ISO 8208 (X.25 PLP)                    | <ul style="list-style-type: none"> <li>• The elements of ISO 8208 applicable for use depend on the OSI role of ISO 8208 (i.e., provision of CONS, support of CLNP):               <ul style="list-style-type: none"> <li>a. When ISO 8208 is used to support CONS, the optional user facilities in Section 5.1 of ISO 8878 shall be supported.</li> <li>b. When ISO 8208 is used to support CLNP (when providing the CLNS), Permanent Virtual Circuit may be used.</li> </ul> </li> <li>• Virtual Call Service is required.</li> <li>• Any mutually agreed window and packet size may be used; however, all DTEs must be capable of supporting a window size of 2, a packet size of 128 octets, and a sequence number modulus of 8.</li> <li>• The Basic RPOA Selection Facility shall be implemented and its use or non-use selectable on a per virtual call basis. (1)</li> </ul> |
| 2 | Data Link Layer      | ISO 7776 (HDLC Procedures-- X.25 LAPB) | <ul style="list-style-type: none"> <li>• The address assignments are:<br/>               DTE = A (=11000000 binary)<br/>               DCE = B (=10000000 binary).<br/>               On a DTE/DTE interface, one of the DTEs, by a prior agreement, shall use the DCE address.</li> <li>• The modulus shall be 8.</li> <li>• A window size (k) of 7 shall be supported. In addition, other window sizes may also be supported.</li> <li>• The Multilink Procedures are excluded.</li> </ul>  |

Notes:

1. Agreement on the Basic RPOA Selection Facility parameter is an ongoing, not a stable, implementation agreement.

References:

1. Stable Implementation Agreements for Open Systems Interconnection Protocols, Version 1, Edition 1, NIST, December 1988.
2. Ongoing Implementation Agreements for Open Systems Interconnection Protocols: Continuing Agreements, NISTIR 88-3824-2, NIST, February 1989.

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A-8

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**APPENDIX B**

**FUNCTIONAL PROFILES IDENTIFIED IN THE  
NTIS TRANSITION STRATEGY**

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## FUNCTIONAL PROFILES IDENTIFIED IN THE NTIS TRANSITION STRATEGY

### 1. INTRODUCTION

(U) The *NATO Technical Interoperability Standards (NTIS) Transition Strategy* [Ref. 4] is developed by the Tri-Service Group on Communications and Electronics Equipment (TSGCEE) and promulgated by the Conference of National Armaments Directors (CNAD). This appendix identifies the functional profiles identified in the 1989 *NTIS Transition Strategy*. All are based on existing or emerging recommendations developed by international or regional standards bodies. Most are based on recommendations from the European Workshop for Open Systems (EWOS).

(U) The notation used to identify and distinguish the functional profiles is that currently being used by EWOS. This notation will be changed in future editions of the *NTIS Transition Strategy* to the taxonomy developed by ISO in TR 10000. The ISO taxonomy is described in Section 9.3.2.

### 2. APPLICATION PROFILES

(U) There are four functional profiles identified in Figure B-1:

- A.111, Simple File Transfer
- A.221, Basic Teletex
- A.331, Message Handling Service for Interpersonal Messaging (IPM): IPM End System to IPM End System
- A.332, Message Handling Service for IPM: User Agent (UA) to Message Store (MS).

|   |                                  |
|---|----------------------------------|
| 7 | ISO 8571<br>ISO 8650             |
| 6 | ISO 8823<br>ISO 8824<br>ISO 8825 |
| 5 | ISO 8327                         |

(a) A.111, Simple File Transfer

|   |              |
|---|--------------|
| 7 | CCITT - T.60 |
| 6 | CCITT - T.61 |
| 5 | CCITT - T.62 |

(b) A.221, Basic Teletex

|   |                     |                                  |
|---|---------------------|----------------------------------|
|   | IPM service         | ISO 10021-7/X.420                |
|   | MT service          | ISO 10021-4/X.411                |
| 7 | MT protocol         | ISO 10021-6/X.419                |
|   | Reliable transfer   | ISO 9066-2                       |
|   | Association control | ISO 8650                         |
| 6 |                     | ISO 8823<br>ISO 8824<br>ISO 8825 |
| 5 |                     | ISO 8327                         |

(c) A.331, Message Handling Service:  
Interpersonal Messaging: IPM End System  
to IPM End System

|   |                     |                                  |
|---|---------------------|----------------------------------|
|   | MS service          | ISO 10021-5/X.413                |
|   | IPM service         | ISO 10021-7/X.420                |
|   | MT service          | ISO 10021-4/X.411                |
| 7 | MT protocol         | ISO 10021-6/X.419                |
|   | Remote Operations   | ISO 9072-2                       |
|   | Reliable transfer   | ISO 9066-2                       |
|   | Association control | ISO 8650                         |
| 6 |                     | ISO 8823<br>ISO 8824<br>ISO 8825 |
| 5 |                     | ISO 8327                         |

(d) A.332, Message Handling Service:  
Interpersonal Messaging: UA to MS

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**3. TRANSPORT PROFILES**

(U) Figure B-2 identifies 20 transport profiles. The first four [B-2(a) to B-2(d)] are for the Integrated Services Digital Network (ISDN):

- T.111x,<sup>1</sup> ISDN Circuit Switched Bearer Services over the Connection-Oriented Network Service (CONS) using the B-Channel (LAP B, X.25/PLP)
- T.121x, ISDN Packet Switched Bearer Services over CONS using the B-Channel (X.31)
- T.122, ISDN Packet Switched Bearer Services over CONS using the D-Channel (X.31)
- T.131x, ISDN Port Access to a Packet Switched Digital Network (PSDN) (X.31, X.32).

|   |                                   |                        |  |
|---|-----------------------------------|------------------------|--|
| 4 |                                   | ISO 8073 classes 0 + 2 |  |
|   |                                   | ISO 8878, ISO 9574     |  |
| 3 | Q.931/I.451                       | ISO 8208 (X.25/PLP)    |  |
| 2 | Q.921/I.441 (LAPD)                | ISO 7776 (X.25 LAPB)   |  |
| 1 | D-channel (I.430, ISO 8877)/I.431 | B-channel              |  |

(a) T.111, ISDN Circuit Switched Bearer Services CONS Using B-Channel

|   |                                   |                        |  |
|---|-----------------------------------|------------------------|--|
| 4 |                                   | ISO 8073 classes 0 + 2 |  |
|   |                                   | ISO 8878, ISO 9574     |  |
| 3 | Q.931/I.451                       | ISO 8208 (X.25/PLP)    |  |
| 2 | Q.921/I.441 (LAPD)                | ISO 7776 (X.25 LAPB)   |  |
| 1 | D-channel (I.430, ISO 8877)/I.431 | B-channel              |  |

(b) T.121, ISDN Packet Switched Bearer Service CONS Using B-Channel (X.31 Case B)

|   |                                   |                        |  |
|---|-----------------------------------|------------------------|--|
| 4 |                                   | ISO 8073 classes 0 + 2 |  |
|   |                                   | ISO 8878, ISO 9574     |  |
| 3 | Q.931/I.451                       | ISO 8208 (X.25/PLP)    |  |
| 2 | Q.921/I.441 (LAPD)                |                        |  |
| 1 | D-channel (I.430, ISO 8877)/I.431 |                        |  |

(c) T.122, ISDN Circuit Switched Bearer Services CONS Using D-Channel

|   |                                   |                        |  |
|---|-----------------------------------|------------------------|--|
| 4 |                                   | ISO 8073 classes 0 + 2 |  |
|   |                                   | ISO 8878, ISO 9574     |  |
| 3 | Q.931/I.451                       | ISO 8208 (X.25/PLP)    |  |
| 2 | Q.921/I.441 (LAPD)                | ISO 7776 (X.25 LAPB)   |  |
| 1 | D-channel (I.430, ISO 8877)/I.431 | B-channel              |  |

(d) T.131, ISDN Port Access to a PSDN (X.31 Case A/X.32)

|                             |   |                        |      |
|-----------------------------|---|------------------------|------|
| 4                           |   | ISO 8073 classes 0 + 2 |      |
| V.25 or V.25bis<br>ISO 2110 | 3 | ISO 8208               |      |
|                             | 2 | ISO 7776               | T.71 |
|                             | 1 | V.24<br>ISO 2110       |      |

(e) T.21, Analogue Telephone Circuit, Permanent Circuit (CONS)

|   |                                  |                        |      |
|---|----------------------------------|------------------------|------|
| 4 |                                  | ISO 8073 classes 0 + 2 |      |
|   |                                  | ISO 8208               |      |
|   |                                  | ISO 7776               |      |
| 1 | V.24, ISO 2110                   |                        | T.71 |
|   | V.35, ISO 2593<br>V.36, ISO 4902 |                        |      |

(f) T.22, Analogue Telephone Circuit, Switched Circuit (CONS)

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*Figure B-2. (U) Transport Functional Profiles*

<sup>1</sup> (U) In the ISDN profiles, x=1 for the Permanent case and x=2 for the Switched case.

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|   |                        |
|---|------------------------|
| 4 | ISO 8073 classes 0 + 2 |
| 3 | ISO 8208               |
| 2 | ISO 7776               |
| 1 | X.21<br>X.21bis        |

(g) T.31x, Permanent Access to a PSDN, T.70/CONS

|   |                                    |
|---|------------------------------------|
| 4 | Draft STANAG 4264<br>classes 0 + 2 |
| 3 | Draft STANAG 4263                  |
| 2 | Draft STANAG 4262                  |
| 1 | Draft STANAG 4261                  |

(h) T.312M, Permanent Access to a PSDN, CONS (Military)

|   |                  |      |
|---|------------------|------|
| 4 | ISO 8073 class 0 | X.32 |
| 3 | ISO 8208         |      |
| 2 | ISO 7776         |      |
| 1 | X.25 level 1     |      |

(i) T.321, Switched Access to a PSDN, CONS, Telephone Circuit Access

|   |                      |      |
|---|----------------------|------|
| 4 | ISO 8073 classes 0,2 | X.32 |
| 3 | ISO 8208             |      |
| 2 | ISO 7776             |      |
| 1 | X.25 level 1         |      |

(j) T.322, Switched Access to a PSDN, CONS, Digital Data Circuit Access

|      |                        |      |
|------|------------------------|------|
| 4    | ISO 8073 classes 0 + 2 |      |
| X.21 | 3                      | T.70 |
|      | 2                      | T.70 |
| 1    | CCITT X.21             |      |

(k) T.41, Digital Data Circuit, Telematic End Systems, T.70 Case

|      |                        |                      |
|------|------------------------|----------------------|
| 4    | ISO 8073 classes 0 + 2 |                      |
| X.21 | 3                      | ISO 8208<br>ISO 8878 |
|      | 2                      | ISO 7776             |
| 1    | CCITT X.21             |                      |

(l) T.42X, Digital Data Circuit, CONS

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Figure B-2. (U) (Continued)

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|   |                        |             |
|---|------------------------|-------------|
| 4 | ISO 8073 classes 0 + 2 |             |
| 3 | ISO 8208<br>ISO 8878   | ISO<br>8881 |
| 2 | ISO 8802-2 class II    |             |
| 1 | ISO 8802-3             |             |

(m) T.611, Local Area Network  
CSMA/CD, CONS

|   |                        |             |
|---|------------------------|-------------|
| 4 | ISO 8073 classes 0 + 2 |             |
| 3 | ISO 8208<br>ISO 8878   | ISO<br>8881 |
| 2 | ISO 8802-2 class II    |             |
| 1 | ISO 8802-4             |             |

(n) T.612, Local Area network  
Token Bus, CONS

|   |                        |             |
|---|------------------------|-------------|
| 4 | ISO 8073 classes 0 + 2 |             |
| 3 | ISO 8208<br>ISO 8878   | ISO<br>8881 |
| 2 | ISO 8802-2 class II    |             |
| 1 | ISO 8802-5             |             |

(o) T.613, Local Area Network  
Token Ring, CONS

|   |                          |  |
|---|--------------------------|--|
| 4 | ISO 8073 class 4         |  |
| 3 | ISO 8473 inactive subset |  |
| 2 | ISO 8802-2 (type 1)      |  |
| 1 | ISO 8802-3               |  |

(p) T.6211, Local Area Network  
CSMA/CD, CLNS Single-LAN  
Environment

|   |                     |  |
|---|---------------------|--|
| 4 | ISO 8073 class 4    |  |
| 3 | ISO 8473            |  |
| 2 | ISO 8802-2 (type 1) |  |
| 1 | ISO 8802-3          |  |

(q) T.6212, Local Area Network  
CSMA/CD, CLNS Multiple-LAN  
Environment

|   |                     |  |
|---|---------------------|--|
| 4 | ISO 8073 class 4    |  |
| 3 | ISO 8473            |  |
| 2 | ISO 8802-2 (type 1) |  |
| 1 | ISO 8802-4          |  |

(r) T.622, Local Area Network  
Token Bus, CLNS Multiple-LAN  
Environment

|   |                          |  |
|---|--------------------------|--|
| 4 | ISO 8073 class 4         |  |
| 3 | ISO 8473 inactive subset |  |
| 2 | ISO 8802-2 (type 1)      |  |
| 1 | ISO 8802-5               |  |

(s) T.6231, Local Area Network  
Token Ring, CLNS Single-LAN  
Environment

|   |                     |  |
|---|---------------------|--|
| 4 | ISO 8073 class 4    |  |
| 3 | ISO 8473            |  |
| 2 | ISO 8802-2 (type 1) |  |
| 1 | ISO 8802-5          |  |

(t) T.6232, Local Area Network  
Token Ring, CLNS Multiple-LAN  
Environment

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*Figure B-2. (U) (Continued)*

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- (U) Two of the transport profiles [B-2(e) and B-2(f)] are for analogue telephone circuits:
  - T.21, Permanent Circuit with CONS
  - T.22, Switched Circuit with CONS.
- (U) Four PSDN transport profiles [B-2(g) and B-2(j)] are shown in Figure B-2:<sup>2</sup>
  - T.31x, Permanent Access to a PSDN, Using T.70 (T.311) or CONS (T.312)
  - T.312M, Permanent Access to a PSDN with CONS (draft STANAG for military use)
  - T.321, Switched Access to a PSDN, Telephone Circuit, Using Transport Protocol Class 0 (TP0) over CONS
  - T.322, Switched Access to a PSDN, Data Circuit, Using TP0 and TP2 over CONS.
- (U) Two digital data circuit transport profiles [B-2(k) and B-2(l)] are shown in Figure B-2:
  - T.41, Digital Data Circuit for Telematic End Systems Using T.70
  - T.42x, Digital Data Circuit Using CONS (T.421 for Permanent Circuit and T.422 for Switched Circuit).
- (U) The final six transport profiles [B-2(m) and B-2(t)] are for local area networks (LANs):<sup>3</sup>
  - T.611, CSMA/CD LAN with CONS
  - T.612, Token Bus LAN with CONS
  - T.613, Token Ring LAN with CONS
  - T.6211, CSMA/CD LAN, CLNS Single-LAN Environment
  - T.6212, CSMA/CD LAN, CLNS Multiple-LAN Environment
  - T.622, Token Bus, CLNS Multiple-LAN Environment
  - T.6231, Token Ring LAN, CLNS Single-LAN Environment
  - T.6232, Token Ring LAN, CLNS Multiple-LAN Environment.

#### 4. RELAY PROFILES

- (U) Figure B-2 identifies 11 relay profiles. These are:
  - Relaying the CONS:<sup>4</sup>
    - R.11, LAN to LAN
    - R.12, LAN to X.25 (PSDN)
  - Relaying the CLNS:
    - R.21, LAN to LAN
    - R.22, LAN to X.25 (PSDN)
  - Relaying the X.25 Packet Layer Protocol:
    - R.31, LAN to LAN
    - R.32, LAN to X.25 (PSDN, Virtual Call)
    - R.33, X.25 (PSDN, Virtual Call) to X.25 (PSDN, Virtual Call)

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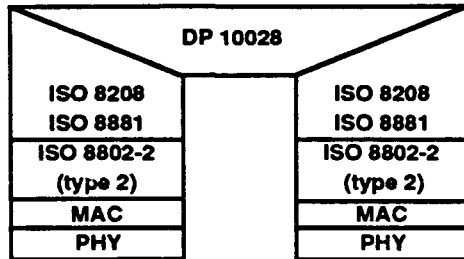
<sup>2</sup> (U) All the T-profiles provide the Connection-Oriented Transport Service (COTS). U-profiles would use the Connectionless Transport Services (CLTS)--no U-profiles have been identified in the 1989 *NTIS Transition Strategy*.

<sup>3</sup> (U) No T-profiles are given in the 1989 *NTIS Transition Strategy* for T.614, Fiber Distributed Data Interface (FDDI) LAN with CONS or for T.624, FDDI LAN with CLNS.

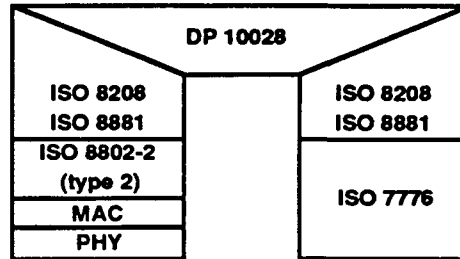
<sup>4</sup> (U) The 1989 *NTIS Transition Strategy* also identifies (without specifying the protocol stacks) a military profile being developed in SG9 WG1 for R.131(M), Relaying the CONS, WAN/PSDN to WAN/PSDN Using X.75.

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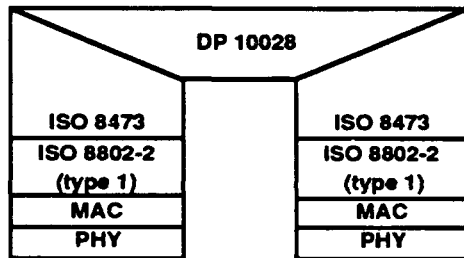
- Relaying the Media Access Control (MAC) Service:
  - R.41, CSMA/CD to CSMA/CD
  - R.42, CSMA/CD to Token Ring
  - R.43, Token Ring to Token Ring
  - R.44, CSMA/CD to Fiber Distributed Data Interface (FDDI)



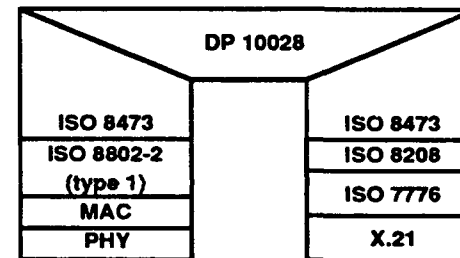
(a) R.11, Relaying the  
CONS, LAN-LAN



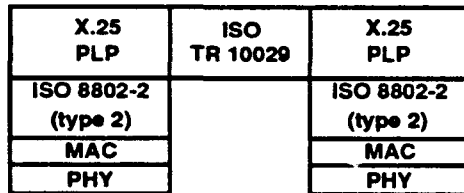
(b) R.12, Relaying the  
CONS, LAN-X.25 (PSDN)



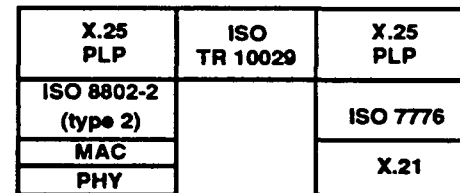
(c) R.21, Relaying the  
CLNS, LAN-LAN



(d) R.22, Relaying the  
CLNS, LAN-X.25 (PSDN)



(e) R.31, Relaying the X.25  
Packet Layer Protocol, LAN-LAN

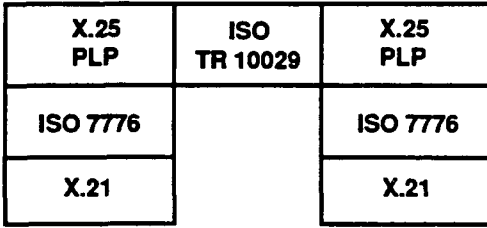


(f) R.32, Relaying the X.25  
Packet Layer Protocol, LAN-X.25  
(PSDN, Virtual Call)

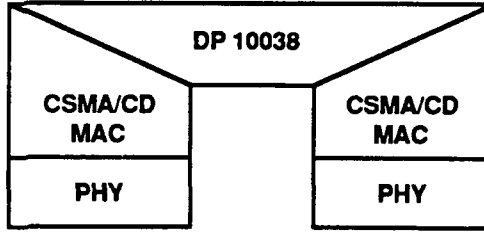
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*Figure B-3. (U) Relay Functional Profiles*

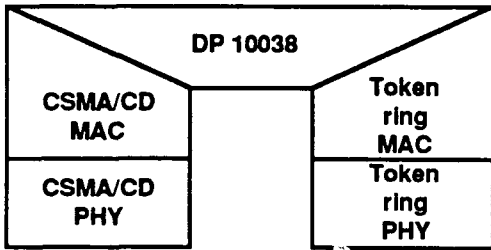
**UNCLASSIFIED**



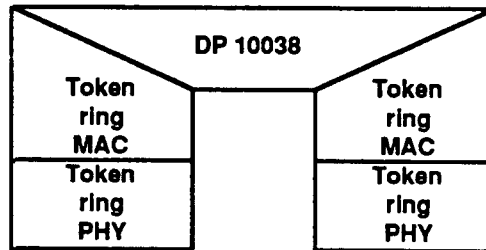
(g) R.33, Relaying the X.25 PLP, X.25 (PSDN Virtual Call)-(PSDN, Virtual Call)



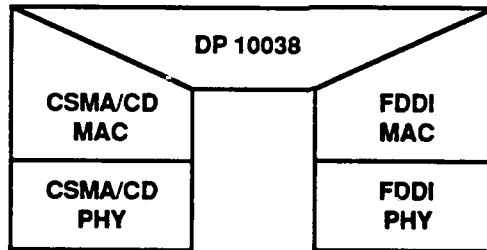
(h) R.41, Relaying the MAC Service, CSMA/CD-CSMA/CD



(i) R.42, Relaying the MAC Service, CSMA/CD-Token Ring



(j) R.43, Relaying the MAC Service, Token Ring-Token Ring



(k) R.44, Relaying the MAC Service, CSMA/CD-FDDI

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*Figure B-3. (U) Relay Functional Profiles (Continued)*

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**APPENDIX C**

**NATIONAL INITIATIVES FOR MILITARY USE OF  
OSI STANDARDS**

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**NATIONAL INITIATIVES FOR MILITARY USE OF  
OSI STANDARDS**

**1. INTRODUCTION**

**1.1 General**

(U) This appendix identifies national initiatives that make or plan to make significant use of OSI standards in military applications. Major bilateral and multilateral initiatives are discussed in the main body of this working paper; these include the Quadilateral Interoperability Programme (Section 9.3.5) and STAMINA (9.3.6).

**1.2 Purpose**

(U) The primary purpose of this review of national initiatives is to identify the ways in which military features are being addressed in national systems. In some cases, there may be fully compliant use of OSI standards. In other cases, there may be defined some extensions to the standards that could be considered by international bodies as candidates for new options to the commercial standards, so that in the time frame of ATCCIS (and other NATO CCIS projects) the military features (e.g., a secure local area network) may be specified by civil standards. On the other hand, analysis of national initiatives may lead to conclusions that some features may need to be specified as deviations from civil standards and, in these cases, the relevant STANAGs may need to have similar deviations.

**1.3 Scope and Organization**

(U) National initiatives discussed in Section 2 are addressed, where possible, in terms of requirements, profiles, and transition strategies that have been recommended or adopted. A short review is provided in Section 3 of work being done to evaluate the performance of civil standards for military applications. Several initiatives that have led to fielded operational capabilities are discussed in Section 4 in some detail.

**2. OVERVIEW OF NATIONAL INITIATIVES TO IMPLEMENT OSI STANDARDS  
IN MILITARY AND RELATED SYSTEMS**

**2.1 France**

**Army Tactical CCIS Systems (U).** Army tactical CCIS systems in France are using or are projecting to use more and more components based on OSI standards. The Army is following the general recommendations of standards organizations such as AFNOR, SPAG, CCITT, and CEN/CENELEC (see Appendix F), and would thereby try to use, wherever possible, the products (hardware and software) built upon these standards.

(U) One example of the implementation of OSI standards in Army tactical systems is the use of ETHERNET™ (ISO 8802.3) to link cells within a command post. In addition, tactical networks, such as RITTER and RETINAT, are based on CCITT X.25 packet switched standards. Table C-1 identifies the international OSI standards that the Army intends to use in its standardized MHS Gateway, based on QTIDP specification.

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*Table C-1. (U) French Army Standardized MHS Gateway*

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| OSI Layer              | International Standard                      | Brief Title of Standard      |
|------------------------|---|------------------------------|
| Application (Layer 7)  | CCITT X.400<br>ISO 9066-2<br>ISO 8649, 8650 | MHS<br>RTSE<br>ACSE          |
| Presentation (Layer 6) | CCITT X.409                                 | Abstract Syntax Notation     |
| Session (Layer 5)      | ISO 8326, 8327                              | Basic Service and Protocol   |
| Transport (Layer 4)    | ISO 8072, 8073                              | Class 2 Service and Protocol |
| Network (Layer 3)      | ISO 8208                                    | Basic Service and Protocol   |
| Data Link (Layer 2)    | ISO 7776                                    | HDLC LAP B                   |
| Physical (Layer 1)     | CCITT X.21                                  |                              |

**RETINAT (U).** RETINAT is a data communications systems for the French Army. The network operates 33 switches of two types (one for military districts and one for military regions). The network accommodates 1,400 synchronous and 600 asynchronous ports and supports data rates from 300 bps to 64 Kbps. The switches are interconnected with 64-Kbps trunks and use X.75 gateways for interoperability with other data networks.<sup>1</sup>

**Real Time Transport Service (RTTS) (U).** The French MOD has developed an architecture and implementations of that architecture for a Real Time Transport Service (RTTS). GAM-T-103 is a specification for an implementation of this architecture.<sup>2</sup> RTTS results from more than 15 years of experience in the design and realization of real-time data networks for military systems. RTTS provides not only data communication services but also synchronization and management services. RTTS was described at the June 1990 Military OSI Symposium at STC.<sup>3</sup> The paper addressed the ISO Transport Service, real-time constraints, and a proposed real-time Transport Service. It presented the classes of service, the models used for data transfer, the connection-oriented and connectionless modes for communication services, the synchronization services, and the management services. RTTS has been proposed in draft STANAG 4254 (Annex E) as the basis for defining real-time services for NATO CCISs (see Section 10.4.4).

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<sup>1</sup> (U) *Secure Data Communication Defence System*, Vincenzo Cassese, ALCATEL CIT, France, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

<sup>2</sup> (U) *Military Real Time Local Area Network*, GAM-T-103, Ministre de la Defense, Republique Francaise, 9 February 1987, UNCLASSIFIED.

<sup>3</sup> (U) *Definition of Real-Time Services for the OSI Transport Layer*, Pascal Prophete, STEI, French MOD, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

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**Public Message System (U).** ATLAS 400 is a public messaging system based on CCITT MHS X.400-1984 and is a good illustration of the national implementation of X.400 standards. Administration and design of ATLAS 400 is under the responsibility of TRANSPAC, a public company that is a subsidiary of FRANCE TELECOM. The ATLAS 400 services can be provided to private companies or administrations, and different kinds of systems can be built:

- A large company can get its own "private" messaging system, and all the nodes can be split throughout the country at the different company's locations.
- It is also possible to get a system that allows different organizations (public or private) to exchange messages between them. This can be useful, for example, to exchange documents between provider and client. Such an implementation would be used to exchange information between different companies.

(U) The ATLAS 400 functional profile is defined in *Specification Technique d'Utilisation et de Raccordement (STUR) ATLAS 400*, which defines Layers 1 to 7. This document also derives from an early effort of the Centre National d'Etude des Telecommunications (CNET) to promote the X-Series standardization (this work, named ARCHITEL, is described below).

(U) ATLAS 400 is only an interpersonal messaging system, and so uses only the Interpersonal Messaging Protocol from the X.400 Series. ATLAS 400 can also be adapted to the size of the company's computer equipment. For example, the Message Transfer Agent may be locally implemented or derived from the ATLAS 400 implementation. Thus, the User Agent and the Message Transfer Agent are not necessarily co-resident. This illustrates the possibilities of tailoring the system to client use.

**ARCHITEL (U).** Historically, ARCHITEL is a group effort within CNET. Its purpose was to promote the use of X-Series standards for the widespread use of FRANCE TELECOM and telecommunications companies, in particular by the CNET contractors. ARCHITEL defined X-Series profiles in the early 1980s. ARCHITEL implemented these profiles, specifically those for the lower five layers, to validate the parameters and options used for interoperation and also to clarify the standards where necessary. In some cases, ARCHITEL identified and developed recommendations to address portions of the standards that were judged to be imprecise. The profiles defined in ARCHITEL specified Class 0 and Class 2 for the Transport Layer and the connection-oriented network service for CCITT X.25. (X.25 is used in the public packet switched network, TRANSPAC.)

(U) The ARCHITEL profile is a complete specification that precludes at Layer 3 such capabilities as adding user data to a packet call, using nonstandard packet sizes, etc. All the parameters and options for each layer needed to ensure interoperation are addressed.

(U) ARCHITEL has published the reference document, *STUR ARCHITEL*, which states all the functional profiles for the lower five layers of the CCITT OSI Reference Model (e.g., X.215 and X.225 for the Session Layer). *STUR ARCHITEL* is informative, not mandatory. It was one of the earliest functional profile descriptions for the industrial community and was therefore instrumental in providing proof of concept of the use of OSI standards on a national scale. Thus, historically, *STUR ARCHITEL* was the basis for the development for OSI implementations now in use by the military. The military implementations have also included Transport Class 3.

### 2.2 Netherlands, Norway, France, United Kingdom

(U) Four NATO nations are participating in a project entitled "Cooperative Prefeasibility Studies for Tactical Communications Systems for the Land Combat Zone--Post 2000." In this study, candidate subsystem architectures are being developed on the basis of current and near future communications technologies as ISDN, EUROCOM, FDDI, PABX, packet radio and cellular telephony. From these technologies six subsystem architecture alternatives were derived each with either a nodal (centralized) or a nodeless (distributed) characteristic.

(U) From this set, subsystem architectures are selected on the basis of military operational requirements and threat expectations to form one system architecture for the entire Land Combat Zone. The chosen system architecture to cover the intermediate and the rear zone of the land combat zone. The wide

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area communications subsystem consists of a backbone of distributed Local Area Communications Subsystem (LACS) elements with centralized LACS elements providing access to the backbone.<sup>4</sup>

### 2.3 United Kingdom

**Robust Protocols Research Programme (U).** The UK MOD and NATO has established the Robust Protocols Research Programme at RSRE to quantify and minimize the risks associated with the UK MOD and NATO policies for procuring future CCISs to ISO OSI standards. The approach being taken is to take commercial off-the-shelf protocols that are as near as possible to the perceived military requirement. The performance of these protocols is being established under ideal and degraded conditions in the laboratory.

(U) Initial work has concentrated on the X.400 and FTAM standards. A protocol stack, using X.400 or FTAM, Transport Service Class 4 (TP4), and connectionless network service (CLNS) over X.25(1984) has been selected. These were selected to give a worst case scenario for evaluating the protocol standards. Early results have provided an upper bound to the overheads that may be experienced under ideal conditions. This result will be used for the design and sizing of messaging networks. Some measurements on the performance of FTAM over degraded links have also been obtained. These have shown how a more "intelligent" implementation of the data link protocol could provide optimum throughput over a range of degraded conditions.<sup>5</sup>

**Defense Fixed Telecommunications System (DFTS) (U).** MOD central Defense staffs are establishing a Defense Packet Switched Network (DPSN). This project is a major element of a wider Defense-wide communications infrastructure covering all communications services: the Defense Fixed Telecommunications System (DFTS). Over time, the present MOD and Armed Forces communications systems will integrate to DFTS. Profiles that have been recommended for the DFTS are of three types: end-system services, common application services, and basic communications services. End-system services, together with the proposed standards, are electronic trading (based on EDI), revisable document exchange (based on ODA), general file transfer (based on FTAM), remote terminal access (based on VT), inter-personal messaging (based on MMHS), and inter-organizational messaging (also based on MMHS). Common application services include message handling (MMHS), Directory, ACP 127 interworking (MMHS), shared file store (FTAM), and shared database (RDA and SQL). The basic communications service profiles are T.31(M) for WAN access, T/611 and T/613 for LAN access, R.131(M) for WAN-to-WAN relay, and R/21 for LAN-to-LAN relay.<sup>6</sup>

(U) The UK MOD has a commitment to provide its Single Service strategic communications needs via a common communication network (DFTS). It is also MOD policy that such provision should, to the greatest extent possible, be procured from the civil market to standards recognized by the international community. Progress in implementing the DFTS has been slow as the priority of each of the Single Services has been to deploy their own systems, leaving convergence to DFTS until a later date. However, one subset of DFTS, the packet switched data communications network (DPSN), was identified as requiring common provision to satisfy immediate operational needs.

(U) The DPSN procurement has been guided by the DFTS Architecture and Procurement Working Group (DAPWG), which recommended that (1) the network be based upon the internationally

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<sup>4</sup> (U) *Post 2000 Communications Architectures*, A. T. A. M. van de Voort, TNO Physics and Electronics Laboratory, Netherlands, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

<sup>5</sup> (U) *Practical Evaluation of OSI Protocols*, J. Price, D.B. Hearn, J. Laws, A.F. Martin, and J. Staromlynska, RSRE, UK MOD, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

<sup>6</sup> (U) *MOD(UK) Plans for OSI: Civil Section Relationship*, M. A. Bailey, MOD(UK) Directorate General of Information Technology Systems (DGITS), Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

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recognized X.25 standard for network access; and (2) potential candidate network systems should be mature, have considerable expansion capability, and be supported by a manufacturer with a total commitment to the product and development of the relevant standards. The procurement has been distinguished by the short time scale between statement of requirement and in-service operation, and being both within the financial provision and satisfying the operational requirement. For the future some significant issues have to be developed and resolved, not the least being interworking with other systems, e.g., ISDN, multilevel security and management across the boundary between DPSN and end-user systems.<sup>7</sup>

### 2.4 United States

**DoD Transition to GOSIP (U).** The US DoD intends to adopt OSI protocols as a full co-standard with DoD protocols, specifically for message handling and file transfer (MIL-STDs 1777, 1778, 1780, and 1781). In 1990, 2 years after US GOSIP was approved as a federal standard, "OSI protocols will become the sole mandatory interoperable protocol suite."<sup>8</sup> The Defense Communications Agency (DCA) has been named as the DoD Executive Agent for Data Communications Protocol Standards, and in June 1988 this agency promulgated an OSI implementation strategy.<sup>9</sup> The Services and Agencies have developed transition plans to comply with this strategy.

**Packet Switching for DDN (U).** The US Defense Communications Agency has implemented an X.25 packet-switched protocol for the Defense Data Network (DDN). This protocol includes the use of the US DoD-unique protocols for Layers 3 and 4, namely the Internet Protocol (IP) and the Transmission Control Protocol (TCP). DDN supports over 50,000 users of a DoD-unique electronic mail (E-Mail). DDN contains a set of physically, procedurally, and cryptographically secured packet switching segments for classified E-Mail in the Defense Integrated Secure Network (DISNET) (e.g., DISNET-1, DISNET-2, DISNET-3). There are additional segments for unclassified E-Mail [e.g., Military Network (MILNET) and Advanced Research Projects Agency Network (ARPANET)]. Local area networks (LANs) are connected to the DDN by gateways or hosts using the DoD IP.

**Defense Message System (DMS)--Upgrades for DDN (U).** The US has initiated<sup>10,11</sup> a project called the Defense Message System (DMS) that will eventually integrate DDN with the Automatic Digital Network (AUTODIN). DMS will phase in<sup>12</sup> such protocols and services as US GOSIP, CCITT X.400 Message Handling System, High-Level Data Link Control (HDLC) for subscribers, new asynchronous protocol(s) with reliable transfer for subscribers, and CCITT X.500 Directory Services. TCP/IP protocols will be phased out. Initially (Phase I) a US DoD-unique security program called BLACKER will be implemented at the host-to-host level, which will ultimately result in an integrated DISNET. Later (1993) DDN will consist of MILNET (unclassified) segments and DISNET (classified) segments connected by BLACKER-protected gateways.

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<sup>7</sup> (U) *UK Defence Packet Switched Network (DPSN)*, Alan Dibble, DSLC, and John Laws, RSRE, UK MOD, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED

<sup>8</sup> (U) *Memorandum on Open Systems Interconnection Protocols*, ASD(C3I), 2 July 1987, UNCLASSIFIED.

<sup>9</sup> (U) *The Department of Defense Open Systems Interconnection (OSI) Implementation Strategy*, Defense Communications System Organization, DCA, May 1988 (promulgated 17 June 1988), UNCLASSIFIED.

<sup>10</sup> (U) Briefing to the US Postcoordination Meeting for TSGCEE SG9 on Defense Message System, DCA, 21 March 1989, UNCLASSIFIED.

<sup>11</sup> (U) *Implementation of Multicommand Required Operational Capability (MROC) 3-88, The Defense Mapping System (DMS)*, Director for C3 Systems, Joint Staff, 6 February 1989, UNCLASSIFIED.

<sup>12</sup> (U) *Defense Message System (DMS) Target Architecture and Implementation Strategy (TAIS)*, DCA, December 1988, UNCLASSIFIED.

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**US Army Initiatives (U).** The US Army has a number of initiatives underway that address tactical implementations of OSI standards. The initiatives are under the direction of the Interoperability and Standards Directorate of the Communications-Electronics Command. The Army has an initiative to evaluate OSI protocols (including possible enhancements) in the newly developed Single-Channel Ground/Air Radio System (SINCGARS) combat net radio (VHF-FM). Specifically, the Army is examining options to provide an automatic voice/data contention resolution protocol at the Medium Access Control (MAC) sublayer of the data link layer (Layer 2). Some investigation of a forward error correcting Layer 2 protocol is also ongoing. In addition, an OSI profile is being developed for a local area network (T.LAN). Further, the Army has procured with its Common Hardware and Software (CHS) nondevelopmental item (NDI) program a number of commercial OSI implementations, including ISO 8802.2 and 8802.3 for the local area network (TCP/IP and other DoD protocols will be used initially at layers above Layer 2). CHS has CCITT X.25 switched protocols for wide area networks (these also are used in conjunction with TCP/IP). Finally, the CHS has a standard graphics interface and plans in the next procurement phase to obtain, if possible, a POSIX-conformant operating system.<sup>13</sup>

**US Marine Corps Initiatives (U).** The Marine Corps has adopted a Technical Interface Design Plan (TIDP) for Marine Tactical Systems (MTS)<sup>14</sup> that mandates the use of bit-oriented messages and two functional profiles for protocols in all its command and control systems. One profile for broadcast mode is designed to be used in combat net radio. It has been implemented in the AN/PSC-2 Digital Communications Terminal (DCT). The second profile of protocols is for switched mode and was developed from the Joint Tactical Communications Program (TRI-TAC) Interface Control Documents. This profile has been implemented with the Unit Level Tactical Data Switch (ULTDS). The switched profile is also being implemented with the Tactical Air Operations Module (TAOM) and a developmental system for air operations--Advanced Tactical Command and Control Center (ATACC). Although not fully OSI conformant, the two MTS profiles are based on several OSI standards (ISO 3309, ISO 7809, and ISO 4335). The Marine Corps' approach to data communications standards and profiles follows the OSI seven-layer model and incorporates military features not covered within the ISO standards.

**DoD Protocol Suite (U).** Figure C-1 shows the DoD protocol suite.<sup>15</sup> The upper layer protocols providing user functionality support file transfer [File Transfer Protocol (FTP),<sup>16</sup> MIL-STD-1780]; electronic mail [Simple Mail Transfer Protocol (SMTP), MIL-STD-1781]; and remote system access [TELNET Protocol,<sup>17</sup> MIL-STD-1782]. The middle layers provide a reliable host-to-host transport protocol [Transmission Control Protocol (TCP) MIL-STD-1778] on top of a connectionless (CL) internetworking protocol [Internet Protocol (IP), MIL-STD-1777].

(U) No lower layer protocols are specified in the DoD protocol suite--it uses whatever protocols are required to access the network to which it is attached. Thus, for example, the DoD protocol suite uses the Ethernet<sup>TM</sup> (ISO 8802.3 CSMA/CD Media Access Control for a coaxial cable 10-Mbps LAN) protocol to operate of a local area network and the DDN implementation<sup>18</sup> of the CCITT X.25

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<sup>13</sup> (U) Discussions with staff from the Information Systems Directorate, CECOM, March 1989, UNCLASSIFIED.

<sup>14</sup> (U) *Technical Interface Design Plan for Marine Tactical Systems (MTS TIDP)*, Volume V, *Protocol Standard*, Headquarters, US Marine Corps, July 1987, UNCLASSIFIED.

<sup>15</sup> (U) The figures and information for this section and the following sections on US GOSIP and proposed mixed stacks for Army CCISs is taken from *Use of OSI Protocols for US Army Tactical Command and Control Applications*, Richard Nieporent and Brajesh Mishra, The Mitre Corporation, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

<sup>16</sup> (U) FTP provides a simple application for transfer of ASCII, EBCDIC, and binary files.

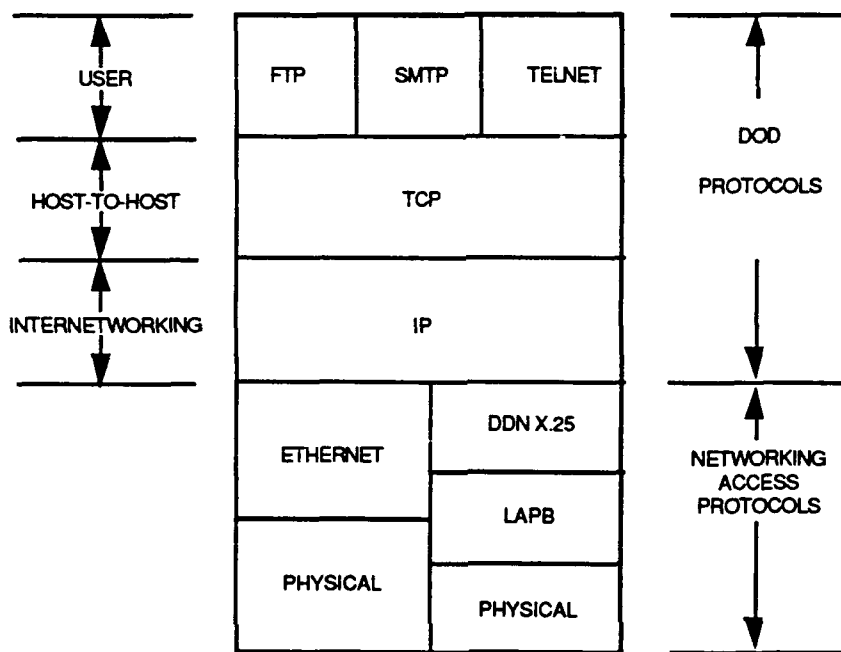
<sup>17</sup> (U) TELNET Protocol provides a simple scroll-mode terminal capability.

<sup>18</sup> (U) The DDN implementation of X.25 was provided by Bolt Beranek and Newman. It is also planned for use in the Mobile Subscriber Element (MSE) for Army area communications.



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protocol (X.25 Packet Level Protocol, ISO 8208) and the HDLC LAPB (ISO 7776) procedures to operate over a wide area packet switching network. Although DoD protocols are not international standards, they have become a de facto open standard in the US--almost every vendor provides the DoD protocols in their version of the UNIX operating system. The DoD protocols are also included in the ATCCS Common Hardware and Software (CHS) procurement and are specified for use over the CHS IEEE 802.3 (ISO 8802.3) tactical LAN. Finally, the DoD protocols are used by the MSE packet switched network (PSN).



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Figure C-1. (U) DoD Protocol Suite

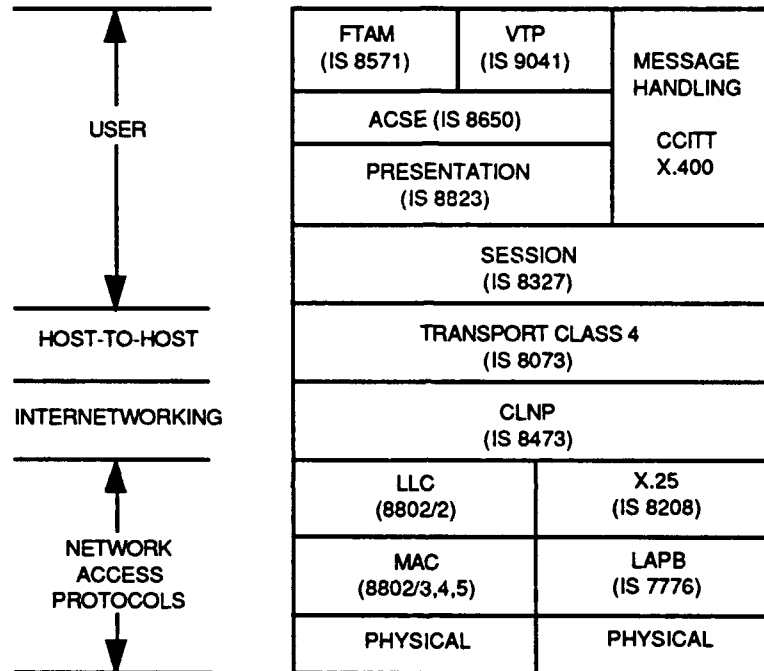
- (U) The DoD protocol suite has two drawbacks for their use in tactical CCISs:
- They are not US GOSIP compliant. It would be necessary for implementations of the DoD Protocols to undergo an expensive and time-consuming transition to satisfy the GOSIP mandate. In particular, the battlefield functional area (BFA) applications will have to be modified to use the functionality of the GOSIP protocols.
  - GOSIP Application Layer protocols provide more functionality than the DoD protocols. Moreover, more effort is now being committed by the nations for the OSI protocols than by the US in the DoD arena. As new OSI protocols are developed that meet tactical communication requirements, they are expected to be incorporated in GOSIP. Thus, future versions of GOSIP are expected to provide considerably more functionality than the DoD protocol suite.

Version 2 of US GOSIP (U). Figure C-2 shows the US GOSIP protocol suite as it will appear in Version 2 (planned to be mandated for use in August 1991). The applications supported are the same as the DoD protocols: file transfer (FTAM, ISO 8571), electronic mail (MHS, CCITT X.400-series

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1984 recommendations;<sup>19</sup> and MOTIS, ISO 10021 and 9066], and the Virtual Terminal Protocol (VTP, ISO 9040 and 9041). Also, like the DoD protocol suite, a transport protocol (Transport Class 4, ISO 8073) is specified that will provide reliable host-to-host communications, and a CL network protocol (CLNP, ISO 8473) is specified for internetworking. Unlike the DoD protocols, US GOSIP provides for the Layer 7 Association Control Service Element (ACSE, ISO 8650), connection-oriented protocols for the Presentation Layer (ISO 8823, Layer 6), and connection-oriented protocols for the Session Layer (ISO 8327, Layer 5).

(U) However, unlike the DoD protocol suite, GOSIP explicitly specifies a number of network access protocols, including IEEE 802 (Logical Link Control, ISO 8802.2; CSMA/CD, ISO 8802.3; Token Bus, ISO 8802.4; and Token Ring, ISO 8802.5) for communications over a LAN and the X.25 protocol for wide area packet switch network communications.



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*Figure C-2. (U) US GOSIP Protocol Suite, Version 2*

(U) There is one major disadvantage to using GOSIP in Army CCISs now. The MSE PSN internetworking capability for tactical area communications can not be used with GOSIP, since GOSIP has a different internetworking protocol (CLNP) than the DoD protocol suite (IP). Access to the MSE PSN will still be possible using a direct interface to the tactical LAN.

**Mixed Protocol Stacks for Future Army CCISs (U).** The US Army is developing an automated Army Tactical Command and Control System (ATCCS) for the tactical battlefield. Communications connectivity for the ATCCIS will be provided by the US Army's local and wide area tactical communications networks. A protocol suite must be selected for the ATCCS that can interface to these tactical networks and support a wide range of tactical communications applications. A mixed protocol

<sup>19</sup> (U) US GOSIP 1.0 and 2.0 mandate use of X.400(MHS)-1984. US GOSIP 3.0 is expected to require X.400(MHS)-1988.

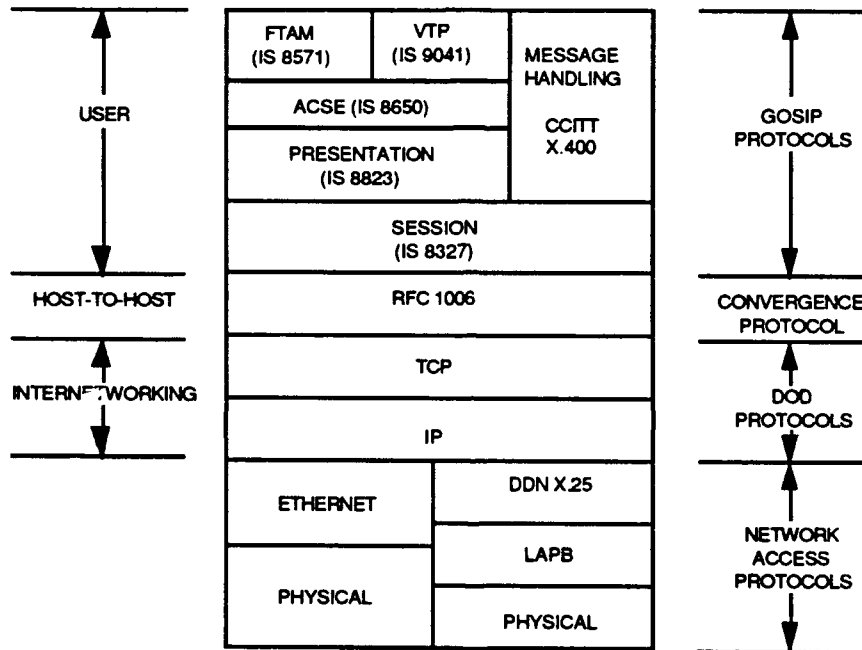
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suite, consisting of OSI upper layer protocols operating of the US DoD transport and internetworking protocols (TCP/IP), has been recommended to support the required ATCCS functionality and interoperability and provide a direct migration path to US GOSIP and the NATO militarized OSI protocols.

(U) Figure C-3 shows a proposed mixed suite of protocols for ATCCS. The upper three layers consists of the GOSIP Session, Presentation, and Application Layers. The same FTAM, X.400, and VTP Application Layer protocols are specified as in GOSIP. The middle protocol layers are the same as in the DoD protocol suite: TCP and IP. Also, as in the DoD protocol suite, the lower layer protocols (Physical, Data Link, and Network Layers) are unspecified.

(U) A Convergence Protocol [Request for Comment (RFC) 1006, *ISO Transport Service on Top of the TCP*, Version 3, 1987] is needed to interface the GOSIP upper layer protocols to the DoD internetworking protocols. The Convergence Protocol provides OSI Transport Class 0 (TP0) along with a packetization protocol.<sup>20</sup> This protocol is commercially available in Version 6.0 of the ISO Development Environment (ISODE).



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*Figure C-3. (U) Proposed Mixed Protocol Suite*

(U) The mixed protocol suite has the increased functionality of the GOSIP Application Layer protocols, without sacrificing compatibility with the MSE PSN. No changes will be necessary in BFA applications, when ATCCS transitions to GOSIP, since they would already use the GOSIP Application Layer protocols.<sup>21</sup>

<sup>20</sup> (U) Since TCP is a stream-oriented protocol and TP0 is a block-oriented protocol, the packetization protocol is needed to preserve the OSI packet boundaries.

<sup>21</sup> (U) *Use of OSI Protocols for US Army Tactical Command and Control Applications*, Richard Nieporent and Brajesh Mishra, The Mitre Corporation, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

3. IDENTIFICATION OF EFFORTS TO EVALUATE THE PERFORMANCE OF CIVIL STANDARDS FOR MILITARY USE

3.1 Introduction

(U) This section identifies a number of papers submitted in June 1990 to the Military OSI Symposium at SHAPE Technical Centre that describes analytical and demonstration efforts to evaluate the performance of OSI and other protocols for use in military systems. These papers should be consulted for detailed results.

3.2 Sources of Reports on Performance Evaluations

(U) *Practical Evaluation of OSI Protocols.* This paper summarizes work being done under the Robust Protocols Research Programme at the Royal Signals and Radar Establishment (RSRE) in the UK MOD. As noted in Section 2.3, the work has concentrated on X.400 and FTAM over TP4, CLNS, and X.25.<sup>22</sup>

(U) *User Performance of Tactical Networks in the ITDN.* User performance experiments were conducted in 1989 on portions of the Integrated Tactical-Strategic Data Network (ITDN) Demonstration that simulated tactical areas at echelons corps and below. The performance of four tactical links [Fleet Satellite Communications (FLTSATCOM), MSE line-of-sight radio, Tactical Satellite (TACSATCOM), and Very Small Aperture Terminal (VSAT)] was measured at the protocol level that most directly affects the network user. The results, though preliminary, can help predict the performance of applications in tactical nets. US DoD protocols were measured; however, the results may provide the basis for informed conjectures about the user-level performance of OSI protocols.<sup>23</sup>

(U) *Transport Protocols and Internetworking in Low Bandwidth Tactical Networks.* This paper examines the impact of packet size on end-to-end functionality (including reliable delivery, packet resequencing, segmentation, and flow control). Tradeoffs between a small packet size required because of the unreliable media and a large packet size required to minimize the header overhead are considered using standard transport protocols. The choice of ULP depends on the application required to run over the network; for instance, military messaging application could use X.400 and its supporting presentation and session layers as specified in US GOSIP or the enhanced versions proposed in STANAGs 4265-4269. The paper also assess the impact of the transport protocol selection on the network architecture in an internetwork configuration.<sup>24</sup>

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<sup>22</sup> (U) *Practical Evaluation of OSI Protocols*, J. Price, D.B. Hearn, J. Laws, A.F. Martin, and J. Staromlynska, RSRE, UK MOD, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

<sup>23</sup> (U) *User Performance of Tactical Networks in the ITDN*, Gladys Reichlen and Allison Mankin, The Mitre Corporation, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

<sup>24</sup> (U) *Transport Protocols and Internetworking in Low Bandwidth Tactical Networks*, Shiraz G. Bhanji, The Mitre Corporation, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

#### 4. DETAILED REVIEW OF SELECTED NATIONAL INITIATIVES

##### 4.1 Example of a Broadcast Profile for Data Communications Using Tactical Radios

(U) This section uses the OSI Reference Model and interoperability parameters to identify interpretations, extensions, and deviations to OSI and other standards in the specification of a set of protocols used to support data transmission over combat net radio by the US Marine Corps. These protocols are specified in Volume V of the Marine Corps MTS TIDP.

(U) The MTS protocols were developed based on US federal standards in the late 1970s. Many of the standards selected have become ISO standards, and the structure of the MTS protocols can be interpreted in terms of the seven-layer OSI Reference Model. The MTS broadcast profile, discussed in this section, is now being used by the Army and the Marine Corps as the basis for defining the initial protocol standards to be used in the TIDP now being developed for Joint Interoperability of Tactical Command and Control Systems (JINTACCS) K-Series Variable Message Format (VMF) bit-oriented messages. The K-Series messages and associated data communications protocols are being specified by the joint Fire Support Subgroup (FSSG) of the JTIDS Message Standards Working Group (JMSWG) under the auspices of the Joint Tactical C3 Agency.

(U) Table C-2 highlights the features provided in the broadcast protocol, used in Marine Corps tactical data systems (TDSs), for each of the seven layers. It further identifies the standards used in each layer and notes the interpretations, exceptions, extensions, and deviations that were specified.

(U) Military features supported by the broadcast protocol standard and identified in Table C-2 include:

- Multiaddressing (Layer 7, through the Message Header; and Layer 2, through the extended address field)
- Data integrity and, more generally, the capability to operate in a high bit-error-rate environment [Layer 2, through use of a 32-bit frame check sequence (FCS) for error checking and the (23,12) half-rate Golay error detection and correction coding (ED&C), together with 16x24-bit interleaving]
- Use of XID command and response (Layer 2)
- Control of emanations by senders and recipients through provisions for optional acknowledgements (ACKs) (Layer 7--request for ACK is part of the message) and for not sending ACKs even when requested (Layer 2), both under operator control
- Limit on the number of retransmissions permitted (Layer 2)
- Providing for net access (uses an international standard in Layer 2 for handling media access contention and collision detection<sup>25</sup> and defines an algorithm for wait times for reattempting access); net access algorithms could be extended to support precedence and preemption.

##### 4.2 Example of a "Datagram" Switched Protocol Standard for Tactical Radios

(U) This section summarizes a set of protocols used to support data transmission through tactical data switches by the US Marine Corps. These are the MTS switched protocols that are specified in Volume V of the Marine Corps *Technical Interface Design Plan for Marine Tactical Systems*.

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<sup>25</sup> (U) The listen-before-talk contention method is called Carrier Sense Multiple Access with Collision Detection (CSMA/CD); this method has become an international standard for local area networks (ISO 8802.3).

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(U) Table C-3 highlights the features provided in the switched MTS protocol for each of the seven layers. The table identifies the international and US standards used in each layer, and notes the interpretations, exceptions, extensions, and deviations that are specified.

### 4.3 Details of Standards for French National Initiatives for Enhanced Interoperability

(U) The Army will use standardized products based on the following standards:

- Programming language: LTR3 (Language Temps Reel), Ada, C
- Database: Relational database management systems, SQL
- Operating System: UNIX
- Development methods: Based on the French military standard GAM-T-17.

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*Table C-2. (U) A Functional Profile of Broadcast Protocols Used in Tactical Systems by the US Marine Corps*

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| ISO Layer, Function |                                      | Standards Cited                            | Notes on Interoperability Parameters  |
|---------------------|--------------------------------------|--|---|
| 7                   | Msg Header<br>Msg Acknowledgment     | None<br>None                               | Supports multiple addresses, precedence, and security classification.   |
| 6                   | Msg Format<br>Information Field Size | None<br>None                               | Maximum message length is 3500 octets.  |
| 5                   | None                                 | N/A  | Null layer.   |
| 4                   | None                                 | N/A  | Null layer.   |
| 3                   | Message Segmenting                   | N/A  | Messages are not segmented.   |
| 2                   | Frame Formatting                     | ISO 3309/7809 (HDLC) with Options 7 and 14 | Opt 7=Extended Address Field; 2-17 octets (base std is one octet; Opt 7 specifies no maximum on extended address field size).<br>Opt 14=32-bit frame check seq (FCS) (base standard is 16-bit FCS). |
|                     | Frame Addressing                     | ISO 3309                                   |   |
|                     | Commands & Responses                 | ISO 4335/7809 with Option 1                | Opt 1=XID.<br>Does not support S&BM, DISC cmds and FRMR,UA,DM resp (radio application).<br>Does not support P/F bit.  |
|                     | Media Access                         | No standard applies                        | Uses CSMA/CD with unique algorithms for reattempting access to net.   |
|                     | Data Link Initialization and Release | ISO 4335/7809 with Option 1 (XID)          | XID is used during net establishment.   |
|                     | Frame Transfer                       | ISO 4335/7809                              | Uses all 3 types of frames.   |
|                     | Acknowledgment (ACK)                 | ISO 4335                                   | ACK is optional; when invoked, it follows the standard.   |
|                     | Retransmission                       | Not controlled by standards                | Max 2 retries (under operator control) (no provision for setting a max in stds).<br>Standards suggest use of P/F bit to control retransmission.   |
|                     | ED&C--Error Detection                | IS 3309/7809 w Opt 14                      | 32-bit FCS (algorithm is ISO 3309, Sec 3.6.3).  |
|                     | ED&C--Error Coding                   | Not controlled by standards                | (23,12) half-rate Golay; 24th bit is zero filled (detects 6/corrects 3 errors in each 24-bit codeword).   |
| ED&C--Interleaving  | Not controlled by standards          | 16x24-bit time dispersive coding (TDC).    |   |

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*Table C-2. (U) (Continued)*

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| 1 | ISO Layer, Function   | Standards Cited  | Notes on Interoperability Parameters |
|---|---|--|--------------------------------------|
|   | --Electrical<br>--Voltage Levels<br>--Load Impedance  | MIL-STD-188-114<br>MIL-STD-188C<br>MIL-STD-188/24(Prt2)<br>MIL-STD-188-141 | [Similar to CCITT V.10/X.261]        |
|   | Mechanical<br>--Connectors  | MIL-STD-242G(Prt8)<br>MIL-P-55149  |                                      |
|   | Cable Lengths<br>Functional (pin assign)  | MIL-STD-242G(Prt8)<br>MIL-STD-242G(Prt8)                                   |                                      |
|   | Procedural<br>--COMSEC Pre/Postamble<br>Frame Placement<br>--Keytime Delay<br>--Bit Synchronization<br>--Transmission Synch<br>--Clocking Ctrl & Timing | DCT Spec<br>DCT Spec<br>DCT Spec<br>DCT Spec<br>N/A                        |                                      |

References:

1. Technical Interface Design Plan for Marine Tactical Systems (MTS TIDP), Volume V, Protocol Standard, Headquarters, U.S. Marine Corps, July 1987, UNCLASSIFIED.
2. Discussions with Systems Integration Directorate, MCRDAC, and LOGICON/Eagle Technology, Inc., March 1989.

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*Table C-3. (U) A Functional Profile of "Datagram" Switched Protocols Used in Tactical Systems by the US Marine Corps*

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| ISO Layer, Function   | Standards Cited   | Notes on Interoperability Parameters  |
|---|---|---|
| 7<br>Msg Header<br>Msg Acknowledgment   | None [1]<br>None  | <ul style="list-style-type: none"> <li>Supports multiple addresses, precedence, and security classification.</li> </ul>   |
| 6<br>Msg Format<br>Information Field Size   | None<br>None  | <ul style="list-style-type: none"> <li>Uses the same flagging scheme as the syntax adopted for US JINTACCS K-Series messages</li> <li>Max is 40 segments, 260 octets per segment (message length)</li> </ul>  |
| 5<br>None   | N/A   | <ul style="list-style-type: none"> <li>Null layer</li> </ul>  |
| 4<br>End-End Sequence Control<br>End-End Congestion/<br>Flow Control  | None<br>None found  | <ul style="list-style-type: none"> <li>Transport layer accumulates and orders packets for users; uses 7 octets (vice 20-60 octets for TCP)</li> <li>Connectionless-oriented layer, a variant of TP4</li> </ul>  |
| 3<br>Network Routing/Switching<br><br>Message Segmenting<br>Packet Addressing<br>Packet Precedence<br><br>Network Flow &<br><br>End-End Error Recovery<br>(Message Accountability)<br>Congestion Control<br>Interneting | None found<br><br>Not controlled by standards<br>None<br>None<br><br>None found<br><br>None<br>N/A  | <ul style="list-style-type: none"> <li>Connectionless-oriented with deterministic routing [2]</li> <li>Supports "floating" host, using operator-initiated disconnect and reconnect, but requiring no change of address</li> <li>260-octet maximum message segment</li> <li>Uses unique 3-octet routing indicator and provides for multiple addressing for up to 16 destinations</li> <li>Uses 3 classes of precedence (SysCom, Data1, Data2), in which military precedences (Y-Z-O-P-R) are handled as Data2</li> <li>Traffic from subscribers can be limited on precedence; traffic in network is processed by packet precedence</li> <li>Detects loss of message frames, with notification for nonperishable messages</li> <li>Not supported</li> </ul> |
| 2<br>Frame Formatting<br><br>Frame Addressing<br>Commands & Responses<br><br>Media Access<br><br>Data Link Initialization<br>and Release<br><br>Frame Transfer<br>Acknowledgment (ACK)<br>Retransmission                | ISO 3309/7809 (HDLC) with Options 10 and 14<br>ANSI X3.66-1979 (ADCCP) (MIL188 TRI-TAC Mode VII)<br>ISO 3309<br><br>ISO 4335/7809 with additional Options 2,4,5,8,11 [5]<br><br>N/A<br><br>ISO 4335/7809<br>ANSI X3.66-1979 (ADCCP) TRI-TAC ICD 16<br>ISO 4335/7809<br>ISO 4335<br>ISO 4335 | <ul style="list-style-type: none"> <li>Opt 10 calls for extended control field (two octets)</li> <li>U-frame is extended (two octets) [3]</li> <li>Opt 14 calls for 32-bit FCS</li> <li>Station address varies [4]</li> <li>SIM cmd may be initiated at both stations for link initialization</li> <li>RIM response not implemented</li> <li>Does not support poll-final (P/F) bit</li> <li>When established (initialized), full-duplex point-to-point link has no access contention</li> <li>Addresses security through use of UI-frames [6]</li> <li>Uses all 3 types of frames</li> <li>ACK or NAK is required</li> <li>Maximum of 5 retries</li> <li>Retransmission is automatic if no ACK [7]</li> </ul>   |

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*Table C-3. (U) (Continued)*

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| ISO Layer, Function | Standards Cited   | Notes on Interoperability Parameters   |
|---------------------|---|--|
| 2                   | ED&C--Error Detection<br><br>ED&C--Error Coding<br><br>ED&C--Interleaving   | IS 3309/7809 w Opt 14<br><br>Not controlled by standards<br><br>Not controlled by standards<br><br><ul style="list-style-type: none"> <li>• 32-bit FCS (algorithm is ISO 3309, Sec 3.6.3).</li> <li>• (23,12) half-rate Golay; 24th bit is zero filled (detects 6 and corrects 3 errors in 24 coded bits).</li> <li>• No time dispersal coding (TDC)</li> </ul>  |
| 1                   | Electrical<br>--Voltage Levels<br>--Load Impedance<br><br>Mechanical<br>--Connectors<br><br>--Cable Lengths<br>Functional (pin assign)<br>Procedural<br>--COMSEC Pre/Postamble<br>Frame Placement<br>--Keytime Delay (sec)<br>--Bit Synchronization<br>--Transmission Synch<br><br>--Clocking Ctrl & Timing | MIL-STD-188-114<br>MIL-STD-188C<br>MIL-STD-188/24(Prt 2)<br>TT-B1-4204-1101-001<br>MIL-STD-188-141<br><br>MIL-STD-242G(Prt 8)<br>MIL-P-55149<br><br>MIL-STD-242G(Prt 8)<br>MIL-STD-242G(Prt 8)<br><br>N/A<br>N/A<br>N/A<br>TRI-TAC ICD (U.S.) [8]<br><br>MIL-STD-188-100<br>(Para 4.3.1.6)<br><br><ul style="list-style-type: none"> <li>• [Similar to CCITT V.10/X.26]</li> <li>• Conditioned di-phase signalling (TRI-TAC modem-like standard interface)</li> <li>• For binding posts</li> <li>• Varies [8]</li> <li>• 16 bits within keytime delay</li> <li>• 32-bit transmission synch pattern;</li> <li>• 24-bit transm (16-bit) word count (Golay coded)</li> <li>• 16 or 32 Kb/s switch rate</li> </ul> |

Notes:

1. Where there are standards, but none are cited for this protocol, "None" is used; where there are no applicable standards, "N/A" is used.
2. Profile establishes datagram services, not virtual circuits (CCITT X.25 Packet Layer Protocol is connection oriented).
3. U-frame format agrees with ANSI X3.66 but not with ISO 4335(1987) for extended control field regarding use of second octet. ANSI 3.66 requires a zero-filled (after the poll-final bit) second octet, but ISO 4335 has no extended control field for the U-frame.
4. For link-level frame addressing, TRI-TAC and ISO 3309 (Section 3.2) may be considered as consistent under the following interpretation: whenever one station sends a frame to the other station, the sender's link-level address is 10000000 and the recipient's link-level address is 11000000.
5. ISO 7809 command/response options implemented: Opt 2--adds REJ cmd/resp; Opt 4--adds UI cmd/resp; Opt 5--adds SIM cmd and RM resp [RM resp not implemented]; Opt 8 deletes I-frame for resp. CCITT X.25 LAP B is equivalent to HDLC Options 2, 8 and 10 (only)--this profile incorporates additional HDLC options not permitted by LAP B.
6. Link Initialization Parameter Notified (LIPN) is an application of the UI-frame that provides for six features: Congestion Control, Link Efficiency Control, Crypto ID Coordination of Security, Link Shutdown Notification, Emergency Shutdown Notification, and Orderly Shutdown Notification.
7. Retransmission may be initiated by REJ, NAK, or time out waiting for an ACK. ACK parameters not controlled by standards include: maximum retransmission attempts; and maximum transmissions outstanding without a response (allows for SATCOM delays). This profile allows 5 retransmissions and 18 transmissions outstanding without a response.
8. Keytime delay and transmission synchronization procedures depend on the link encryption hardware selected.

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**APPENDIX D**

**INTERNATIONAL STANDARDS  
RELEVANT TO ATCCIS**

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INTERNATIONAL CIVIL STANDARDS RELEVANT TO CCISs

I. OSI ARCHITECTURE AND GENERAL STANDARDS<sup>1</sup>

A. OSI BASIC REFERENCE MODEL AND CONVENTIONS:

|                          |  |
|--------------------------|--|
| STANAG 4250♦             | NATO Reference Model for OSI<br>Part 1--General Description, Revised Draft<br>Part 2--Security, Draft (SANISI Document)<br>Part 3--Naming and Addressing, Draft (Working Paper)<br>Part 4--Management, Draft (Working Document)<br>Part 5--Military Features, Draft (Working Document)                                     |
| ISO <sup>2</sup> 7498-1♦ | OSI Reference Model - Part 1: Basic Reference Model, General Aspects [SC21 N 3273] (CD text for revision incorporating AD <sup>1</sup> expected November 1990)<br>AD <sup>3</sup> 1♦ Connectionless-Mode Transmission<br>PDAD <sup>4</sup> 2♦ Multipeer Data Transmission (MPDT)<br>PDAD 3♦ Upper Layer Architecture (ULA) |
| ISO 7498-2♦              | OSI Reference Model - Part 2: Security Architecture  |
| ISO 7498-3♦              | OSI Reference Model - Part 3: Naming and Addressing  |
| ISO 7498-4♦              | OSI Reference Model - Part 4: Management Framework   |
| TR <sup>5</sup> 8509♦    | Service Conventions  |
| CD <sup>6</sup> xxxx-1   | Conventions for Service Definitions - Part 1: General Model and Conventions (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supersede TR 8509)  |
| CD xxxx-2                | Conventions for Service Definitions - Part 2: Application Layer (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supersede TR 8509)  |
| CD xxxx-3                | Conventions for Service Definitions - Part 3: Layers 1-6 (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supersede TR 8509)   |

<sup>1</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

<sup>2</sup> ISO: International Standard with final approval from ISO.

<sup>3</sup> AD: Addendum for ISO standard.

<sup>4</sup> PDAD: Proposed or Preliminary Draft Addendum to ISO standard.

<sup>5</sup> TR: Technical Report for ISO.

<sup>6</sup> CD: Committee Draft for ISO standard [formerly Draft Proposal (DP)].

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|                         |  |
|-------------------------|--|
| DTR <sup>7</sup> 9575   | OSI Routing Framework  |
| CDTR <sup>8</sup> xxxx◆ | Tutorial on Naming and Addressing, July 1990 [SC21 N 5102]   |
| SC6 N 4782 <sup>9</sup> | An Architectural Framework for Private Networks, Pre-Publication Version of ECMA TR 44, December 1987  |
| SC21 SD-9 <sup>10</sup> | Approved Commentaries on the Basic Reference Model for Open Systems Interconnection, SC21 OSI Reference Model Editor, 19 June 1990 [SC21 N 5217]                       |
| SC21 N 3207             | Relationship Between Objects in Peer Open Systems, December 1988 [SC21/WG6]  |
| SC21 N 3711             | Requirements for Multipeer Data Transmission, July 1989  |
| SC21 N 3906             | Final Report to SC21 in Florence on the Reassessment of Project JTC 1.21.9.1 on Multipeer Data Transmission, October 1989  |
| SC21 N 4240             | Working Draft Addendum to ISO 7498 - General Aspects, December 1989  |
| SC21 N 4546             | Liaison Statement of SC21/WG1 on Update of the OSI Reference Model, CCITT SG VII, March 1990   |
| SC21 N 4559             | Liaison Statement to SC21 on OSI Reference Model Update Effort, CCITT SG VII, March 1990   |
| SC21 N 4565             | Liaison Statement to SC21/WG4/WG7 on Time Synchronization, CCITT SG VII, March 1990  |
| SC21 N 4647             | Requirements for Service Conventions, May 1990   |
| SC21 N 4681             | User Requirements for Multi-Party Communications (MPC), Canada, May 1990   |
| SC21 N 4682             | Establishment of User Requirements, Canada, May 1990   |
| SC21 N 4763             | On-Going Multipeer Projects Within JTC1, ANSI, May 1990  |
| SC21 N 5017             | Relationship Between Concepts and Models for OSI and ODP, SC21/WG6, July 1990  |
| SC21 N 5073             | Final Answer to Q1/30.5 on Definition of the Term "Quality of Service.", SC21/WG1, May 1990  |
| SC21 N 5074             | Final Answer to Q1/330.6 on Relay, Routing, and Network Management, SC21/WG1, May 1990   |
| SC21 N 5081             | Draft Answer to Q1/61 on Consistency Among ISO Standards Related to the OSI Reference Model, May 1990  |
| SC21 N 5082             | Call for Contributions on Protocol Profile Testing Methodology, Multi-Party Testing Methodology, TTCN Extensions, and Test Report Standardization, SC21/WG1, July 1990 |
| SC21 N 5084             | Liaison Statement to SC6 on OSI Conformance Issues, SC21/WG1, May 1990   |
| SC21 N 5092             | Revision of ISO 7498, Working Draft, SC21/WG1, July 1990   |
| SC21 N 5093             | Status and Method of Operation for the Reference Model Revision, SC21/WG1, May 1990  |
| SC21 N 5095             | Liaison to SC6 on Revision of the Reference Model, May 1990  |

<sup>7</sup> DTR: Draft Technical Report for ISO.

<sup>8</sup> CDTR: Committee Draft Technical Report for ISO (formerly Proposed Draft Technical Report).

<sup>9</sup> Selected working drafts (e.g., SC6 N 4782) have been included from ISO/IEC JTC1 Subcommittee (SC) 6, SC18, SC21, the Special Group on Functional Standardization (SGFS). These and other JTC1 standards organizations are discussed in Appendix F.

<sup>10</sup> SD: Standing Document for ISO.

## UNCLASSIFIED

SC21 N 5096 Liaison to CCITT SG VII on Revision of the Reference Model, June 1990  
SC21 N 5099 Liaison Statement to CCITT SG VII(Q.25) on Service Conventions, SC21/WG1, May 1990  
SC21 N 5105 Final Answer to Q1/56.6.1 on Positioning of Circuit Switched Networks, SC21/WG1, May 1990  
SC21 N 5109 Liaison Statement to CCITT SG VII(Q23) on Naming and Addressing, SC21/WG1, May 1990  
SC21 N 5110 Call to National Bodies and Liaison Organizations for Contributions on Technical Structure of Quality of Service (QoS) Architecture, May 1990  
SC21 N 5196 Report of the Special Meeting on User Requirements, SC21, 7 June 1990  
SC21 N 5197 Report of the Standards Maintenance Group, SC21, 4 June 1990  
CCITT X.200 Reference Model of OSI for CCITT Applications  
CCITT X.210 OSI Layer Service Definition Conventions

### B. WORK PLANS AND COORDINATION AGREEMENTS:

JTC1 N 535 Directives for the Work of ISO/IEC Joint Technical Committee 1 (JTC1) on Information Technology, Secretariat, 31 August 1989  
JTC1 N 598 JTC1 Strategic Plan, Editing Team, 20 November 1989  
SGFS<sup>11</sup> N 151 CCITT Liaison Statement on Work of SGFS, 6 November 1989 (includes X.220)  
SC21 SD-1 Report of the Secretariat to the Plenary Meeting of ISO/IEC JTC1 SC21, 5-6 June 1990, Seoul, Republic of Korea, SC21 Secretariat, 12 April 1990 [SC21 N 4588] (provides terms of reference and points of contact for working groups)  
SC21 SD-2 ISO/IEC JTC1 SC21 Programme of Work (POW) - Target Date Summary for All Active and Published Projects, SC21 Secretariat, April 1990  
SC21 SD-8 Schedule of Meetings, SC21, 19 June 1990 [SC21 N 5216]  
SC21 N 3122 Informal Guide for ISO/IEC JTC1 and CCITT Cooperation, 15 January 1989  
SC21 N 3205 Proposed Modus Operandi and Programme of Work of SC21/WG6 ULA Rapporteur Group, December 1988 [SC21/WG6]  
SC21 N 4758 Request to ISO/IEC SC21 from OSF for Establishment of Liaison Relationship, 4 May 1990  
SC21 N 4801 Liaison Statement to SC21 on Joint Efforts Between SG VII(Q20) and SG I(Q16), CCITT SG I(Q.16), 21 May 1990  
SC21 N 5071 Recommendations Approved by SC21/WG1 at its Seoul Meeting, 23-31 May 1990, SC21/WG1, May 1990  
SC21 N 5072 List of Output Documents of SC21/WG1 Meeting, Seoul, 23-31 May 1990, SC21/WG1, July 1990  
SC21 N 5131 Recommendations of the SC21/WG6 Meeting, 23 May - 1 June 1990, Seoul, SC21/WG6, June 1990  
SC21 N 5136 Recommendations of SC21/WG3 Meeting in Seoul, May/June 1990, SC21/WG3, 19 June 1990  
SC21 N 5154 Recommendations of the SC21/WG5 Meeting, Seoul, 24 May - 1 June 1990, SC21/WG5, June 1990

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<sup>11</sup> SGFS: Special Group on Functional Standardization [develops International Standard Profiles (ISPs)].

## UNCLASSIFIED

- SC21 N 5194 Resolutions of the Fourth Plenary Meeting of SC21, 5 June 1990, Seoul, SC21, 5 June 1990
- SC21 N 5203 SC21/WG1 Convenor's Report to SC21 Plenary Meeting, Seoul, 5-6 June 1990, SC21/WG1, 3 June 1990
- SC21 N 5219 Draft Management Guidelines for SC21, Rapporteur for Strategic Planning, July 1990

### C. FORMAL DESCRIPTION TECHNIQUES (FDTs):

- ISO 8807♦ LOTOS - A Formal Description Technique Based on the Temporal Ordering of Observational Behavior
- PDAD 1 Graphical Representation of LOTOS (G-LOTOS) (new work item proposal of December 1989 not accepted; status uncertain) [SC21 N 4871]
- ISO 9074♦ Estelle - A Formal Description Technique Based on an Extended State Transition Model
- PDAD 1♦ Estelle Tutorial [SC21 N 4230]
- DTR 10167 Guidelines for the Application of Estelle, LOTOS, and SDL [SC21 N 4259] (editing meeting scheduled September 1990)
- CDTR xxxx♦ Architectural Semantics for FDTs, Revised Draft, July 1990, SC21/WG1 [SC21 N 5116]
- SC21 N 3132 TTCN Operational Semantics, November 1988
- CCITT X.250 Formal Description Techniques for Data Communications Protocols and Services
- CCITT Z.100 Specification and Description Language (SDL)
- CCITT Z.110 Criteria for the Use and Applicability of Formal Description Techniques

### D. SECURITY:

- ISO 8372 Information Processing - Modes of Operation for a 64-bit Block Cipher Algorithm, 1987
- ISO 9160 Information Processing - Data Encipherment - Physical Layer Interoperability Requirements, 1988
- DIS<sup>12</sup> 9796 Information Processing - Digital Signature Scheme Giving Message Recovery, 1989
- ISO 9797 Information Processing - Data Cryptographic Techniques - Data Integrity Mechanisms Using a Cryptographic Check Function Employing a Block Cypher Algorithm, 1989
- DIS 9798-1 Information Processing - Entity Authentication Mechanisms - Part 1: General Model
- DP<sup>13</sup> 9798-2 Information Processing - Entity Authentication Mechanisms - Part 2: Entity Authentication Mechanisms Using Symmetric Algorithms
- ISO 9979 Information Processing - Data Encipherment - Procedures for the Registration of Cryptographic Algorithms, July 1990 [SC27 N 88]

<sup>12</sup> DIS: Draft International Standard for ISO.

<sup>13</sup> DP: Draft Proposal for an ISO standard [to be issued as Committee Drafts (CDs) beginning in 1990].

## UNCLASSIFIED

DIS 10116 Information Processing - Modes of Operation for an N-bit Block Cipher Algorithm, 1989 [SC27 N 86]

WD<sup>14</sup> 10181-1♦ Security Frameworks in Open Systems - Part 1: Overview (CD text expected June 1991), December 1989 [SC21 N 4210]

DP 10181-2♦ Security Frameworks in Open Systems - Part 2: Authentication Framework, December 1989 [SC21 N 4207]

WD 10181-3♦ Security Frameworks in Open Systems - Part 3: Access Control Framework (CD text expected October 1990), December 1988 [SC21 N 3261]

WD 10181-4♦ Security Frameworks in Open Systems - Part 4: Non-Repudiation Framework (CD text expected June 1991), December 1988 [SC21 N 3263]

WD 10181-5♦ Security Frameworks in Open Systems - Part 5: Confidentiality Framework (CD text expected June 1991), December 1988 [SC21 N 3274]

WD 10181-6♦ Security Frameworks in Open Systems - Part 6: Integrity Framework (CD text expected June 1991), December 1988 [SC21 N 3264]

WD 10181-7 Security Frameworks in Open Systems - Part 7: Audit Trail Framework, 1989 [SC21 N 3338]

DP 10646 Information Processing - Multiple octet Coded Character Set, 14 November 1989 [SC21 N 4627]

WD xxxx-1 Cryptographic Mechanisms for Key Management, Part 1: Key Management Overview [SC27/WG2]

WD xxxx-2 Cryptographic Mechanisms for Key Management, Part 2: Key Management Using Secret Key Techniques [SC27/WG2]

WD xxxx-3 Cryptographic Mechanisms for Key Management, Part 3: Key Management Using Public Key Techniques [SC27/WG2]

WD xxxx-4 Cryptographic Mechanisms for Key Management, Part 4: Key Management Using Public Key Register [SC27/WG2]

JTC1 N 474 Proposal for a New Work Item: OSI Upper Layers Security Model, 21 July 1989

SC21 N 3141 Response to SC21 N 2864, Issues Concerning the Requirements for Security Services in the Presentation Layer, November 1988 [SC21/WG1]

SC21 N 3167 Response to SC18 Liaison on Encryption, January 1989 [SC21/WG3]

SC21 N 3266 Guide for Open Systems Security, December 1988 [SC21/WG1]

SC21 N 3267 Plan for Work on Security in SC21, December 1988 [SC21/WG1]

SC21 N 3283 Working Draft for Lower-Layer Security Model, December 1988 [SC21/WG1]

SC21 N 3337 Security Management Domain and Security Policies

SC21 N 3991 Security Exchange Service Element, CCITT Q19/VII(DAF), November 1989 (CD text in SC21/WG6 expected in 1992)

SC21 N 4526 Application Layer Security Considerations, Workshop of Distributed Applications, 18 April 1990

SC21 N 4648 Security and Security Exchange Information, 28 February 1990, Canadian contribution to SC21/WG6

SC21 N 4833 Report to JTC1 from SC27 on Security Techniques, SC27 Secretariat, 21 May 1990 [SC27 N 94, 3 May 1990]

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<sup>14</sup> WD: Working Draft for ISO (status of text prior to being submitted as a Committee Draft).



## UNCLASSIFIED

- SC21 N 4834 Liaison Statement from SC27 to JTC1 Advisory Group, SC27 Secretariat, 21 May 1990 [SC27 N 93, 3 May 1990]
- SC21 N 4835 Report of the First Plenary Meeting of SC27 at Stockholm, 24-26 April 1990, SC27 Secretariat, 21 May 1990 [SC27 N 92, 1 May 1990]
- SC21 N 4836 Resolutions Taken at the First Plenary Meeting of SC27 at Stockholm, 24-26 April 1990, 21 May 1990 [SC27 N 94, 3 May 1990]
- SC21 N 5001 Upper Layers Security Model, Third Working Draft, SC21/WG6, 5 June 1990 (CD text expected in 1991)
- SC21 N 5002 Commencement of Work on Security ASEs, SC21/WG6, 31 May 1990
- SC21 N 5003 Distributed Applications Security Modelling and Infrastructure, SC21/WG6, July 1991

### E. OSI MANAGEMENT:

- DIS 10040♦ Systems Management Overview, July 1990 [SC21 N 4685] (IS text expected July 1991)
- DIS 10165-1♦ Structure of Management Information - Part 1: Management Information Model, July 1990 [SC21 N 4484] (IS text expected July 1991)
- DIS 10165-2♦ Structure of Management Information - Part 2: Definition of Management Information, July 1990 [SC21 N 4867] (IS text expected August 1991)
- DIS 10165-4♦ Structure of Management Information - Part 4: Guidelines for the Definition of Managed Objects, July 1990 [SC21 N 4852] (IS text expected July 1991)
- ISO 9595♦ Common Management Information Service (CMIS) Definition, 15 May 1990
- DAD<sup>15</sup> 1♦ CancelGet Service, 1 February 1990 [SC21 N 3876] (IS text expected November 1990)
  - DAD 2♦ Add/Remove Service, 1 February 1990 [SC21 N 3877] (IS text expected November 1990)
  - PCDAM<sup>16</sup> 3 Support of Allomorphism, July 1990 [SC21 N 4966] (CD text expected November 1990)
  - PCDAM 4 Access Control [SC21 N 4969] (CD text expected November 1990)
- ISO 9596♦ Common Management Information Protocol (CMIP) Specification
- DAD 1♦ CancelGet Service, 1 February 1990 [SC21 N 3878] (IS text expected November 1990)
  - DAD 2♦ Add/Remove Service, 1 February 1990 [SC21 N 3879] (IS text expected November 1990)
  - PCDAM 3 Support of Allomorphism, July 1990 [SC21 N 4967] (CD text expected November 1990)
  - PCADM 4 State Table (new work item; CD text expected July 1991)
- WD 9596-2 Common Management Information Protocol (CMIP) Specification, Part 2: PICS Proforma [SC21 N 4965] (CD text expected November 1990)
- DIS 10164-1♦ Systems Management - Part 1: Object Management Function, July 1990 [SC21 N 4067, December 1989]

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<sup>15</sup> DAD: Draft Addendum to ISO standard.

<sup>16</sup> PCDAM: Proposed Committee Draft Amendment for ISO.

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DIS 10164-2♦ Systems Management - Part 2: State Management Function, July 1990  
[SC21 N 4068, December 1989]

DIS 10164-3♦ Systems Management - Part 3: Relationship Management Function, July 1990  
[SC21 N 4069, December 1989]

DIS 10164-4♦ Systems Management - Part 4: Alarm Reporting Function, July 1990  
[SC21 N 4070, December 1989]

DIS 10164-5♦ Systems Management - Part 5: Event Report Management Function, July 1990  
[SC21 N 4071, December 1989]

DIS 10164-6♦ Systems Management - Part 6: Log Control Function, July 1990  
[SC21 N 4063, December 1989]

DIS 10164-7♦ Systems Management - Part 7: Security Alarm Reporting Function, July 1990  
[SC21 N 4064, December 1989]

CD 10164-8 Systems Management - Part 8: Security Audit Trail Function, July 1990  
[SC21 N 4955]

CD 10164-9 Systems Management - Part 9: Objects and Attributes for Access Control,  
July 1990 [SC21 N 4956]

CD 10164-10 Systems Management - Part 10: Accounting Meter Function, July 1990  
[SC21 N 4958]

CD 10164-11 Systems Management - Part 11: Workload Monitoring Function, July 1990  
[SC21 N 4959]

WD 10164-X Systems Management - Part X: Software Management Function, July 1990  
[SC21 N 4976] (CD text expected November 1990)

WD 10164-Y Systems Management - Part Y: Test Management Function, July 1990  
[SC21 N 4978] (CD text expected November 1990)

WD 10164-Z Systems Management - Part Z: Confidence and Diagnostic Test Classes,  
July 1990 [SC21 N 4957] (CD text expected November 1990)

WD 10164-A Systems Management - Part A: Time Management Function, July 1990  
[SC21 N 4953] (new work item; CD text expected November 1990)

WD 10164-B Systems Management - Part B: Measurement Summarization Function, Second  
Working Draft, July 1990 [SC21 N 4972] (CD text expected November 1990)

WDTR<sup>17</sup> xxxx Systems Management Tutorial, July 1990, SC21/WG4 [SC21 N 4942]  
(CCITT X.702)

WDTR xxxx, Annex A Systems Management Tutorial - Annex A: Access Control, 30 May 1990  
[SC21 N 4970]

SC6 N 5447 Liaison Statement to SC21/WG4 on Lower Layer Management,  
13 October 1990

SC6 N 5784 General Principles for the Definition of Lower Layer Management, 2nd Draft,  
JTC1 SC6/WG2/WG4, April 1990

SC21 N 3307 WG4 Architecture Issues List

SC21 N 3311♦ Configuration Management Overview

SC21 N 3316 Access Control for OSI Management and The Directory

SC21 N 3317 Working Document on Extended Information Models

SC21 N 3318 Working Document on the Directory Schema

SC21 N 3319 Working Document on Replication and Knowledge Distribution

<sup>17</sup> WDTR: Working Draft Technical Report for ISO.

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SC21 N 3320 Working Document on Access Control  
SC21 N 3321 Working Document on Enhanced Search  
SC21 N 3322 Working Document on Attribute Classes  
SC21 N 3323 Request for National Body and CCITT Member Contributions on Directory PICS Proforma  
SC21 N 4058 State Tables for CMIP, January 1990  
SC21 N 4077 ♦ Fault Management Working Document, SC21/WG4, December 1989  
SC21 N 4085 ♦ Accounting Management Working Document, Third Version, SC21/WG4, November 1989  
SC21 N 4091 ♦ OSI Security Management Working Document, 15 November 1989  
SC21 N 4906 Upper Layer Management - Call for Contributions, SC21/WG6, June 1990  
SC21 N 4943 Extended Systems Management Architecture, July 1990 (planned to be an amendment to DIS 10040)  
SC21 N 4944 Generic Managed Objects, July 1990  
SC21 N 4945 Definition of a Management Information Register and Registration Procedures, July 1990  
SC21 N 4946 Requirements and Guidelines for Managed Object Conformance Statement (MOCS) Proformas, July 1990  
SC21 N 4947 Formal Descriptions of CMIP, July 1990  
SC21 N 4948 Systems Management Relationship Model, July 1990 (expected to use entity-relationship modelling)  
SC21 N 4949 Systems Management: Response Time Monitoring, July 1990  
SC21 N 4960 Generic Managed Objects, Working Draft, SC21/WG4, July 1990  
SC21 N 4961 Request for Contributions to Progress Work on the Definition of State Tables for CMIP, May 1990  
SC21 N 4968 Synchronization Across Multiple Managed Objects, SC21/WG4, July 1990  
SC21 N 4969 Call for National Body Contributions on Time Management, SC21/WG4, May 1990  
SC21 N 4973 The Use of System Title by OSI Management, SC21/WG4, July 1990  
SC21 N 4974 Use of Global Naming for Identification of Managed Objects, SC21/WG4, July 1990  
SC21 N 4975 A General Model for Relationship Management, SC21/WG4, 31 May 1990  
SC21 N 4977 Use of Action to Invoke State Changes, SC21/WG4, July 1990  
SC21 N 4979 Request for National Body Comment on the Need for an Access Control Information Management Function, SC21/WG4, May 1990  
SC21 N 4980 Security Audit Framework Working Document, SC21/WG4, July 1990  
SC21 N 4981 ♦ Performance Management Working Document, Sixth Working Draft, 4 July 1990  
SC21 N 4982 WG4 Systems Management Issues, SC21/WG4, July 1990  
SC21 N 5079 Draft Answer to Q1/63.1 on Conformance to Objects in the Context of OSI Management, SC21/WG1, May 1990  
SC21 N 5080 Call for Contributions on OSI Management Conformance Issues, SC21/WG1, July 1990

## UNCLASSIFIED

### F. OSI REGISTRATION AUTHORITIES:

- DIS 9834-1♦ Procedures for Specific OSI Registration Authorities - Part 1: General Procedures, March 1990 [SC21 N 4352] (DIS ballot suspended and expected to restart in August 1990; IS text expected June 1991)
- DIS 9834-2♦ Procedures for Specific OSI Registration Authorities - Part 2: Registration Procedures for Document Types, 1990 [SC21 N 2605, May 1988] (DIS ballot suspended and expected to restart in August 1990; IS text expected June 1991)
- ISO 9834-3♦ Procedures for Specific OSI Registration Authorities - Part 3: Procedures for Specific Registration of Joint Object Identifier Component Values for Joint ISO-CCITT Use, April 1990 [SC21 N 4718]
- DIS 9834-4♦ Procedures for Specific OSI Registration Authorities - Part 4: Register of VT Profiles, March 1990 [SC21 N 4325] (DIS ballot suspended and expected to restart in August 1990; IS text expected July 1991)
- DIS 9834-5♦ Procedures for Specific OSI Registration Authorities - Part 5: Register of VT Control Object Definitions, March 1990 [SC21 N 4322] (DIS ballot suspended and expected to restart in August 1990; IS text expected July 1991)
- DP 9834-6 Procedures for Specific OSI Registration Authorities - Part 6: Registration Authority Procedures for Application Process Titles and Application Entity Titles, July 1989 (DIS text expected August 1990)
- WD 9834-B Procedures for Specific OSI Registration Authorities - Part B: Registration of Abstract Syntaxes
- WD 9834-C Procedures for Specific OSI Registration Authorities - Part C: Registration of Transfer Syntaxes
- WD 9834-D Procedures for Specific OSI Registration Authorities - Part D: Registration of Application Contexts
- WD 9834-E Procedures for Specific OSI Registration Authorities - Part E: Registration of System Titles
- WD 9834-F Procedures for Specific OSI Registration Authorities - Part F: Registration of Authentication Mechanisms
- TR 9973 Registration of Graphical Items
- WD xxxx Registration of System Titles (DP expected November 1990)
- SC21 N 5014 Liaison Statement to CCITT SG VII (Q.23) on Collaborative Work on OSI Registration, 6 June 1990

### G. OSI CONFORMANCE TESTING:

- DIS 9646-1.2♦ OSI Conformance Testing Methodology and Framework - Part 1: General Concepts, April 1989 (IS text expected September 1990)
- DIS 9646-2.2♦ OSI Conformance Testing Methodology and Framework - Part 2: Abstract Test Suite Specification, April 1989 (IS text expected September 1990)  
WDAD<sup>18</sup> 1 Testing and Formal Description Techniques (FDTs)
- DIS 9646-3♦ OSI Conformance Testing Methodology and Framework - Part 3: Executable Test Derivation, May 1990  
WDAD 1 TTCN Extensions, July 1990 [SC21 N 5077]

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<sup>18</sup> WDAD: Working Draft Addendum to ISO standard.

## UNCLASSIFIED

DIS 9646-4 ♦ OSI Conformance Testing Methodology and Framework - Part 4: Test Realization (Requirements for Implementors), June 1989 (IS text expected September 1990)

DIS 9646-5 ♦ OSI Conformance Testing Methodology and Framework - Part 5: Requirements on Test Laboratories and Clients for the Conformance Assessment Process (Test Execution), June 1989 (IS text expected September 1990)

DP 9646-6 OSI Conformance Testing Methodology and Framework - Part 6: Interpretation of Test Report, 1989

WD xxxx Multi-Party Testing Methodology, July 1990, SC21/WG1 [SC21 N 5076] (CD text expected October 1990)

DTR xxxx Catalogue of PICS Proforma Notations, July 1990 (joint work of WG1 and CCITT SG VII; meeting scheduled for February 1991)

SC21 N 4215 Formal Methods in Conformance Testing (new work item, January 1990)

SC21 N 5075 Protocol Profile Testing Methodology, Second Working Draft, SC21/WG1, July 1990

SC21 N 5078 Catalogue of PICS Proforma Notations, SC21/WG1, July 1990

SC21 N 5117 Multiparty Testing for MHS, SC21/WG1, July 1990

CCITT X.290 OSI Conformance Testing Methodology and Framework for Protocol Recommendations for CCITT Applications (see DP 9646-1 and DP 9646-2)

### H. TAXONOMY AND PROFILES:

STANAG 4257 ♦ NATO Standard Profile on Military Message Handling System (MMHS), Draft, February 1990

STANAG xxxx ♦ NATO Standard Profile on R.131(M), Draft, 1989

STANAG xxxx ♦ NATO Standard Profile on TC 111(M), Draft, Version 1.3, 13 July 1990

STANAG xxxx ♦ NATO Standard Profile on TA 51(M), Draft, Version 2.0, 23 July 1990

TR 10000-1 ♦ International Standardized Profiles (ISPs) - Part 1: Taxonomy Framework, 9 February 1990 [JTC1 SGFS, SGFS N 184]

TR 10000-2 ♦ ISPs - Part 2: Taxonomy of Profiles, 9 February 1990 [JTC1 SGFS, SGFS N 185]

DISP 10607-1 ISPs - AFT nn - File Transfer, Access, and Management - Part 1: Specification of ACSE, Presentation and Session Protocols for the Use by FTAM, 26 April 1990 [SGFS N 131] (submitted by SPAG)

DISP 10607-2 ISPs - AFT nn - File Transfer, Access, and Management - Part 2: Definition of Document Types, Constraint Sets and Syntaxes, 26 April 1990 [SGFS N 131] (submitted by SPAG)

DISP 10607-3 ISPs - AFT nn - File Transfer, Access, and Management - Part 3: AFT 11 - Simple File Transfer Service (Unstructured), 26 April 1990 [SGFS N 131] (submitted by SPAG)

WDISP 10607-4 ISPs - AFT nn - File Transfer, Access, and Management - Part 4: AFT 12 - Positional File Transfer Service, July 1990

WDISP 10607-5 ISPs - AFT nn - File Transfer, Access, and Management - Part 5: AFT 22 - Positional File Access Service, July 1990

WDISP 10607-6 ISPs - AFT nn - File Transfer, Access, and Management - Part 6: AFT 12 - File Management Service, July 1990

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|                            |  |
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| SGFS N 201                 | ISPs - Taxonomy Update, ISP Approval, and Maintenance Process, 7 May 1990 (standing SGFS document)   |
| SC21 N 3674                | ISPs - Directory of ISPs and Profiles Contained Therein, June 1989   |
| SC21 N 3675                | ISPs - ISP Approval and Maintenance Process, June 1989   |
| SC21 N 3678                | ISPs - Proposed New AMH Taxonomy, June 1989  |
| SC21 N 4716                | Initial List of Planned PDISPs, 30 April 1990  |
| ENV <sup>19</sup> 41 101 ♦ | LANs: Provision of the OSI Connection-Mode Transport Service (COTS) Service Using the Connection-Mode Network Service (CLNS) on a CSMA/CD Single LAN, June 1986                                  |
| ENV 41 102 ♦               | LANs: Provision of the OSI COTS and the CLNS on a CSMA/CD Single or Multiple LAN Configuration, June 1986  |
| ENV 41 103 ♦               | LANs: Provision of the OSI COTS and the Connection-Mode Network Service (CONS) in an End System on a CSMA/CD LAN, December 1987  |
| ENV 41 104                 | Packet Switched Data Networks: Permanent Access, August 1987   |
| ENV 41 105 ♦               | Packet Switched Data Networks: Switched Access, June 1988  |
| ENV 41 106 ♦               | Digital Data Circuit (CSDN) - Provision of the OSI COTS in the T.70 Case for Telematic End Systems, June 1988  |
| ENV 41 107 ♦               | Digital Data Circuit (CSDN) - Provision of the OSI COTS and the OSI CONS, June 1988  |
| ENV 41 108 ♦               | LANs: Provision of the OSI COTS and CONS in an End System on a Token Ring LAN, May 1988  |
| ENV 41 109 ♦               | LANs: Provision of the OSI COTS Using CLNS on a Token Ring Single LAN, February 1988   |
| ENV 41 110 ♦               | LANs: Provision of the OSI COTS Using CLNS in an End System on a Token Ring LAN in a Single or Multiple LAN Configuration, February 1988   |
| ENV 41 201                 | Private Message Handling System - User Agent and Message Transfer Agent; Private Management Domain to Private Management Domain, June 1986   |
| ENV 41 202                 | Message Handling Systems; User Agent and Message Transfer Agent: Access to an Administration Management Domain (ADMD), August 1987   |
| ENV 41 203                 | Exchange of Telex Documents Between Two End Systems, Which May Be Teletex Terminals, June 1988   |
| ENV 41 204 ♦               | FTAM: Simple File Transfer, June 1988  |
| ENV 41 205 ♦               | FTAM: File Management, June 1987   |
| ENV 41 901                 | X.29-Mode Procedures Between a Packet Mode DTE or a PAD and a PAD via a Public or Private X.25 Packet Switched Network or ISO 8208 Packet Level Entity and ISO 7776 Link Level Entity, June 1987 |
| M-IT-02                    | Directory of Functional Standards (For Interworking in an OSI Environment) Adopted by the CEN/CENELEC/CEPT/ITSTC, March 1987   |

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<sup>19</sup> ENV indicates an interim standard approved by the Joint European Standards Institution (CEN/CENELEC) and the European Workshop for Open Systems (EWOS).

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D-12

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II. LAYER 1: PHYSICAL LAYER<sup>20</sup>

A. GENERAL:

|               |  |
|---------------|--|
| STANAG 4251 ♦ | NATO Reference Model for OSI - Layer 1 (Physical Layer) Service Definition, Draft, July 1990     |
| STANAG 4261 ♦ | NATO Reference Model for OSI - Layer 1 (Physical Layer) Protocol Specification, Draft, July 1990 |
| ISO 9160      | Physical Layer Interoperability Requirements   |
| DIS 9316      | Small Computer System Interface (SCSI)   |
| DIS 9318      | Intelligent Peripheral Interface - Physical Level  |
| DIS 10022 ♦   | Physical Service Definition  |
| CCITT X.211   | Physical Service Definition for OSI for CCITT Applications (see DIS 10022), 1988 Blue Books      |

B. MECHANICAL:

|              |   |
|--------------|---|
| ISO 2110.3 ♦ | 25-Pin DTE/DCE Interface Connector and Pin Assignments (Revision of ISO 2110)<br>PDAD 1      Interface Connector and Contact Number Assignments for a DTE/DCE for Data Signalling Rates Above 20 kbit/s |
| ISO 2593 ♦   | 34-Pin DTE/DCE Interface Connector and Pin Assignments  |
| ISO 4902 ♦   | 37-Pin DTE/DCE Interface Connector and Pin Assignments (Revision of ISO 4902)   |
| ISO 4903 ♦   | 15-Pin DTE/DCE Interface Connector and Pin Assignments (Revision of ISO 4903)   |
| TR 7477 ♦    | Arrangements for DTE/DTE Physical Connection Using V.24 and X.24 Interchange Circuits   |
| ISO 8481 ♦   | DTE/DTE Physical Connection Using X.24 Interchange Circuits with DTE-Provided Timing  |
| ISO 8877 ♦   | Interface Connector and Contact Assignments for ISDN Basic Access Interface Located at Reference Points S and T<br>DAD 1 ♦      Standard ISDN Basic Access TE Connecting Cord                           |
| DP 10173     | ISDN Primary Access Connector at Reference Points S and T   |
| CCITT I.340  | ISDN Connection Types   |

C. ELECTRICAL:

|            |  |
|------------|--|
| ISO 8482 ♦ | Twisted Pair Multipoint Interconnections |
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<sup>20</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].



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| DIS 9549♦       | Galvanic Isolation of Balanced Interchange Circuits   |
| CCITT V.5       | Data Signalling Rates for Synchronous Data Transmission in the General Switched Telephone Network |
| CCITT V.6       | Data Signalling Rates for Synchronous Data Transmission on Leased Telephone-Type Circuits         |
| CCITT V.28♦     | Electrical Characteristics for Unbalanced Double-Current Interchange Circuits                     |
| CCITT V.31♦     | Electrical Characteristics for Single-Current Interchange Circuits Controlled by Contact Closure  |
| CCITT V.31 bis♦ | Electrical Characteristics for Single-Current Interchange Circuits Using Opto Couplers            |
| CCITT V.35♦     | Data Transmission at 48 kbit/s Using 60-108 kHz Group Band Circuits                               |
| CCITT V.36♦     | Modems for Synchronous Data Transmission Using 60-108 kHz Group Band Circuits                     |

### D. FUNCTIONAL:

|             |   |
|-------------|---|
| ISO 7480♦   | Start-Stop Transmission Signal Quality at DTE/DCE Interfaces  |
| ISO 9543♦   | Synchronous Transmission Signal Quality at DTE/DCE Interfaces   |
| CCITT I.411 | ISDN User-Network Interfaces - Reference Configuration  |
| CCITT I.412 | ISDN User-Network Interfaces - Interface Structures and Access Capabilities   |
| CCITT X.1   | International User Classes of Service in Public Data Networks and Integrated Services Digital Networks (ISDNs)            |
| CCITT X.4   | General Structure of Signals of International Alphabet No. 5 Code for Data Transmission Over Public Data Networks         |
| CCITT X.10  | Categories of Access for DTE to Public Data Transmission Services Provided by PDNs and/or ISDNs through Terminal Adaptors |
| CCITT X.24♦ | List of Definitions for Interchange Circuits Between DTE and DCE on Public Data Networks                                  |

### E. PROCEDURAL:

|              |  |
|--------------|--|
| ISO 8480♦    | DTE/DCE Back-Up Control Operation Using the 25-Pole Connector  |
| ISO 9067♦    | Automatic Fault Isolation Procedures Using Test Loops  |
| CCITT I.420  | Basic User-Network Interface (ISDN)  |
| CCITT I.421  | Primary Rate User-Network Interface (ISDN)   |
| CCITT I.430♦ | Basic User-Network Interface - Layer 1 Specification (ISDN)  |
| CCITT I.431♦ | Primary Rate User-Network Interface - Layer 1 Specification (ISDN)   |
| CCITT I.460♦ | Multiplexing, Rate Adaptation and Support of Existing Interfaces (ISDN)                                      |
| CCITT I.461♦ | Support of X.21 and X.21 bis Based DTEs by an ISDN (X.30)  |
| CCITT I.462♦ | Support of Packet Mode Terminal Equipment by an ISDN (X.31)  |
| CCITT I.463♦ | Support of DTEs with V-Series Type Interfaces by an ISDN   |
| CCITT I.464♦ | Multiplexing Rate Adaptation and Support of Existing Interfaces for Restricted 64 kbit/s Transfer Capability |

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| CCITT V.10/X.26♦ | Electrical Characteristics for Unbalanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communication   |
| CCITT V.11/X.27♦ | Electrical Characteristics for Balanced Double-Current Interchange Circuits for General Use With Integrated Circuit Equipment in the Field of Data Communications  |
| CCITT V.20♦      | Telex and Gentex Signalling on Radio Channels (Synchronous 7-Unit Systems Affording Error Correction by Automatic Repetition)  |
| CCITT V.24♦      | List of Definitions for Interchange Circuits Between DTE and DCE   |
| CCITT V.25       | Automatic Answering Equipment and/or Parallel Automatic Calling Equipment on the General Switched Telephone Network Including Procedures for Disabling of Echo Control Devices for Both Manually and Automatically Established Calls |
| CCITT V.28♦      | Electrical Characteristics for Unbalanced Double-Current Interchange Circuits  |
| CCITT V.31♦      | Electrical Characteristics for Single-Current Interchange Circuits Controlled by Contact Closure   |
| CCITT V.31 bis♦  | Electrical Characteristics for Single-Current Interchange Circuits Using Opto Couplers   |
| CCITT V.35♦      | Data Transmission at 48 kbit/s Using 60-108 kHz Group Band Circuits, 1988  |
| CCITT V.36♦      | Modems for Synchronous Data Transmission Using 60-108 kHz Group Band Circuits, 1988  |
| CCITT V.37♦      | Synchronous Data Transmission at a Data Signalling Rate Higher than 72 kbit/s Using 60-108 kHz Group Band Circuits   |
| CCITT V.54       | Loop Test Devices for Modems   |
| CCITT X.20♦      | Interface Between DTE and DCE for Start-Stop Transmission Services on Public Data Networks   |
| CCITT X.20 bis   | Use on Public Data Networks of DTE Which Is Designed for Interfacing to Asynchronous Duplex V-Series Modems  |
| CCITT X.21♦      | Interface Between DTE and DCE for Synchronous Operation on Public Data Networks  |
| CCITT X.21 bis♦  | Use on Public Data Networks of DTE Which Is Designed for Interfacing to Synchronous V-Series Modems  |
| CCITT X.22♦      | Multiplex DTE/DCE Interface for User Classes 3-6   |
| CCITT X.31♦      | Support of Packet Mode Terminal Equipment by an ISDN   |
| CCITT X.32♦      | Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Accessing a Packet Switched PDN Through a Public Switched Telephone Network or a Circuit Switched PDN   |
| CCITT X.150      | Principles of Maintenance Testing for Public Data Networks Using DTR and DCE Test Loops  |

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## F. LOCAL AREA NETWORKS (LANs):

- DP 8802-1 ♦ LANs - Part 1: General Introduction
- ISO 8802-2.2 ♦ LANs - Part 2: Logical Link Control
  - DAD 1 ♦ Flow Control Techniques for Bridged LANs
  - DAD 2 ♦ Type 3 Operation - Acknowledge Connectionless Service
  - PDAD 4 ♦ Editorial Changes and Technical Corrections, June 1989
- ISO 8802-3 ♦ LANs - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Access Method and Physical Layer Specifications
  - DAD 1 ♦ Physical Signalling, Medium Attachment, and Baseband Medium Specifications for Type 1BASE5
  - DAD 2 ♦ Repeater Set and Repeater Unit Specification for Use with 10BASE5 and 10 BASE2 Networks
  - DAD 3 ♦ Broadband Medium Attachment Unit and Broadband Medium Specifications, Type 10BROAD36
  - PDAD 4 ♦ CSMA/CD, STARLAN, 1BASE5
  - DAD 5 ♦ Medium Attachment Baseband Medium Specification for a Vendor-Independent Fibre Optic Inter Repeater Link (FOIRL)
- ISO 8802-4.2 ♦ LANs - Part 4: Token-Passing Bus Access Method and Physical Layer Specifications
- ISO 8802-5 ♦ LANs - Part 5: Token Ring Access Method and Physical Layer Specifications
  - PDAD 1 4 and 16 Mbit/s Specification
  - PDAD 2 MAC Sublayer Enhancement
  - PDAD 3 Management Entity Specification
  - PDAD 4 Source Routing MAC Bridge
- DIS 8802-6 ♦ LANs - Part 6: Distributed Queue Dual Bus (DQDB) Media Access Control (MAC)
- ISO 8802-7 ♦ LANs - Part 7: Slotted Ring Access Method and Physical Layer Specification
- DIS 8802-9 ♦ LANs - Part 9: Integrated Voice and Data (IVD) LAN
- ISO 9314-1 ♦ Fibre Distributed Data Interface (FDDI) - Part 1: Physical Layer Protocol (PHY)
- ISO 9314-2 ♦ FDDI - Part 2: Media Access Control (MAC)
- DIS 9314-3 ♦ FDDI - Part 3: Physical Layer Medium Dependent (PMD)
- DTR 9578 Communication Interface Connectors Used in LANs
- DP 10038 ♦ MAC Sublayer Interconnection (MAC Bridging)
- DIS 10039 ♦ MAC Service Definition

III. LAYER 2: DATA LINK LAYER<sup>21</sup>

A. GENERAL:

- STANAG 4252♦ NATO Reference Model for OSI - Layer 2 (Data Link Layer) Service Definition, Draft, July 1990
- STANAG 4262♦ NATO Reference Model for OSI - Layer 2 (Data Link Layer) Protocol Specification, Draft, July 1990
- ISO 8886.3<sup>22</sup>♦ Data Link Service Definition for OSI
- DTR 10171♦ List of Standard Data Link Layer Protocols That Utilize HDLC Classes of Procedures, 1989
- CCITT X.212 Data Link Service Definition for OSI for CCITT Applications (see ISO 8886), 1988 Blue Books

B. CHARACTER-ORIENTED SERVICE (BASIC MODE):

- ISO 1155 Use of Longitudinal Parity to Detect Errors in Information Messages
- ISO 1177 Character Structure for Start/Stop and Synchronous Character Oriented Transmission
- ISO 1745 Basic Mode Control Procedures for Data Communication Systems
- ISO 2111 Basic Mode Control Procedures - Code Independent Information Transfer
- ISO 2628 Basic Mode Control Procedures - Complements
- ISO 2629 Basic Mode Control Procedures - Conversational Information Message Transfer

C. BIT-ORIENTED SERVICE (HIGH-LEVEL DATA LINK CONTROL PROCEDURES [HDLC]):

- ISO 3309♦ HDLC - Frame Structure
  - DAD 1♦ Start/Stop Transmission
  - WAD 2 Extended Transparency Option
- ISO 4335♦ HDLC - Elements of Procedures
  - AD 1♦ Asynchronous (Start/Stop) Transmission Operation
  - AD 2♦ Enhancement of the XID Function Utility
  - DAD 3♦ Start/Stop Transmission
  - PDAD 4♦ Flow Control Unnumbered Information (FUI)
  - PDAD 5 Multi-Selective Reject
- ISO 7478♦ Multilink Procedures

<sup>21</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

<sup>22</sup> For ISO standards, the decimal indicates the version number; thus, DIS 8886.3 is Version 3 (no decimal indicates Version 1).

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- ISO 7776♦ HDLC - Description of the X.25 LAPB-Compatible DTE Data Link Procedures
  - PDAD 1 PICS Proforma
- ISO 7809♦ HDLC - Consolidation of Classes of Procedures
  - AD 1♦ UI Command/Response
  - AD 2♦ Descriptions of Optional Functions
  - DAD 3♦ Stop/Start Transmission
  - PDAD 4♦ List of Standard Data Link Layer Protocols that Utilize HDLC Classes of Procedures [see DTR 10171]
  - PDAD 5 Connectionless Class of Procedure
  - PDAD 6 Extended Transparency Option
  - PDAD 7 Multi-Selective Reject
- ISO 8471♦ HDLC Balanced Classes of Procedures - Data Link Layer Address Resolution/Negotiation in Switched Environments
- ISO 8885♦ HDLC - General Purpose XID Frame Information Field Content and Format
  - DAD 1♦ Additional Operational Parameters for the Parameter Negotiation Data Link Layer Subfield and Definition of a Multilink Parameter Negotiation Data Link Layer Subfield
  - DAD 2♦ Stop/Start Transmission
  - PDAD 3♦ Definition of a Private Parameter Negotiation Data Link Layer Subfield
  - PDAD 4 Extended Transparency Option
  - PDAD 5 Multi-Selective Reject
- CCITT T.71♦ LAPB Extended for Half-Duplex Physical Level Facility

**D. INTEGRATED SERVICES DIGITAL NETWORK (ISDN):**

- CCITT I.440 ISDN User-Network Interface Data Link Layer - General Aspects
- CCITT I.441♦ ISDN User-Network Interface Data Link Layer - Specification

**E. ERROR CORRECTION:**

- CCITT X.141 General Principles for the Detection and Correction of Errors in Public Data Networks

**F. CONFORMANCE SUITE:**

- DP 8882-2♦ Data Link Layer Conformance Test Suite

IV. LAYER 3: NETWORK LAYER<sup>23</sup>

A. GENERAL:

- STANAG 4253 ♦ NATO Reference Model for OSI - Layer 3 (Network Layer) Service Definition, Draft, July 1990
- STANAG 4263 ♦ NATO Reference Model for OSI - Layer 3 (Network Layer) Protocol Specification, Draft, July 1990
- ISO 8348 ♦ Network Service Definition
- AD 1 ♦ Connectionless-Mode Transmission
  - AD 2 ♦ Network Layer Addressing
  - AD 3 ♦ Additional Features of the Network Service
- ISO 8648 ♦ Internal Organization of the Network Layer
- ISO 8880-1 ♦ Protocol Combination to Provide and Support the OSI Network Service - Part 1: General Principles
- ISO 8880-2 ♦ Protocol Combination to Provide and Support the OSI Network Service - Part 2: Provision and Support of the Connection-Mode Network Service
- ISO 8880-3 ♦ Protocol Combination to Provide and Support the OSI Network Service - Part 3: Provision and Support of the Connectionless-Mode Network Service
- WD 8880-4 ♦ Protocol Combination to Provide and Support the OSI Network Service - Part 4: Interconnection of OSI Environments
- DTR 9577 ♦ Protocol Identification in the OSI Network Layer
- PDTR<sup>24</sup> 10172 Network/Transport Protocol Interworking Specification
- ISO 10177 Intermediate-System Support of the OSI Connection-Mode Network Service Using ISO 8208 in Accordance with ISO 10028, 13 October 1989
- SC21 N 4347 Progression of Work on Network Layer Management, SC6/WG2, January 1990 [SC21 N 4630]
- CCITT T.70 ♦ Network-Independent Basic Transport Service for the Telematic Services
- CCITT X.213 Network Service Definition for OSI for CCITT Applications

B. PACKET-SWITCHED SERVICE:

- ISO 8208 ♦ X.25 Packet Level Protocol (PLP) for DTE
- DAD 1.2 ♦ Alternative Logical Channel Number Allocation
  - PDAD 2 ♦ Extensions for Private Switched Use (WITHDRAWN, 1989)
  - DAD 3 ♦ Conformance Requirements

<sup>23</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

<sup>24</sup> PDTR: Proposed Draft Technical Report for ISO.

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|                  |   |
|------------------|---|
| ISO 8878 ♦       | Use of X.25 to Provide the OSI Connection-Mode Network Service  |
|                  | DAD 1 Protection and Priority   |
|                  | DAD 2 Use of an X.25 PVC to Provide the OSI CONS  |
|                  | PDAD 3 Conformance  |
|                  | WDAD 4 PICS Proforma  |
| ISO 8881.3 ♦     | Use of the X.25 PLP in LANs   |
| ISO 8882-1 ♦     | X.25-DTE Conformance Testing - Part 1: General Principles   |
| DP 8882-2 ♦      | X.25-DTE Conformance Testing - Part 2: Data Link Conformance Test Suite   |
| DIS 8882-3 ♦     | X.25-DTE Conformance Testing - Part 3: Packet Level Conformance Test Suite  |
| CCITT X.25(84) ♦ | Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit |
| CCITT X.75(84) ♦ | Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between PSDNs                       |
| CCITT X.223      | Use of X.25 to Provide the OSI Connection-Mode Network Service for CCITT Applications (see ISO 8878)                                |
| CCITT X.244      | Procedure for the Exchange of Protocol Identification During Virtual Call Establishment on Packet Switched Public Data Networks     |

### C. CONNECTIONLESS SERVICE:

|             |  |
|-------------|--|
| ISO 8473 ♦  | Protocol for Providing the Connectionless-Mode Network Service   |
|             | PDAD 1 ♦ Provision of the Underlying Service Assumed by ISO 8473 Over Point-to-Point Subnetworks Which Provide the OSI Data Link Service |
|             | PDAD 2 ♦ Estelle Formal Description of ISO 8473 (to be rebaloted as a DTR)   |
|             | AD 3 ♦ Provision of the Underlying Service Assumed by ISO 8473 over Subnetworks Which Provide the OSI Data Link Service                  |
| DIS 9068 ♦  | Provision of the Connectionless Network Service Using ISO 8208   |
| PDTR xxxx ♦ | Formal Description of ISO 8473   |

### D. ISDN:

|               |  |
|---------------|--|
| ISO 9574 ♦    | Provision of the OSI Connection-Mode Network Service (CONS) by Packet Mode Terminal Equipment Connected to an Integrated Services Digital Network (ISDN) |
|               | WDAD 1 Provision of the CONS on an ISDN Circuit-Switch Channel   |
| CCITT I.450 ♦ | ISDN User-Network Interface - Layer 3 - General Aspects  |
| CCITT I.451 ♦ | ISDN User-Network Interface - Layer 3 - Specification  |
| CCITT I.461 ♦ | Support of X.21 and X.21 bis Based DTEs by an ISDN (X.30)  |
| CCITT I.462 ♦ | Support of Packet Mode Terminal Equipment by an ISDN (X.31)  |
| CCITT I.463 ♦ | Support of DTEs with V-Series Type Interfaces by an ISDN   |

Note: Additional ISDN standards are listed in the last section of this Appendix.

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### E. ROUTING AND RELAY:

|             |  |
|-------------|--|
| ISO 9542♦   | End System to Intermediate System Routing Exchange Protocol for Use in Conjunction with the Protocol for Providing the Connectionless-Mode Network Service |
| DTR 9575♦   | OSI Routing Framework, April 1988  |
| DP 10028.2♦ | Definition of the Relaying Functions of a Network Layer Intermediate System  |
| TR 10029♦   | Operation of an X.25 Interworking Unit   |
| DIS 10030♦  | End System to Intermediate System Routing Information Exchange Protocol for Use in Conjunction with ISO 8208 (X.25 PLP) [SC6 N 5006]                       |
| DP xxxx♦    | Intermediate System Routing  |
| SC6 N 4053  | End System to Intermediate System Routing Exchange Protocol for Use in Conjunction With ISO 8473   |
| CCITT X.110 | International Routing Principles and Routing Plan for Public Data Networks   |
| CCITT X.353 | Routing Principles for Interconnecting the Maritime Satellite Data Transmission System With Public Data Networks   |

### F. AUTOMATIC CALLING/ANSWERING EQUIPMENT:

|                 |  |
|-----------------|--|
| CCITT V.25♦     | Automatic Answering Equipment and/or Parallel Automatic Calling Equipment on the General Switched Telephone Network Including Procedures for Disabling of Echo Control Devices for Both Manually and Automatically Established Calls |
| CCITT V.25 bis♦ | Automatic Calling and/or Answering Equipment on the General Switched Telephone Network (GSTN) Using the 100-Series Interchange Circuits  |

### G. CIRCUIT SWITCHED SERVICE:

Covered by CCITT X.21, X.24, X.26, X.27, ISO 4903, listed under Physical Layer Standards.

### H. LOCAL AREA NETWORKS (LANs):

|            |   |
|------------|---|
| DP 10038♦  | MAC Sublayer Interconnection (MAC Bridging) |
| DIS 10039♦ | MAC Service Definition                      |

Other standards are covered in the discussion of LAN standards for Layer 2 (Section III).



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V. LAYER 4: TRANSPORT LAYER<sup>25</sup>

A. GENERAL:

|               |   |
|---------------|---|
| STANAG 4254 ♦ | NATO Reference Model for OSI - Layer 4 (Transport Layer) Service Definition, Draft, July 1990     |
| STANAG 4264 ♦ | NATO Reference Model for OSI - Layer 4 (Transport Layer) Protocol Specification, Draft, July 1990 |
| ISO 8072 ♦    | Transport Service Definition  |
|               | AD 1 ♦ Connectionless-Mode Transmission   |
| PDTR 10023 ♦  | A Formal Description of ISO 8072 in LOTOS   |
| PDTR 10172    | Network/Transport Protocol Interworking Specification   |
| CD xxxx ♦     | A Formal Description of the Transport Service Definition in Estelle                               |
| CD xxxx ♦     | A Formal Description of the Transport Protocol Specification in Estelle                           |
| CD xxxx ♦     | Transport Layer Management  |
| CD xxxx ♦     | Transport Layer Security  |
| CCITT T.70 ♦  | Network-Independent Basic Transport Service for the Telematic Services                            |
| CCITT X.214   | Transport Service Definition for OSI for CCITT Applications                                       |

B. CONNECTION-ORIENTED SERVICE:

|              |  |
|--------------|--|
| ISO 8073 ♦   | Connection Oriented Transport Protocol Specification             |
|              | AD 1 ♦ Network Connection Management Subprotocol                 |
|              | DAD 2 ♦ Operation of Class 4 Over Connectionless Network Service |
|              | DAD 3 ♦ Protocol Implementation Conformance Statement Proforma   |
| PDTR 10024 ♦ | A Formal Description of ISO 8073 in LOTOS                        |
| CCITT X.224  | Transport Protocol Specification for OSI for CCITT Applications  |

C. CONNECTIONLESS SERVICE:

|                  |   |
|------------------|---|
| ISO 8073 DAD 2 ♦ | Connection Oriented Transport Protocol Specification - Addendum 2: Operation of Class 4 Over Connectionless Network Service |
| ISO 8602 ♦       | Protocol for Providing the Connectionless-Mode Transport Service  |

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<sup>25</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

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**D. CONFORMANCE TESTING:**

- DIS 10025-1♦      Transport Conformance Testing for Connection Oriented Transport Protocol  
Operating Over the Connection Oriented Network Service (CONS) - Part 1:  
General Principles
- DP 10025-2♦      Transport Conformance Testing for Connection Oriented Transport Protocol  
Operating Over the Connection Oriented Network Service (CONS) - Part 2:  
Test Suite Structure and Test Principles
- DP 10025-3♦      Transport Conformance Testing for Connection Oriented Transport Protocol  
Operating Over the Connection Oriented Network Service (CONS) - Part 3:  
Abstract Test Suite Specification

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VI. LAYER 5: SESSION LAYER<sup>26</sup>

A. GENERAL:

|                      |  |
|----------------------|--|
| STANAG 4255 ♦        | NATO Reference Model for OSI - Layer 5 (Session Layer) Service Definition, Draft, April 1990   |
| STANAG 4265 ♦        | NATO Reference Model for OSI - Layer 5 (Session Layer) Protocol Specification, Draft, April 1990   |
| ISO 8326 ♦           | Basic Connection-Oriented Session Service Definition (equivalent to CCITT X.215), August 1987 (draft revised text of April 1990 incorporates AD1, AD2, and AD3); Technical Corrigendum, April 1990 |
| AD 1 ♦               | Session Symmetric Synchronization for the Session Service (not part of CCITT Recommendation), October 1989 [SC21 N 3507]   |
| AD 2 ♦               | Incorporation of Unlimited User Data, June 1988 [SC21 N 2495]  |
| AD 3 ♦               | Connectionless-Mode Session Service, August 1989 [SC21 N 3462]   |
| WDAM <sup>27</sup> 4 | Additional Resynchronization Functionality, July 1990 [SC21 N 5040] (CD text expected October 1990)  |
| TR 9571 ♦            | LOTOS Description of the Session Service, January 1989 [SC21 N 3148]   |
| TR 9572 ♦            | LOTOS Description of the Session Protocol, January 1989 [SC21 N 3149]  |
| DIS 10168-1 ♦        | Conformance Test Suite for the Session Protocol - Part 1: Test Suite Structure and Test Purposes, 19 April 1990 [SC21 N 4159, 11 December 1989] (IS text expected June 1991)                       |
| WD 10168-2 ♦         | Conformance Test Suite for the Session Protocol - Part 2: Generic Test Suite, 1989 (CD text expected June 1992)  |
| WD 10168-3 ♦         | Conformance Test Suite for the Session Protocol - Part 3: Abstract Test Suite for CS Method, 1989 (formal WD text expected February 1991, CD text June 1991)                                       |
| DIS 10168-4 ♦        | Conformance Test Suite for the Session Protocol - Part 4: Session Test Management Protocol Specification, July 1990 [SC21 N 5026] (IS text expected June 1991)                                     |
| CCITT X.215          | Session Service Definition for OSI for CCITT Applications  |

<sup>26</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

<sup>27</sup> WDAM: Working Draft Amendment for ISO.

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### B. CONNECTION-ORIENTED SERVICE:

- ISO 8327♦      Basic Connection-Oriented Session Protocol Specification, August 1987 (draft revised text of April 1990 incorporates AD1 and AD2); Technical Corrigendum, April 1990
- AD 1♦      Session Symmetric Synchronization for the Session Protocol, October 1989 [SC21 N 3508]
  - AD 2♦      Incorporation of Unlimited User Data, June 1988 [SC21 N 2494]
  - WDAM 4      Additional Resynchronization Functionality, July 1990 [SC21 N 5041] (CD text expected October 1990)
- CD 8327-2♦      Basic Connection-Oriented Session Protocol Specification - Part 2: PICS Proforma, July 1990 [SC21 N 5022] (DIS text expected November 1990, IS text November 1991)
- CCITT X.225      Session Protocol Specification for OSI for CCITT Application

### C. CONNECTIONLESS SERVICE:

- ISO 9548♦      Session Connectionless Protocol to Provide Connectionless-Mode Session Service
- CD 9548-2      Session Connectionless Protocol to Provide Connectionless-Mode Session Service - Part 2: PICS Proforma, July 1990 [SC21 N 5022] (DIS text expected November 1990, IS text November 1991)
- ISO 8326 AD 3♦      Basic Connection-Oriented Session Service Definition, Connectionless-Mode Session Service, August 1989 [SC21 N 3462]

### D. TELEMATIC SERVICES:

- CCITT T.5♦      General Aspects of Group 4 Facsimile Apparatus
- CCITT T.62♦      Control Procedures for Teletex and Group 4 Facsimile Services
- CCITT X.3♦      Packet Assembly/Disassembly Facility (PAD) in a Public Data Network (PDN), 1988.
- CCITT X.20♦      Interface Between DTE and DCE for Start-Stop Transmission Services on Public Data Networks, 1988
- CCITT X.28♦      DTE/DCE Interface for a Start/Stop Mode DTE Accessing the PAD in a PDN Situated in the Same Directory (Country), 1988
- CCITT X.29♦      Procedures for the Exchange of Control Information and User Data Between a PAD and a Packet Mode DTE or Another PAD, 1988

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VII. LAYER 6: PRESENTATION LAYER<sup>28</sup>

A. GENERAL:

|              |   |
|--------------|---|
| STANAG 4256♦ | Presentation Layer Service Definition, Draft, January 1990  |
| STANAG 4266♦ | Presentation Layer Protocol Specification, Draft, January 1990  |
| ISO 8822♦    | Connection-Oriented Presentation Service Definition, August 1988  |
| AD 1♦        | Connectionless-Mode Presentation Service, July 1990 [SC21 N 4933]   |
| WDAM 2♦      | Support of Session Symmetric Synchronization Service, February 1990 (CD text expected September 1990)   |
| CDAM 3       | Unlimited User Data, July 1990 [SC21 N 5065] (DIS text expected June 1991, IS text in June 1992)  |
| CDAM 4       | Abstract Syntax Registration, July 1990 [SC21 N 5067] (DIS text expected June 1991, IS text in June 1992)   |
| WDAM 5       | Confidentiality and Integrity, July 1990 [SC21 N 3164] (CD text expected June 1991)   |
| WDAM 6       | Additional Resynchronization Functionality, January 1990 [SC21 N 4121] (CD text expected October 1990)  |
| ISO 8823♦    | Connection-Oriented Presentation Protocol Specification   |
| WDAM 2♦      | Support of Session Symmetric Synchronization Service, February 1990 (CD text expected September 1990)   |
| CDAM 3       | Unlimited User Data, July 1990 [SC21 N 5065] (DIS text expected June 1991, IS text in June 1992)  |
| CDAM 4       | Transfer Syntax Registration, July 1990 [SC21 N 5068] (DIS text expected June 1991, IS text in June 1992)   |
| WDAM 5       | Confidentiality and Integrity, July 1990 [SC21 N 3164] (CD text expected June 1991)   |
| WDAM 6       | Additional Resynchronization Functionality, January 1990 [SC21 N 4121] (CD text expected October 1990)  |
| DIS 8823-2   | Connection-Oriented Presentation Protocol Specification - Part 2: PICS Proforma, July 1990 [SC21 N 5025] (IS text expected November 1991)   |
| CD xxxx-1♦   | Conformance Test Suite for the Presentation Protocol, Part 1: Test Suite Structure and Test Purposes, SC21/WG6, July 1990 [SC21 N 5019] (DIS text expected in November 1990, IS text November 1991)   |
| WD xxxx-2♦   | Conformance Test Suite for the Presentation Protocol, Part 2: Test Suite Structure and Test Purposes for ASN.1 Encodings, SC21/WG6, July 1990 [SC21 N 5019] (CD text expected February 1991, DIS text November 1991, IS text November 1992) |

<sup>28</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

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- CCITT X.216 Presentation Service Definition for OSI for CCITT Applications (see ISO 8822, 1988)
- CCITT X.226 Presentation Protocol Specification for OSI for CCITT Application, (see ISO 8823, 1988)

### B. CONNECTIONLESS SERVICE:

- ISO 8822 AD 1 ♦ Connection-Oriented Presentation Service Definition - Connectionless-Mode Presentation Service, July 1990 [SC21 N 4933]
- ISO 9576 ♦ Presentation Connectionless Protocol to Provide Connectionless-Mode Presentation Service, July 1990 [SC21 N 4934]
- CD 9576-2 Presentation Connectionless Protocol to Provide Connectionless-Mode Presentation Service - Part 2: PICS Proforma, July 1990 [SC21 N 5020] (DIS text expected November 1990, IS text November 1991)

### C. ABSTRACT SYNTAX NOTATION ONE (ASN.1):

- STANAG 4258 ♦ Specification of ASN.1, Draft, January 1990
- STANAG 4259 ♦ Specification of Basic Encoding Rules for ASN.1, Draft, January 1990
- ISO 8824 ♦ Specification of ASN.1, December 1987; Revised text of April 1990 incorporates AM1 on ASN.1 Extensions [SC21 N 4720]
- DAM 1 ♦ ASN.1 Extensions, June 1988 (incorporated in Revised Edition of ISO 8824)
- WDAM 2 New Features, July 1989 [SC21 N 3165] (CD text expected June 1991)
- ISO 8825 ♦ Specification of Basic Encoding Rules for ASN.1, November 1987; Revised text of April 1990 incorporates AM1 on ASN.1 Extensions [SC21 N 4721]
- DAM 1 ♦ ASN.1 Extensions, June 1988 (incorporated in Revised Edition of ISO 8825)
- WDAM 2 New Features, July 1989 [SC21 N 3165] (CD text expected June 1991)
- WD 8825-2 Conformance Test Suite for the Presentation Protocol - Part 2: Test Suite Structure and Test Purposes for ASN.1 Encodings, July 1990 [SC21 N 5019 (WG6)] (CD text expected February 1991)
- SC21 N 3174 Working Document on ASN.1, Including Timetable, March 1989 [SC21/WG6]
- CCITT X.208 Specification of Abstract Syntax Notation One (ASN.1) (see ISO 8824, Revised Edition)
- CCITT X.209 Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1) (see ISO 8825, Revised Edition)

### D. TELEMATIC SERVICES:

- CCITT T.6 ♦ Facsimile (FAX) coding schemes and coding control functions for Group 4 Facsimile Apparatus
- CCITT T.51 ♦ Coded Character Sets for Telematic Services
- CCITT T.61 ♦ Character Repertoire and Coded Character Sets for the International Teletex Service
- CCITT T.73 ♦ Document Interchange Protocol for the Telematic Services

VIII. LAYER 7: APPLICATION LAYER<sup>29</sup>

## A. GENERAL:

|             |  |
|-------------|--|
| STANAGs♦    | [Separate Application Layer STANAGs will be developed for each application; each will contain the service definition, the protocol specification, and an interoperability profile.] <sup>30</sup>            |
| ISO 9545♦   | Application Layer Structure (ALS), December 1989 [SC21 N 3825, August 1989]  |
|             | WDAD 1♦ Connectionless Mode Transmission, June 1988 [SC21 N 2470] (CD text expected June 1991)   |
|             | WDAD 2 Extended Application Layer Structure (XALS), July 1990 [SC21 N 5012] (CD text expected November 1990)   |
| WD xxxx     | Service and Protocol for Authentication Exchange Application Service Element (ASE), January 1990 [SC21 N 4110] (CD expected May 1991)  |
| CDTR xxxx   | Methodology and Guidelines for the Development of Application Layer Protocols, June 1990 [SC21 N 4903] (new work item of June 1988 failed but programme of work with CDTR is still active; status uncertain) |
| SC21 N 3109 | Architectural and Descriptive Issues Identified During the Workshop on Application Layer Standardization, December 1988 [SC21/WG1]   |
| SC21 N 3208 | Requirements for More Efficient Use of Application Associations, December 1988 [SC21/WG6]  |
| SC21 N 3209 | Upper Layer Security Model, July 1989 (CD expected June 1991)  |
| SC21 N 3733 | Access Control for OSI Applications, July 1989   |
| SC21 N 4002 | Extended Application Layer Structure, ANSI Contribution to SC21/WG6, 19 October 1989   |
| SC21 N 4107 | Modelling for Communications Aspects of Distributed Applications, January 1990 (new work item; CD text expected June 1991)   |
| SC21 N 4108 | Management Information in the Upper Layers, January 1990 (CD expected June 1991)   |
| SC21 N 4354 | Topics Proposed for Discussion at the JTC1 Workshop on Distributed Applications, Phoenix, March 1990, UK Contribution, January 1990  |
| SC21 N 4519 | Clarification of ALS Modelling Concepts, Workshop on Distributed Applications, 18 April 1990   |
| SC21 N 4520 | Issues for Consideration by Joint ULA/ODP Meeting, Seoul, May/June 1990, Workshop on Distributed Applications, 18 April 1990   |
| SC21 N 4674 | Liaison Statement Regarding Common Application Interfaces for the Telematic Services, CCITT SG I, 23 May 1990  |
| SC21 N 4764 | Progression of Association Pools, ANSI, 9 May 1990   |

<sup>29</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

<sup>30</sup> *NTIS Transition Strategy* [Ref. 4], p.3.



## UNCLASSIFIED

SC21 N 4766 US Response to SC21/WG6 N 770 on Requirements for Extended ALS, ANSI, May 1990

SC21 N 4904 Request for Comment on Characteristics of an Application Service Element and Application Service Object, SC21/WG6, May 1990

SC21 N 4905 Request for Comment on Introduction of a New Relationship in ALS, SC21/WG6, June 1990

SC21 N 4908 Liaison to CCITT SG VII(Q19,Q25) on ULA Topics, SC21/WG6, June 1990

SC21 N 4926 Liaison to CCITT SG VII(Q19) on DAF, SC21/WG6, June 1990

SC21 N 5003 Distributed Applications Security Modelling and Infrastructure, SC21/WG6, July 1991

SC21 N 5011 Modelling Recovery in the Application Layer, SC21/WG6, 1 June 1990 (new work item; CD text expected June 1991)

SC21 N 5016 Meeting Report for SC21/WG1/WG4/WG6/WG7 Joint Meeting on Service Conventions, ODP, and ULA on 29 May 1990, SC21, June 1990

### B. OSI DIRECTORY:

ISO 9594-1♦ The Directory - Part 1: Overview of Concepts, Models, and Service

ISO 9594-1/7♦ Amendments to Parts 1-7, Support of Nameform2 (formal WD text planned for June 1991, CD text in November 1991, DIS text in November 1992, and IS text in November 1993)

ISO 9594-1/7♦ Amendments to Parts 1-7, Schema, PCDAMs, July 1990 [SC21 N 4914] (CD text planned for October 1990, DIS text in October 1991, and IS text in October 1992)

ISO 9594-2♦ The Directory - Part 2: Models

ISO 9594-2/5♦ Amendments to Parts 2-5, Access Control, PDAMs, December 1989 [SC21 N 4041] (DIS text for June 1991 and IS text in June 1992)

ISO 9594-2/5♦ Amendments to Parts 2-5, Replication and Knowledge Management, PCDAMs, July 1990 [SC21 N 4913] (CD text planned for October 1990, DIS text in October 1991, and IS text in October 1992)

ISO 9594-3♦ The Directory - Part 3: Abstract Service Definitions

ISO 9594-3/4 Amendments to Parts 3,4, Enhanced Search, PCDAMs, July 1990 [SC21 N 4924] (CD text planned for October 1990, DIS text in October 1991, and IS text in October 1992)

ISO 9594-4♦ The Directory - Part 4: Procedures for Distributed Operations

ISO 9594-5♦ The Directory - Part 5: Protocol Specifications

ISO 9594-6♦ The Directory - Part 6: Selected Attribute Types

ISO 9594-7♦ The Directory - Part 7: Selected Object Classes

ISO 9594-8♦ The Directory - Part 8: Authentication Framework

WD 9594-9♦ The Directory - Part 9: DIT Structure and Naming, July 1990 [SC21 N 4985] (CD text expected October 1990, DIS text in October 1991, IS text in October 1992)

WD 9594-10♦ The Directory - Part 10: Replication and Knowledge Management, July 1990 [SC21 N 4913] (CD text expected October 1990, DIS text in October 1991, IS text in October 1992)

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|             |  |
|-------------|--|
| WD 9594-11♦ | The Directory - Part 11: Directory PICS Proforma, July 1989 [SC21 N 4039] (CD text expected November 1991)         |
| WD 9594-X♦  | The Directory - Part X: Text Suite Structure and Test Purposes, July 1990 [SC21 N 4951] (CD text expected 1992)    |
| WD 9594-Y♦  | The Directory - Part Y: Abstract Test Suite for the OSI Directory, July 1990 [SC21 N 4951] (CD text expected 1992) |
| SC21 N 4799 | Letter for Information on Disposition of EDIMS Use of Directory, 21 May 1990                                       |
| SC21 N 4803 | Publication of Directory Schema and Other Registered Object Definitions, Canada, 2 May 1990                        |
| SC21 N 4804 | Proposed DIT Structure Rule Definition, 10 May 1990  |
| SC21 N 4806 | Use of External Data Transfer Systems for Shadow Updates, 10 May 1990  |
| SC21 N 4918 | Question on Standardization of Directory API, July 1990  |
| SC21 N 4922 | Information on Distributed Entries, SC21/WG4, July 1990  |
| SC21 N 4924 | Extensions to Directory Abstract Service, Working Draft, SC21/WG4, July 1990                                       |
| SC21 N 4951 | Test Suites for OSI Directory, SC21/WG4, July 1990 (new work item)   |
| CCITT X.500 | The Directory - Overview of Concepts, Models, and Services   |
| CCITT X.501 | The Directory - Models   |
| CCITT X.509 | The Directory - Authentication Framework   |
| CCITT X.511 | The Directory - Abstract Service Definition  |
| CCITT X.518 | The Directory - Procedures for Distributed Operation   |
| CCITT X.519 | The Directory - Protocol Specifications  |
| CCITT X.520 | The Directory - Selected Attribute Types   |
| CCITT X.521 | The Directory - Selected Object Classes  |

### C. OPERATING SYSTEM INTERFACE:

|            |  |
|------------|--|
| ISO 9945-1 | Portable Operating System Interface for Computer Environments (POSIX) - Part 1: System Interface, 1990 |
| DP 9945-2  | POSIX - Part 2: Shell and Utilities, 1989  |
| DP xxxx♦   | Operating System Command and Response Language (OSCRL)   |
| DP xxxx♦   | System Software Interface for Application Programmes (SSI)   |

### D. ASSOCIATION CONTROL SERVICE ELEMENT (ACSE):

|           |   |
|-----------|---|
| ISO 8649♦ | Service Definition for the ACSE (equivalent to CCITT X.217)   |
| DAD 1♦    | Peer-Entity Authentication During Association Establishment, September 1989 [SC21 N 3771] (editing meeting July 1990) |
| AM 2♦     | Connectionless-Mode ACSE Service, April 1989 [SC21 N 3458]  |
| WDAD 3♦   | Application Context Management (CD text expected October 1991)  |

## UNCLASSIFIED

- ISO 8650♦ Protocol Specification for the ACSE (equivalent to CCITT X.227); Technical Corrigendum, 1 June 1990
- DAD 1♦ Peer-Entity Authentication During Association Establishment, September 1989 [SC21 N 3772] (editing meeting July 1990)
  - WDAD 3♦ Application Context Management (CD text expected October 1991)
  - WDAD 4 Application Entity Titles
- DIS 8650-2 ACSE PICS Proforma, July 1990 [SC21 N 5024] (IS text expected June 1991)
- ISO 10035♦ Connectionless ACSE Protocol Specification, July 1990 [SC21 N 3456]
- WD 10035-2 Connectionless ACSE Protocol Specification - Part 2: PICS Proforma for Connectionless ACSE Protocol, July 1989 [SC21 N 3218] (CD text possible in June 1991)
- DIS 10169-1♦ Conformance Test Suite for the ACSE Protocol - Part 1: Test Suite Structure and Test Purposes, February 1989 [SC21 N 3219] (IS text expected June 1991)
- CCITT X.217 Association Control Service Definition for OSI for CCITT Applications (see ISO 8649)
- CCITT X.227 Association Control Protocol Specification for OSI for CCITT Applications (see ISO 8650)

### E. COMMITMENT, CONCURRENCY, AND RECOVERY (CCR) SERVICE

#### ELEMENT:

- ISO 9804♦ Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element Service, April 1990 [SC21 N 4611] (CCITT X.237)
- CDAD 1♦ Enhancements, July 1990 [SC21 N 4615] (DIS text expected May 1991, IS text in May 1992)
  - WDAD 2♦ Session Mapping Changes (Additional Resynchronization Functionality), July 1990 [SC21 N 5122] (CD text expected November 1990)
  - WDAD 3♦ Restart (CD text expected May 1992)
- ISO 9805♦ Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Service Element Protocol, April 1990 [SC21 N 4612] (CCITT X.247)
- CDAD 1♦ Enhancements, July 1990 [SC21 N 4616] (DIS text expected May 1991, IS text in May 1992)
  - WDAD 2♦ Session Mapping Changes (Additional Resynchronization Functionality), July 1990 [SC21 N 5123] (CD text expected November 1990)
  - WDAD 3♦ Restart (CD text expected May 1992)
- CD 9805-2♦ Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Service Element Protocol - Part 2: PICS Proforma, July 1990 [SC21 N 5121] (DIS text expected November 1991, IS text in November 1992)
- SC21 N 3180 Possible CCR Extensions - Base Text, January 1989 [SC21/WG6]
- SC21 N 4279 CCR Conformance Test Suite, January 1990 (CD text expected June 1993)

## UNCLASSIFIED

### F. RELIABLE TRANSFER (RT), REMOTE OPERATIONS (RO), AND REMOTE PROCEDURE CALL (RPC):

|               |   |
|---------------|---|
| ISO 9066-1.2♦ | Reliable Transfer - Part 1: Model, Notation and Service Definition  |
| ISO 9066-2.2♦ | Reliable Transfer - Part 2: Protocol Specification  |
| ISO 9072-1.2♦ | Remote Operations - Part 1: Concepts and Model  |
| ISO 9072-2.2♦ | Remote Operations - Part 1: Protocol Specification  |
| DIS 10148     | Basic Remote Procedure Call (RPC) Using OSI Remote Operations, [SC21 N 3463; fast-track ballot failed; DIS 10148 WITHDRAWN; proposal for new work item, SC21 N 4153, January 1990] (CD text for RPC model, service, and protocol now planned for June 1991) |
| SC21 N 4523   | Modelling of Application Program Interfaces and Remote Procedure Calls, Distributed Applications Workshop, 2 April 1990   |
| SC21 N 4767   | US Response to SC21/WG6 N 7889 on Requirements for RPC Interface Definition Notation, 11 May 1990   |
| SC21 N 4925   | Liaison to SC22/WG11 Concerning Remote Procedure Call Interface Definition Notation (IDN), June 1990  |
| SC21 N 4927   | Remote Procedure Call, Working Draft, SC21/WG6, 1 June 1990   |
| SC21 N 4928   | Remote Procedure Call Definitions and Requirements, SC21/WG6, June 1990   |
| CCITT X.218   | Reliable Transfer: Model and Service Definition (see ISO 9066-1)  |
| CCITT X.219   | Remote Operations: Model, Notation and Service Definition (see ISO 9072-1)  |

### G. MESSAGE HANDLING SYSTEM (MHS):

|              |  |
|--------------|--|
| STANAG 4257♦ | Military Message Handling System (MMHS), Draft, May 1990   |
| CCITT X.218  | Reliable Transfer: Model and Service Definition (see ISO 9066-1)   |
| CCITT X.219  | Remote Operations: Model and Service Definition (see ISO 9072-1)   |
| CCITT X.228  | Reliable Transfer: Protocol Specification (see ISO 9066-2)   |
| CCITT X.229  | Remote Operations: Protocol Specification (see ISO 9072-2)   |
| CCITT X.400♦ | Message Handling Systems (MHSs): System Model - Service Elements (see ISO 10021-1 for MOTIS)   |
| CCITT X.401♦ | MHSs - Basic Service Elements and Optional User Facilities   |
| CCITT X.402♦ | MHSs: Overall Architecture (ISO 10021-2, MOTIS)  |
| CCITT X.403♦ | MHSs: Conformance Testing  |
| CCITT X.407♦ | MHSs - Abstract Service Definition Conventions (ISO 10021-3, MOTIS)  |
| CCITT X.408♦ | MHSs - Encoded Information-Type Conversion Rules   |
| CCITT X.409♦ | MHSs - Presentation Transfer Syntax and Notation [replaced by X.208 (ISO 8824 with DAD1) and X.208 (ISO 8825 with DAD1)]                               |
| CCITT X.410♦ | MHSs - Remote Operations and Reliable Transfer Server [replaced by X.218 (ISO 9066-1), X.219 (ISO 9072-1), X.228 (ISO 9066-2), and X.229 (ISO 9072-2)] |
| CCITT X.411♦ | MHSs - Message Transfer Layer (see ISO 10021-4)  |
| CCITT X.413♦ | MHSs - Message Store: Abstract Service Definition (ISO 10021-5, MOTIS)   |

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|              |  |
|--------------|--|
| CCITT X.419♦ | MHSs: Protocol Specifications (ISO 10021-6, MOTIS)                   |
| CCITT X.420♦ | MHSs - Interpersonal Messaging User Agent Layer (ISO 10021-7, MOTIS) |
| CCITT X.430♦ | MHSs - Access Protocol for Teletex Terminals                         |
| CCITT F.400  | Message Handling System and Service Overview                         |
| CCITT F.401  | Naming and Addressing for Public Message Handling Services           |
| CCITT F.410  | The Public Messaging Transfer Service                                |
| CCITT F.415  | Intercommunication with Public Physical Delivery Services            |
| CCITT F.420  | The Public Interpersonal Messaging (IPM) Service                     |
| CCITT F.421  | Intercommunication Between the IPM Service and the Telex Service     |
| CCITT F.422  | Intercommunication Between the IPM Service and the Teletex Service   |
| CCITT F.500  | International Public Directory Services                              |

### H. MESSAGE ORIENTED TEXT INTERCHANGE SYSTEM (MOTIS):<sup>31</sup>

|              |  |
|--------------|--|
| ISO 10021-1♦ | MOTIS - Part 1: System and Service (CCITT X.400)   |
| ISO 10021-2♦ | MOTIS - Part 2: Overall Architecture (CCITT X.402)   |
| ISO 10021-3♦ | MOTIS - Part 3: Abstract Service Definition Conventions (CCITT X.407)                              |
| ISO 10021-4♦ | MOTIS - Part 4: Message Transfer System - Abstract Service Definition and Procedures (CCITT X.411) |
| ISO 10021-5♦ | MOTIS - Part 5: Message Store - Abstract Service Definition (CCITT X.413)                          |
| ISO 10021-6♦ | MOTIS - Part 6: Protocol Specifications (CCITT X.419)  |
| ISO 10021-7♦ | MOTIS - Part 7: Interpersonal Message System (CCITT X.420)   |
| DP xxxx      | Mailbox Access Service and Protocol  |

### I. MANUFACTURING MESSAGE SPECIFICATION:

|             |  |
|-------------|--|
| DIS 9506-1♦ | Manufacturing Message Specification - Part 1: Service Definition     |
| DIS 9506-2♦ | Manufacturing Message Specification - Part 2: Protocol Specification |

### J. FILE TRANSFER, ACCESS AND MANAGEMENT (FTAM):

|              |   |
|--------------|---|
| ISO 8571-1♦  | FTAM - Part 1: General Introduction   |
|              | DAM 1♦ Filestore Management, July 1990  |
|              | PDAM 2♦ Overlapped Access, April 1990   |
| ISO 8571-1/5 | Amendments to Parts 1-5: Enhancement to FTAM Services to Satisfy Additional User Requirements, January 1990 (new work item) [SC21 N 4162] (CD text expected May 1991) |

<sup>31</sup> DIS 8505♦, DIS 8883♦, and DIS 9065♦ are not included in this list, since they have been superseded by the other standards included in the list (see Section 4.3.1).

**UNCLASSIFIED**

- ISO 8571-2♦ FTAM - Part 2: Virtual Filestore Definition
  - DAM 1♦ Filestore Management, July 1990
  - PDAM 2♦ Overlapped Access, April 1990
- ISO 8571-3♦ FTAM - Part 3: File Service Definition
  - DAM 1♦ Filestore Management, July 1990
  - PDAM 2♦ Overlapped Access, April 1990
- ISO 8571-4♦ FTAM - Part 4: File Protocol Specification
  - DAM 1♦ Filestore Management, July 1990
  - PDAM 2♦ Overlapped Access, April 1990
- ISO 8571-5♦ FTAM - Part 5: Protocol Implementation Conformance Statement Proforma
  - WDAM 1♦ Filestore Management, July 1990
  - WDAM 2♦ Overlapped Access, July 1990
- DIS 10170-1♦ Conformance Test Suite for the FTAM Protocol - Part 1: Test Suite Structure and Test Purposes, July 1990 [SC21 N 4181, 11 December 1989]
- DP 10170-2♦ Conformance Test Suite for the FTAM Protocol - Part 2: FTAM Abstract Test Suite [SC21 N 3665, June 1989] (CD text expected June 1991)
- DP 10170-3♦ Conformance Test Suite for the FTAM Protocol - Part 3: ACSE Abstract Test Suite Embedded Under FTAM (CD text expected June 1992)
- DP 10170-4♦ Conformance Test Suite for the FTAM Protocol - Part 4: Presentation Abstract Test Suite Embedded Under FTAM (CD text expected June 1992)
- DP 10170-5♦ Conformance Test Suite for the FTAM Protocol - Part 5: Session Abstract Test Suite Embedded Under FTAM (CD text expected June 1992)
- DISP 10607-1 ISPs - AFT nn - File Transfer, Access, and Management - Part 1: Specification of ACSE, Presentation and Session Protocols for the Use by FTAM, 26 April 1990 [SGFS N 131] (submitted by SPAG)
- DISP 10607-2 ISPs - AFT nn - File Transfer, Access, and Management - Part 2: Definition of Document Types, Constraint Sets and Syntaxes, 26 April 1990 [SGFS N 131] (submitted by SPAG)
- DISP 10607-3 ISPs - AFT nn - File Transfer, Access, and Management - Part 3: AFT 11 - Simple File Transfer Service (Unstructured), 26 April 1990 [SGFS N 131] (submitted by SPAG)
- WDISP 10607-4 ISPs - AFT nn - File Transfer, Access, and Management - Part 4: AFT 12 - Positional File Transfer Service, July 1990
- WDISP 10607-5 ISPs - AFT nn - File Transfer, Access, and Management - Part 5: AFT 22 - Positional File Access Service, July 1990
- WDISP 10607-6 ISPs - AFT nn - File Transfer, Access, and Management - Part 6: AFT 12 - File Management Service, July 1990
- SC21 N 3372 Sharing an Association Between FTAM and Other ASE, February 1989 [SC21/WG5]
- SC21 N 4162 Proposal for a NWI for Enhancement of FTAM Services to Satisfy Additional User Requirements, December 1989
- SC21 N 4184 Request for National Body Comment on Security Enhancements to FTAM, SC21/WG5, November 1989

## UNCLASSIFIED

SC21 N 4192 Proposed FTAM Document Type to Support CGM, SC21/WG5, December 1989

SC21 N 5155 Enhancement of FTAM Security Services, New Work Item Proposal, SC21/WG5, July 1990

SC21 N 5164 Planned Work Schedule for FTAM, SC21/WG5, June 1990

SC21 N 5165 FTAM Constraint Set and Document Types for CGM, SC21/WG5, June 1990

SC21 N 5189 Liaison Statement to JTC1/SWG-EDI on EDIFACT Document Types for FTAM, SC21/WG5, June 1990

### K. VIRTUAL TERMINAL (VT):

ISO 9040♦ Virtual Terminal Service - Base Class (April 1990 Revised Edition incorporates AD1)

- AD 1♦ Extended Facility Set
- DAM 2♦ Additional Functional Units, July 1990 (IS text expected June 1991)

ISO 9041♦ Virtual Terminal Protocol - Basic Class (April 1990 Revised Edition incorporates AD1)

- AD 1♦ Extended Facility Set
- DAM 2♦ Additional Functional Units, June 1990 (IS text expected June 1991)

CD 9041-2♦ Virtual Terminal Protocol - Part 2: PICS Proforma, June 1990 [SC21 N 4175] (DIS text expected January 1991, IS text in January 1992)

SC21 N 3365 Guide to ISO Virtual Terminal Standards, February 1989 [SC21/WG5]

SC21 N 5162 Conformance Test Suite for the VT Protocol, July 1990 (CD text expected December 1990, DIS text in July 1991, IS text in March 1992)

### L. TERMINAL MANAGEMENT (TM), VISUAL DISPLAY TERMINAL (VDT), AND X-WINDOWS:

DIS 9241 Visual Display Terminal (VDT) [TC159 SC4/WG5]

CD 10184-1 Terminal Management - Model, June 1990 [SC21 N 4176] (DIS text expected July 1991, IS text in July 1992)

WD 10184-2 Terminal Management - Service, June 1990 [SC21 N 4176] (formal WD text expected November 1990, CD expected November 1991)

WD 10184-3 Terminal Management - Protocol, June 1990 [SC21 N 4176] (formal WD text expected November 1990, CD expected November 1991)

SC21 N 3369 Terminal Management (TM) Issues List, February 1989 [SC21/WG5]

SC21 N 3381 Statement on TM Strategic Direction, February 1989 [SC21/WG5]

SC21 N 3383 Relationship Between TM and User Interfaces, February 1989 [SC21/WG5]

SC21 N 3930 Liaison Statement from JTC1/SC18 to JTC1/SC21/WG5 on Comments on Terminal Management, SC18/WG4, 19 October 1989

SC21 N 4188 Response to SC18/WG4 N 1183, Comments on Terminal Management, and SC18/WG3 and CCITT SG VII(Q27) Liaison Statement on Terminal Management, SC21/WG5, December 1989

SC21 N 4189 Comments on the Integration of X-Windows into the OSI Environment, December 1989

**UNCLASSIFIED**

**M. JOB TRANSFER AND MANIPULATION (JTM):**

- ISO 8831♦ Job Transfer and Manipulation Concepts and Services; draft Revised Edition of December 1989 incorporates AD1 [SC21 N 4183]
- ISO 8832♦ Specification of the Basic Class Protocol for Job Transfer and Manipulation
  - DAM 1♦ JTM Full Protocol Specification, 28 May 1990 [SC21 N 5225, text with amendment incorporated; and SC21 N 5224, amendment alone] (IS text expected November 1991)
- SC21 N 4603 Position on Reassessment of JTM Full Class Protocol, AFNOR, March 1990
- SC21 N 4641 US Position on JTM Reassessment, March 1990
- SC21 N 4679 Reassessment of Project 1.21.13.03 (JTM Full Class), SC21, 10 June 1990

**N. TELEMATIC SERVICES:**

- CCITT F.200♦ Teletex Service
- CCITT F.200/C♦ Teletex Service, Annex C: Mixed Mode of Operation
- CCITT F.201♦ Internetworking Between the Teletex Service and the Telex Service
- CCITT T.60♦ Terminal Equipment for Use in the Teletex Service
- CCITT T.63♦ Provision for Verification of Teletex Compliance
- CCITT T.72♦ Terminal Capabilities for Mixed Mode of Operation
- CCITT T.90♦ Teletex Requirements for Internetworking with the Telex Service
- CCITT T.91♦ Teletex Requirements for Real-Time Internetworking with the Telex Service in a Packet-Switched Network Environment
- CCITT T.330♦ Telematic Access to Interpersonal Messaging System
- CCITT X.430♦ MHS, Access Protocol for Teletex Terminals

**O. INFORMATION RESOURCE DICTIONARY SYSTEM (IRDS):**

- DP 8800-1 Information Resource Dictionary System (IRDS) - Part 1: Command Language and Panel Interface, April 1987 [SC21 N 1789] (projected suspended until the IRDS services interface reaches DIS status; the command language and panel interface are expected to be split into separate standards)
- ISO 10027♦ IRDS Framework, March 1989 [SC21 N 3426]
- WD xxxx IRDS - Service Interface, July 1990 [SC21 N 5147] (CD text expected January 1991)
- WD xxxx IRDS - Design Support for SQL Applications (CD text expected January 1991)
- WD xxxx IRDS - Export/Import (CD text expected November 1990)
- WD xxxx IRDS - Extensions, July 1990 [SC21 N 5139] (CD text expected June 1992)
- SC21 N 3344 IRDS Rapporteur Group Position on Need for IRDS Specialization for RDA, April 1989 [SC21/WG3]
- SC21 N 4806 Use of External Data Transfer Systems for Shadow Updates, 10 May 1990



## UNCLASSIFIED

SC21 N 5137 Data Management Export/Import for SQL and IRDS, SC21/WG3, July 1990  
(new work item)  
SC21 N 5139 IRDS Extensions, SC21/WG3, July 1990 (new work item)

### P. REMOTE DATABASE ACCESS (RDA):

DP 9579-1♦ Remote Database Access (RDA) - Part 1: Generic Model, Service, and Protocol,  
March 1990 [SC21 N 4282] (CD text expected June 1991)  
DP 9579-2♦ Remote Database Access (RDA) - Part 2: SQL Specialization, March 1990  
[SC21 N 4281]  
WDAM 1 Support for SQL2, March 1990 (CD text expected  
June 1992)  
WDTR xxxx♦ Remote Database Access Tutorial, January 1989 [SC21 N 3343] (CD text  
expected June 1991)  
SC21 N 3344 IRDS Rapporteur Group Position on Need for IRDS Specialization for RDA,  
April 1989 [SC21/WG3]  
SC21 N 3346 RDA Use of Remote Operation Notation of ROSE, December 1988  
[SC21/WG3]  
SC21 N 3351 RDA Requirements for CCR, December 1988 [SC21/WG3]  
SC21 N 3352 Harmonization of RDA and TP, December 1988 [SC21/WG3]  
SC21 N 5138 RDA Support for Shared DBL Statements, July 1990 (new work item;  
rapporteur meeting January 1991)

### Q. DATA MANAGEMENT CONCEPTS:

TR 9007 Concepts and Terminology for the Conceptual Schema and the Information Base  
CD 10032.2♦ Reference Model of Data Management, Revised Draft, July 1990 [SC21 N 2641,  
May 1988] (editing meeting scheduled January 1991)  
WDTR xxxx Tutorial on the Reference Model for Data Management (CDTR expected  
June 1992)  
SC21 N 197 Concepts and Terminology for the Conceptual Schema and the Information Base,  
TC97/SC5, March 1982  
SC21 N 236 Assessment Guidelines for Conceptual Schema Language Proposals,  
TC97/SC21/WG5-3, 31 August 1985  
SC21 N 3358 Generic Data Management Export/Import  
SC21 N 3806 Request for New Question on Conceptual Schema Standardization, September  
1989  
SC21 N 3903 Modelling, Specification, Use, and Role of Conceptual Schemas, October 1989  
SC21 N 4195 Draft WG3 Position on Conceptual Schema Question, February 1990  
SC21 N 4199 Liaison Statement to JTC1/SC1 on SC21/WG3 Terminology, contains the  
Reference Model on Data Management (8 August 1989), February 1990  
SC21 N 4280 Proposed New Work Item: Conceptual Data Modelling Facility, SC21/WG3,  
February 1990  
SC21 N 4383 Development of the Extended Information Model, January 1990  
SC21 N 4511 US Comments on Conceptual Schema, ANSI, 15 March 1990  
SC21 N 4524 Consideration of the Data Management Component of Application Standards,  
Workshop of Distributed Applications, 23 April 1990

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- SC21 N 4593 Metadata Use and Standards for Managing Metadata, ANSI, 4 April 1990  
SC21 N 5137 Data Management Export/Import for SQL and IRDS, SC21/WG3, July 1990  
(new work item)  
SC21 N 5193 Conceptual Schema HOD/C Meeting report Held on 31 May 1990 in Seoul,  
July 1990

**R. DATABASE LANGUAGES AND CONCEPTS:**

- ISO 8907♦ Database Language ND, June 1987  
ISO 9075♦ Database Language SQL, April 1989 (incorporates AD 1) [SC21 N 3158]  
AD 1♦ Integrity Enhancements  
CD 9075.2♦ Database Language SQL2, July 1990 [SC21 N 3155, 25 January 1989]  
WD 9075.3♦ Database Language SQL3 (CD expected June 1992)  
SC21 N 3158 Database Language SQL2 With Integrity Enhancement, January 1989  
[SC21/WG3]  
SC21 N 4875 Recommendation on SQL2 Progress ISO 9075 Revised, 31 May 1990  
SC21 N 5137 Data Management Export/Import for SQL and IRDS, SC21/WG3, July 1990  
(new work item)

**S. DISTRIBUTED TRANSACTION PROCESSING (TP):**

- DIS 10026-1♦ Distributed Transaction Processing (TP) - Part 1: Model, 22 March 1990  
[SC21 N 4288, 15 December 1989] (IS text expected June 1992)  
DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Security, WDAMs,  
January 1990 [SC21 N 4163] (CD text expected June 1991)  
DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Association  
Management, WDAMs, January 1990 [SC21 N 4164] (CD text expected  
June 1992)  
DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Heuristic Decisions,  
WDAMs, January 1990 [SC21 N 4167]  
DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Commitment  
Optimization, WDAMs, January 1990 [SC21 N 4168] (IS text expected  
June 1991)  
DIS 10026-1/3 Draft Amendments to Parts 1-3: Distributed Transaction Processing Dialogue  
Recovery and User Suspension of a Dialogue, WDAMs, January 1990  
[SC21 N 4170] (CD text expected June 1992)  
DIS 10026-1/3 Draft Amendments to Parts 1-3: Distributed Transaction Processing Savepoints,  
January 1990 [SC21 N 4171] (new work item; not accepted by JTC1,  
June 1990)  
DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Sub-Transactions,  
WDAMs, July 1990 [SC21 N 5156] (CD text expected January 1992)  
DIS 10026-1/4 Draft Amendments to Parts 1-3: Transaction Processing Separate Data and  
Commit Associations, WDAMs, July 1990 [SC21 N 5156] (CD text expected  
May 1993)  
DIS 10026-2♦ Distributed Transaction Processing (TP) - Part 2: Service Definition, 22 March  
1990 [SC21 N 4290] (IS text expected June 1991)

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DIS 10026-3♦ Distributed Transaction Processing (TP) - Part 3: Transaction Processing Protocol Specification, 22 March 1990 [SC21 N 4292] (IS text expected June 1991)

CD 10026-4 Distributed Transaction Processing (TP) - Part 4: PICS Proforma, July 1990 [SC21 N 5159] (editing meeting scheduled January 1991)

CD 10026-5 Distributed Transaction Processing (TP) - Part 5: Application Context Proforma, July 1990 [SC21 N 5160]

WD 10026-Y Data Transfer for OSI TP - Unstructured Data Transfer, January 1990 [SC21 N 4166] (new work item; CD text expected June 1991)

WD 10026-Z Data Transfer for OSI TP - Other Transfer Modes, January 1990 [SC21 N 4166] (new work item; CD text expected June 1992)

WD xxxx-1 Conformance Test Suite for the TP Protocol, Part 1: Test Suite Structure and Test Purposes, 6th Working Draft, June 1990 [SC21 N 5162] (formal WD text expected February 1991, CD text June 1992)

WD xxxx-2 Conformance Test Suite for the TP Protocol, Part 2: Abstract Test Suites, January 1990 [SC21 N 4172]

SC21 N 4186 TP: Request for Comments on Sub-Transactions, November 1989

SC21 N 5156 TP Sub-Transactions, New Work Item Proposal, SC21/WG5, July 1990

SC21 N 5157 TP Separate Data and Commit Associations, New Work Item Proposal, SC21/WG5, July 1990

SC21 N 5169 Plan for OSI TP DIS Editing, SC21/WG5, June 1990 (editing meetings on DIS text planned for Nov-Dec 1990, Mar-Apr 1991, and May 1991)

SC21 N 5170 OSI TP Association Management - Statement of Requirements, SC21/WG5, June 1990

SC21 N 5171 OSI TP Security - Statement of Requirements, SC21/WG5, June 1990

SC21 N 5172 Combined Use of RPC and OSI TP, SC21/WG5, June 1990

SC21 N 5173 Working Draft Unstructured Data Transfer (UDT) for TP, SC21/WG5, May 1990

SC21 N 5176 OSI TP Security, New Work Item, June 1990

SC21 N 5177 OSI TP Association Management - Revised New Work Item, SC21/WG5, June 1990

SC21 N 5179 Proposed Replacement Text for the NWI Proposal on Commitment Optimizations in SC21 N 4168 (JTC1 N 631), SC21/WG5, June 1990

SC21 N 5183 Combined Use of CMISE and OSI TP, SC21/WG5, June 1990

SC21 N 5184 Queued Data Transfer for TP, SC21/WG5, May 1990

### T. OPEN DISTRIBUTED PROCESSING (ODP):

CD xxxx-1♦ Basic Reference Model for Open Distributed Processing - Part 1: Introduction (proposal for new work item, 1987) [SC21 N 1547] (CD text expected June 1994)

CD xxxx-2♦ Basic Reference Model for Open Distributed Processing - Part 2: Concepts and Modelling Tools (proposal for new work item, 1987) [SC21 N 1547] (CD text expected June 1992)

CD xxxx-3♦ Basic Reference Model for Open Distributed Processing - Part 3: Framework for ODP Standards (proposal for new work item, 1987) [SC21 N 1547] (CD text expected May 1993)

## UNCLASSIFIED

CD xxxx-4♦ Basic Reference Model for Open Distributed Processing - Part 4: User Guide (proposal for new work item, 1987) [SC21 N 1547] (CD text expected May 1994)

SC21 N 1889 ODP: Proposed Revised Text for the NWI on the Basic Reference Model of Open Distributed Processing, 29 April 1987

SC21 N 2507 ODP: Report on Topic 1 - The Problem of Distributed Processing, March 1988 [SC21/WG7]

SC21 N 2511 ODP: Definitions and Glossary - March 1988 Version, March 1988 [SC21/WG7]

SC21 N 3194 ODP: Working Document on Topic 2.3 - Framework of Abstractions, December 1988 [SC21/WG7]

SC21 N 3202 ODP: Recommendations of SC21/WG7, Sydney, 9 December 1988

SC21 N 3288 ODP: Working Document on Topic 2.2 - Properties and Design Freedoms, December 1988 [SC21/WG7]

SC21 N 3801 Support Environment for Open Distributed Processing, ECMA, September 1989

SC21 N 4019 ODP: Topics List - November 1989 Version - for the Basic Reference Model of Open Distributed Processing, 8 November 1989

SC21 N 4020 ODP: List of Open and Resolved Issues - November 1989 Version, 11 December 1989

SC21 N 4021 ODP: Document Register and Bibliography - November 1989 Version, 11 December 1989

SC21 N 4022 ODP: Working Document on Topic 4.1 - Structures and Functions, 11 December 1989

SC21 N 4023 ODP: Working Document on Topic 6.1 - Modelling Techniques and Their Use in ODP, 11 December 1989

SC21 N 4024 ODP: Working Document on Topic 6.2 - Formalisms and Specifications, 11 December 1989

SC21 N 4025 ODP: Working Document on Topic 8.1 - Draft Basic Reference Model of Open Distributed Processing, 11 December 1989

SC21 N 4026 ODP: Recommendations of SC21/WG7, Florence, 11 December 1989

SC21 N 4027 ODP: Meeting Minutes of the Florence Working Group Meeting of WG7, 11 December 1989

SC21 N 4028 ODP: SC21/WG7 Convener's Report to SC21 Plenary Meeting, 11 December 1989

SC21 N 4029 ODP: Liaison Statement to JTC1/TSG-1 on IAP, 11 December 1989

SC21 N 4030 ODP: Cooperation between SC21/WG7 and CCITT SG VII (Q19/DAF), 11 December 1989

SC21 N 4031 ODP: Session Report on Joint Meeting on FDT, 11 December 1989

SC21 N 4032 ODP: Liaison Statement to JTC1/SWG-EDI on EDI Modelling, 11 December 1989

SC21 N 4033 ODP: Proposal for Future Cooperation Between SC21/WG6 and SC21/WG7 on ULA and ODP, 11 December 1989

SC21 N 4564 ODP: Liaison Statement to SC21/WG7 on Relationship of DAF Architecture/Infrastructure with ODP Topic 4 - Functions and Interfaces, CCITT SG VII, March 1990

SC21 N 4655 Architectural Semantics for ODP - Reassessment Report, SC21/WG7, April 1990

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**U. GRAPHICAL KERNEL SYSTEM (GKS):**

|            |  |
|------------|--|
| ISO 7942   | Graphical Kernel System (GKS) Functional Description<br>DAD 1 Audit Trail Metafile   |
| ISO 8651-1 | GKS Language Bindings - Part 1: FORTRAN  |
| ISO 8651-2 | GKS Language Bindings - Part 2: Pascal   |
| ISO 8651-3 | GKS Language Bindings - Part 3: Ada  |
| WD 8651-4  | GKS Language Bindings - Part 4: C  |
| ISO 8805   | GKS for Three Dimensions (GKS-3D) Functional Description<br>WDAD 1 Name Set Addendum |
| DIS 8806-1 | GKS-3D Language Bindings - Part 1: FORTRAN   |
| DIS 8806-3 | GKS-3D Language Bindings - Part 3: Ada   |
| DIS 8806-4 | GKS-3D Language Bindings - Part 4: C   |

**V. PROGRAMMER'S HIERARCHICAL INTERACTIVE GRAPHICS SYSTEM (PHIGS):**

|            |  |
|------------|--|
| ISO 9592-1 | Programmer's Hierarchical Interactive Graphics System (PHIGS) Language Bindings - Part 1: Functional Description |
| ISO 9592-2 | PHIGS Language Bindings - Part 2: Archive File Format  |
| ISO 9592-3 | PHIGS Language Bindings - Part 3: Clear-Text Encoding of Archive File  |
| ISO 9593-1 | PHIGS Language Bindings - Part 1: FORTRAN Binding  |
| DIS 9593-2 | PHIGS Language Bindings - Part 2: Extended Pascal  |
| DIS 9593-3 | PHIGS Language Bindings - Part 3: Ada  |
| DIS 9593-4 | PHIGS Language Bindings - Part 4: C  |
| SC24 N 224 | PHIGS Plus, 1989   |

**W. DIALOGUES WITH GRAPHICAL DEVICES:**

|            |  |
|------------|--|
| DP 9636-1  | Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 1: Overview, Profiles, and Conformance |
| DP 9636-2  | Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 2: Control, Negotiation, and Errors    |
| DP 9636-3  | Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 3: Output and Attributes               |
| DP 9636-4  | Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 4: Segmentation                        |
| DP 9636-5  | Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 5: Input and Echoing                   |
| DP 9636-6  | Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 6: Raster                              |
| WD 9636-8  | Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 8: FORTRAN Language Binding of CGI     |
| WD 9636-11 | Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 11: C Language Binding of CGI          |

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### X. DOCUMENT EXCHANGE--ODA, ODIF, DOAM, DFR, AND DTAM:

|             |  |
|-------------|--|
| ISO 8211    | Specification for a Data Descriptive File for Information Interchange  |
| ISO 8613-1♦ | Office Document Architecture (ODA) and Interchange Format - Part 1: Introduction and General Principles  |
| ISO 8613-2♦ | ODA and Interchange Format - Part 2: Document Structures<br>PDAD 1    Formal Specification of ODA Document Structures                            |
| ISO 8613-3♦ | ODA and Interchange Format - Part 3: Document Processing Reference Model   |
| ISO 8613-4♦ | ODA and Interchange Format - Part 4: Document Profile  |
| ISO 8613-5♦ | ODA and Interchange Format - Part 5: Office Document Interchange Format (ODIF)   |
| ISO 8613-6♦ | ODA and Interchange Format - Part 6: Character Content Architectures   |
| ISO 8613-7♦ | ODA and Interchange Format - Part 7: Raster Graphics Content Architectures   |
| ISO 8613-8♦ | ODA and Interchange Format - Part 8: Geometric Graphics Content Architectures  |
| DIS 10031-1 | Distributed Office Applications Model (DOAM) - Part 1: General Model   |
| DIS 10031-2 | Distributed Office Applications Model (DOAM) - Part 2: Referenced Data   |
| DIS 10166-1 | Document Filing and Retrieval (DFR) - Part 1: Abstract Service Definition and Procedures, 14 December 1989 [SC18 N 2069, February 1989]          |
| DIS 10166-2 | Document Filing and Retrieval (DFR) - Part 2: Protocol Specification, 14 December 1989 [SC18 N 2070, February 1989]                              |
| SC21 N 4472 | Liaison Statement from JTC1/SC18 to JTC1/SC21 on Changes to ASN.1, SC18/WG3 (title is in error--changes are for ODA, ISO 8613), 22 February 1990 |
| CCITT T.400 | Introduction to Document Architecture, Transfer and Manipulation   |
| CCITT T.411 | Open Document Architecture (ODA) and Interchange Format - Introduction and General Principles (see DIS 8613-1)                                   |
| CCITT T.412 | Open Document Architecture (ODA) and Interchange Format - Document Structures (see DIS 8613-2)   |
| CCITT T.414 | Open Document Architecture (ODA) and Interchange Format - Document Profile (see DIS 8613-4)  |
| CCITT T.415 | Open Document Architecture (ODA) and Interchange Format - Open Document Interchange Format (ODIF) (see DIS 8613-5)                               |
| CCITT T.416 | Open Document Architecture (ODA) and Interchange Format - Character Content Architectures (see DIS 8613-6)                                       |
| CCITT T.417 | Open Document Architecture (ODA) and Interchange Format - Raster Graphics Content Architectures (see DIS 8613-7)                                 |
| CCITT T.418 | Open Document Architecture (ODA) and Interchange Format - Geometric Graphics Content Architectures (see DIS 8613-8)                              |
| CCITT T.431 | Document Transfer and Manipulation (DTAM) - Services and Protocols, Introduction and General Principles  |
| CCITT T.432 | DTAM - Services and Protocols, Service Definition  |
| CCITT T.433 | DTAM - Services and Protocols, Protocol Specification  |
| CCITT T.441 | DTAM - Operational Structure   |

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|             |   |
|-------------|---|
| CCITT T.501 | Document Application Profile MM for the Interchange of Formatted Mixed Mode Documents (Mixed Mode)            |
| CCITT T.502 | Document Application Profile PM1 for the Interchange of Processible Form Documents (Teletex Processible Mode) |
| CCITT T.503 | Document Application Profile for the Interchange of Group 4 Facsimile Documents                               |

### Y. PICTURE DESCRIPTION INFORMATION EXCHANGE:

|             |   |
|-------------|---|
| ISO 8632-1  | Computer Graphics Metafile (CGM): Metafile for the Storage and Transfer of Picture Description Information - Part 1: Functional Specification<br>DAD 1      Audit Trail Metafile<br>PDAD 2     3D Static Picture Capture Metafile |
| ISO 8632-2  | CGM: Metafile for the Storage and Transfer of Picture Description Information - Part 2: Character Encoding  |
| ISO 8632-3  | CGM: Metafile for the Storage and Transfer of Picture Description Information - Part 3: Binary Encoding   |
| ISO 8632-4  | CGM: Metafile for the Storage and Transfer of Picture Description Information - Part 4: Clear Text Encoding   |
| DIS 9281    | Identification of Picture Coding Methods  |
| SC21 N 4192 | Proposed FTAM Document Type to Support CGM, SC21/WG5, December 1989   |
| SC21 N 5165 | FTAM Constraint Set and Document Types for CGM, SC21/WG5, June 1990   |

### Z. STANDARD GENERALIZED MARKUP LANGUAGE (SGML):

|           |   |
|-----------|---|
| ISO 8879  | Standard Generalized Markup Language (SGML)   |
| ISO 9069  | SGML Support Facilities - SGML Document Interchange Format (SDIF)                   |
| DIS 9070  | SGML Support Facilities - Registration Procedures for Public Text Owner Identifiers |
| TR 9573   | SGML Support Facilities - Techniques Using SGML                                     |
| DTR 10037 | SGML and Text-Entry Systems - Guidelines for SGML Syntax-Directed Editing Systems   |

### AA. OTHER APPLICATION LAYER STANDARDS:

|             |   |
|-------------|---|
| CCITT X.3♦  | Packet Assembly/Disassembly Facility (PAD) in a Public Data Network (PDN)                                       |
| CCITT X.28♦ | DTE/DCE Interface for a Start/Stop Mode DTE Accessing the PAD in a PDN Situated in the Same Directory           |
| CCITT X.29♦ | Procedures for the Exchange of Control Information and User Data Between a PAD and a Packet Mode or Another PAD |

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IX. MISCELLANEOUS STANDARDS<sup>32</sup>

A. INTEGRATED SERVICES DIGITAL NETWORK (ISDN): GENERAL STANDARDS<sup>33</sup>

|             |  |
|-------------|--|
| ISO 9574♦   | Provision of the OSI Connection-Mode Network Service by Packet Mode Terminal Equipment Connected to an ISDN                |
| CCITT I.110 | General Structure of the I-Series Recommendations  |
| CCITT I.111 | Relationship With Other Recommendations Relevant to ISDNs  |
| CCITT I.120 | ISDNs  |
| CCITT I.130 | Attributes for the Characterization of Telecommunications Service Supported by an ISDN and Network Capabilities of an ISDN |
| CCITT I.210 | Principles of Telecommunications Services Supported by an ISDN   |
| CCITT I.211 | Bearer Services Supported by an ISDN   |
| CCITT I.212 | Teleservices Supported by an ISDN  |
| CCITT I.310 | ISDN - Network Functional Principles   |
| CCITT I.320 | ISDN Protocol Reference Model  |
| CCITT I.330 | ISDN Numbering and Addressing Principles   |
| CCITT I.331 | Numbering Plan for the ISDN Era  |
| CCITT I.410 | General Aspects and Principles Relating to Recommendations on ISDN User-Network Interfaces                                 |

B. ELECTRONIC DATA INTERCHANGE (EDI):

|             |   |
|-------------|---|
| ISO 9735    | Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) - Application Level Syntax Rules |
| SC21 N 5189 | Liaison Statement to JTC1/SWG-EDI on EDIFACT Document Types for FTAM, SC21/WG5, June 1990                         |
| SC21 N 3925 | Liaison Statement to JTC1 SC21 from JTC1 SWG-EDI, JTC1 SWG-EDI, 19 October 1989                                   |
| SC21 N 4799 | Letter for Information on Disposition of EDIMS Use of Directory, 21 May 1990                                      |

C. TELEMATIC SERVICES:

|             |   |
|-------------|---|
| DP 9071-1.2 | Text and Office Systems - Basic and Optional Requirements - Part 1: Facsimile Equipment           |
| DP 9071-2.2 | Text and Office Systems - Basic and Optional Requirements - Part 2: Text Communications Terminals |
| CCITT T.0   | Classification of Facsimile Apparatus for Document Transmission Over the Public Networks          |

<sup>32</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

<sup>33</sup> A complete list of CCITT 1988 Recommendations on ISDN is provided in Appendix E, Section II.B.



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### D. VOCABULARY AND REPRESENTATIONS:

|             |  |
|-------------|--|
| ISO 2382-9  | Vocabulary - Part 9: Data Communications   |
| ISO 2382-17 | Data Processing - Vocabulary - Part 17: Databases, September 1989 [SC21 N 3808]  |
| ISO 2382-26 | Data Processing - Vocabulary - Part 26: OSI Architecture, September 1989 [SC21 N 3802]                                 |
| ISO 3307    | Representations of Time of the Day   |
| ISO 3534    | Statistics - Vocabulary and Symbols, 1977  |
| ISO 4031    | Representation of Local Time Differentials   |
| ISO 6093    | Representation of Numeric Values in Character Strings for Information Exchange   |
| ISO 6523    | Data Interchange - Structure for the Identification of Organizations   |
| DP 7826     | Representation of Data Elements  |
| ISO 8211    | Specification for a Data Descriptive File for Information Interchange  |
| DIS 8601    | Representation of Dates and Times  |
| ISO 8790    | Computer System Configuration Diagram Symbols and Conventions  |
| DIS 9282-1  | Coded Representation of Pictures - Part 1: Encoding Principles for Picture Representation in a 7- or 8-Bit Environment |
| DIS 9282-2  | Coded Representation of Pictures - Part 2: Encoding Principles for Photographic Images                                 |
| DTR 9544    | Computer-Assisted Publishing - Vocabulary  |

### E. CODED CHARACTER SETS:

|            |   |
|------------|---|
| ISO 646    | ISO 7-Bit Coded Character Set for Information Exchange  |
| ISO 2022   | ISO 7-Bit and 8-Bit Coded Character Sets - Code Extension Techniques  |
| ISO 4873   | 8-Bit Code for Information Interchange - Structure and Rules for Implementation   |
| DIS 6429   | ISO 7-Bit and 8-Bit Coded Character Sets - Control Functions for Coded Character Sets   |
| ISO 6936   | Conversion Between the Two Coded Character Sets of ISO 646 and ISO 6937-2 and the CCITT International Telegraph Alphabet No. 2 (ITA2)                       |
| DIS 6936   | Conversion Between the Two Coded Character Sets of ISO 646 and ISO 6937-2 and the CCITT International Telegraph Alphabet No. 2 (ITA2), Draft Second Edition |
| ISO 6937-1 | Coded Character Sets for Text Communication - Part 1: General Introduction  |
| ISO 6937-2 | Coded Character Sets for Text Communication - Part 2: Latin Alphabetic and Non-Alphabetic Graphic Characters<br>DAD 1      Addendum 1                       |
| DIS 6937-3 | Coded Character Sets for Text Communication - Part 3: Control Functions for Page-Image Format   |
| DIS 6937-7 | Coded Character Sets for Text Communication - Part 7: Greek Graphic Characters  |
| DIS 6937-8 | Coded Character Sets for Text Communication - Part 8: Cyrillic Graphic Characters   |
| ISO 7350   | Registration of Graphic Character Subrepertoires  |
| ISO 8859-1 | 8-Bit Single-Byte Coded Graphic Character Sets - Part 1: Latin Alphabet No. 1   |

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|              |  |
|--------------|--|
| ISO 8859-2   | 8-Bit Single-Byte Coded Graphic Character Sets - Part 2: Latin Alphabet No. 2                          |
| ISO 8859-3   | 8-Bit Single-Byte Coded Graphic Character Sets - Part 3: Latin Alphabet No. 3                          |
| ISO 8859-4   | 8-Bit Single-Byte Coded Graphic Character Sets - Part 4: Latin Alphabet No. 4                          |
| DIS 8859-5.2 | 8-Bit Single-Byte Coded Graphic Character Sets - Part 5: Latin/Cyrillic Alphabet                       |
| ISO 8859-6   | 8-Bit Single-Byte Coded Graphic Character Sets - Part 6: Latin/Arabic Alphabet                         |
| ISO 8859-7   | 8-Bit Single-Byte Coded Graphic Character Sets - Part 7: Latin/Greek Alphabet                          |
| DIS 8859-8   | 8-Bit Single-Byte Coded Graphic Character Sets - Part 8: Latin/Hebrew Alphabet                         |
| DIS 8859-9   | 8-Bit Single-Byte Coded Graphic Character Sets - Part 9: Latin Alphabet No. 5                          |
| DIS 9541-1   | Font and Character Information Exchange - Part 1: Introduction   |
| DIS 9541-2   | Font and Character Information Exchange - Part 2: Registration and Naming Procedures                   |
| DIS 9541-3   | Font and Character Information Exchange - Part 3: Character Identification Method                      |
| DIS 9541-4   | Font and Character Information Exchange - Part 4: Character Collections                                |
| DIS 9541-5   | Font and Character Information Exchange - Part 5: Font Attributes and Character Model                  |
| DIS 9541-6   | Font and Character Information Exchange - Part 6: Font and Character Attribute Subsets and Application |
| DP 9541-7    | Font and Character Information Exchange - Part 7: Font Interchange Format                              |
| DP 10646     | Multiple Octet Coded Character Set, SC27, November 1989  |

### F. MAN-MACHINE LANGUAGE (MML):

|             |   |
|-------------|---|
| CCITT Z.301 | Introduction to the CCITT Man-Machine Language (MML)  |
| CCITT Z.302 | The Meta-Language for Describing MML Syntax and Dialogue Procedures                         |
| CCITT Z.311 | Introduction to Syntax and Dialogue Procedures (MML)  |
| CCITT Z.312 | Basic Format Layout (MML)   |
| CCITT Z.314 | The Character Set and Basic Elements (MML)  |
| CCITT Z.315 | Input (Command) Language Syntax Specification (MML)   |
| CCITT Z.316 | Output Language Syntax Specification (MML)  |
| CCITT Z.317 | Man-Machine Dialogue Procedures (MML)   |
| CCITT Z.321 | Introduction to the Extended MML for Visual Display Terminals                               |
| CCITT Z.322 | Capabilities of Visual Display Terminals  |
| CCITT Z.323 | Man-Machine Interaction   |
| CCITT Z.331 | Introduction to the Specification of the Man-Machine Interface                              |
| CCITT Z.332 | Methodology for the Specification of the Man-Machine Interface - General Working Procedures |
| CCITT Z.333 | Methodology for the Specification of the Man-Machine Interface - Tools and Methods          |
| CCITT Z.341 | Glossary of Terms (MML)   |

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**G. SOFTWARE DEVELOPMENT AND DOCUMENTATION:**

|             |   |
|-------------|---|
| ISO 1538    | Programming Languages - ALGOL 60, 1984  |
| ISO 1539    | Programming Languages - FORTRAN   |
| ISO 1989    | Programming Languages - COBOL   |
| ISO 6160    | Programming Languages - PL/1  |
| ISO 6373    | Programming Languages - BASIC   |
| ISO 6522    | Programming Languages - PL/1 General Purpose Subset   |
| ISO 6592    | Guidelines for the Documentation of Computer-Based Application Systems  |
| ISO 7185    | Programming Languages - Pascal  |
| DP 8485     | Programming Languages - APL   |
| ISO 8652    | Programming Languages - Ada   |
| DTR 9294    | Guidelines for the Management of Software Documentation, Technical Report Type 3                                |
| ISO 9496.2  | Programming Languages - CCITT High Level Language (CHILL)   |
| TR 9547     | Programming Language Processors - Test Methods - Guidelines for Their Development and Acceptability, April 1988 |
| CCITT Z.200 | CCITT High Level Language (CHILL) [see ISO 9496.2]  |
| DTR 10034   | Guidelines for the Preparation of Conformity Clauses in Programming Language Standards                          |

**H. INFORMATION PROCESSING EQUIPMENT:**

|             |   |
|-------------|---|
| DIS 8884    | Keyboards for Multiple Latin-Alphabet Languages - Layout and Operation Using Four Levels                    |
| ISO 9660    | Volume and File Structure of CD-ROM for Information Exchange  |
| DIS 9995-30 | Keyboard Layouts for Text and Office Systems - Part 30: Numeric Section, October 1988                       |
| DIS 9995-31 | Keyboard Layouts for Text and Office Systems - Part 31: Numeric Zone of the Numeric Section, October 1988   |
| DIS 9995-41 | Keyboard Layouts for Text and Office Systems - Part 30: Function Zones of the Numeric Section, October 1988 |
| DP 10033    | Recording of Documents Conforming to ISO 8613 on Flexible Disk Cartridges Conforming to ISO 9293            |
| DIS 10149   | Data Interchange on Read-Only 120-mm Optical Data Disks (CD-ROM)  |

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APPENDIX E

NUMERICAL LISTING OF ISO STANDARDS  
RELEVANT TO ATCCIS

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NUMERICAL LISTING OF ISO STANDARDS AND CCITT  
RECOMMENDATIONS RELEVANT TO CCISs<sup>1</sup>

I. ISO STANDARDS

|                          |  |
|--------------------------|--|
| ISO 646                  | Information Processing - ISO 7-Bit Coded Character Set for Information Exchange, July 1983   |
| ISO 1155                 | Use of Longitudinal Parity to Detect Errors in Information Messages  |
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<sup>1</sup> Based on data initially provided by OMNICON in September 1988. Revised July 1990 based on *The OMNICON Index of Standards for Distributed Information and Telecommunications*, 1989, OMNICON, Inc., and status of standards papers from ISO/IEC JTC1, ANSI X3, and the British Standards Institution (BSI). The BSI document, *ISO/IEC JTC1/SC21 Project File*, IST/21:2089, 12 April 1990, was a major source for updating the list of standards.

<sup>2</sup> The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

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## UNCLASSIFIED

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- ISO 8649 DAD 1♦ Information Processing Systems - Open Systems Interconnection - Service Definition for the Association Control Service Element (ACSE) - Addendum 1: Peer-Entity Authentication During Association Establishment, September 1989 [SC21 N 3771] (editing meeting July 1990)
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- ISO 8802-5 ♦ Information Processing Systems - Local Area Networks - Part 5: Token Ring Access Method and Physical Layer Specification, February 1987
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## UNCLASSIFIED

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- DIS 9646-1.2♦ Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 1: General Concepts, Second Edition, April 1989 [SC21 N 3429] (IS text expected September 1990) (CCITT X.290)

## UNCLASSIFIED

- DIS 9646-2.2♦ Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 2: Abstract Test Suite Specification (Excluding Annexes E and F on TTCN), April 1989 [SC21 N 3430] (IS text expected September 1990)
- DP 9646-2 WDAD1 Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 2: Abstract Test Suite Specification, Addendum 1: Testing and Formal Description Techniques (FDTs)
- DIS 9646-3♦ Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 3: The Tree and Tabular Combined Notation (TTCN), May 1990 (revised DIS text to be developed November-December 1990)
- DIS 9646-3 WDAD1 Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 3: The Tree and Tabular Combined Notation (TTCN), Addendum 1: TTCN Extensions, July 1990 [SC21 N 5077] (CD text expected June 1991)
- DIS 9646-4♦ Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 4: Test Realization, 1989 [SC21 N 3504, June 1989] (IS text expected September 1990)
- DIS 9646-5♦ Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 5: Requirements on Test Laboratories and Clients for the Conformance Assessment Process, 1989 [SC21 N 3503, April 1989] (IS text expected September 1990)
- DP 9646-6 Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 6: Interpretation of Test Report
- ISO 9660 Information Processing - Volume and File Structure of CD-ROM for Information Exchange, April 1988
- ISO 9735 Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) - Application Level Syntax Rules, July 1988
- DIS 9796 Information Processing - Digital Signature Scheme Giving Message Recovery, 1989
- ISO 9797 Information Processing - Data Cryptographic Techniques - Data Integrity Mechanisms Using a Cryptographic Check Function Employing a Block Cypher Algorithm, 1989
- DIS 9798-1 Information Processing - Entity Authentication Mechanisms - Part 1: General Model
- DP 9798-2 Information Processing - Entity Authentication Mechanisms - Part 2: Entity Authentication Mechanisms Using Symmetric Algorithms
- ISO 9804♦ Information Processing Systems - Open Systems Interconnection - Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element, July 1990 [SC21 N 4611, 20 April 1990] (CCITT X.237)
- ISO 9804 CDAM1♦ Information Processing - Open Systems Interconnection - Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element, Amendment 1: Enhancements, 1 June 1990 [SC21 N 5119] (DIS text expected May 1991, IS text May 1992)
- ISO 9804 WDAM2 Information Processing - Open Systems Interconnection - Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element, Amendment 2: Session Mapping Changes (Additional Resynchronization Functionality), July 1990 [SC21 N 5122] (CD text expected November 1990)
- ISO 9804 WDAM3♦ Information Processing - Open Systems Interconnection - Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element, Amendment 3: Restart (CD text expected May 1992)

UNCLASSIFIED

- ISO 9805 ♦ Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Protocol, July 1990 [SC21 N 4612, 20 April 1990] (CCITT X.247)
- ISO 9805 CDAM1 ♦ Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Protocol, Amendment 1: Enhancements, 1 June 1990 [SC21 N 5120] (DIS text expected May 1991, IS text May 1992)
- ISO 9805 WDAM2 Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Service Element, Amendment 2: Session Mapping Changes (Additional Resynchronization Functionality), July 1990 [SC21 N 5123] (CD text expected November 1990)
- ISO 9805 WDAM3 ♦ Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Protocol, Amendment 3: Restart (CD text expected May 1992)
- CD 9805-2 ♦ Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Protocol - Part 2: CCR PICS Proforma, 16 July 1990 [SC21 N 5121] (DIS text expected November 1991, IS text November 1992)
- DIS 9834-1 ♦ Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 1: General Procedures, March 1990 [SC21 N 4352] (DIS ballot suspended and reissued in August 1990)
- DIS 9834-2 ♦ Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 2: Registration Procedures for OSI Document Types, 1990 [SC21 N 2605, May 1988] (DIS ballot suspended and reissued in August 1990; IS text expected in June 1991)
- ISO 9834-3 ♦ Information Processing Systems - Open Systems Interconnection - Procedures for OSI Registration Authorities - Part 3: Procedures for Specific Registration of Joint Object Identifier Component Values for Joint ISO-CCITT Use, April 1990 [SC21 N 4718]
- DIS 9834-4 ♦ Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 4: Registration of VT Profiles, March 1990 [SC21 N 4325, 10 January 1990] (DIS ballot suspended and reissued in August 1990; IS text expected July 1991)
- DIS 9834-5 ♦ Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 5: Register of VT Control Object Identifiers, March 1990 [SC21 N 4322, 10 January 1990] (DIS ballot suspended and reissued in August 1990; IS text expected July 1991)
- DP 9834-6 ♦ Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 6: Registration Authority Procedures for Application Process Titles and Application Entity Titles, July 1990 [SC21 N 5218] (DIS text expected August 1990)
- WD 9834-B Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part B: Registration of Abstract Syntaxes, 1990
- WD 9834-C Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part C: Registration of Transfer Syntaxes, 1990
- WD 9834-D Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part D: Registration of Application Contexts, 1990 (work suspended by SC21, November 1989)

## UNCLASSIFIED

- WD 9834-E Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part E: Registration of System Titles, 1990 (will probably be incorporated in OSI management standards)
- WD 9834-F Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part F: Registration of Authentication Mechanisms, 1990 (WITHDRAWN; cancelled by SC21, November 1989)
- ISO 9945-1 Portable Operating System Interface for Computer Environments (POSIX) - Part 1: System Interface, 1990
- DP 9945-2 Portable Operating System Interface for Computer Environments (POSIX) - Part 2: Shell and Utilities, 1989
- TR 9973 Registration of Graphical Items, 1989
- ISO 9979 Information Processing - Data Encipherment - Procedures for the Registration of Cryptographic Algorithms, July 1990 [SC27 N 88]
- DIS 9995-30 Information Processing - Keyboard Layouts for Text and Office Systems - Part 30: Numeric Section, October 1988
- DIS 9995-31 Information Processing - Keyboard Layouts for Text and Office Systems - Part 31: Numeric Zone of the Numeric Section, October 1988
- DIS 9995-41 Information Processing - Keyboard Layouts for Text and Office Systems - Part 30: Function Zones of the Numeric Section, October 1988
- TR 10000-1 ♦ Information Processing Systems - International Standardized Profiles (ISPs) - Part 1: Taxonomy Framework, 9 February 1990 [SGFS N 184]
- TR 10000-2 ♦ Information Processing Systems - International Standardized Profiles (ISPs) - Part 2: Taxonomy of Profiles, 9 February 1990 [SGFS N 185]
- ISO 10021-1 ♦ Information Processing - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 1: System and Service Overview, June 1988 (see CCITT X.400)
- ISO 10021-2 ♦ Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 2: Overall Architecture, June 1988 (see CCITT X.402)
- ISO 10021-3 ♦ Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 3: Abstract Service Definition Conventions, June 1988 (see CCITT X.407)
- ISO 10021-4 ♦ Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 4: Message Transfer System: Abstract Service Definition and Procedures, June 1988 (see CCITT X.411)
- ISO 10021-5 ♦ Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 5: Message Store: Abstract Service Definition, June 1988 (see CCITT X.412)
- ISO 10021-6 ♦ Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 6: Protocol Specifications, June 1988 (see CCITT X.419)
- ISO 10021-7 ♦ Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 7: Interpersonal Messaging System, June 1988 (see CCITT X.420)
- DIS 10022 ♦ Information Processing Systems - Open Systems Interconnection - Physical Service Definition, September 1988 (CCITT X.211)

## UNCLASSIFIED

- PDTR 10023♦ Telecommunications and Information Exchange Between Systems - A Formal Description of ISO 8072 in LOTOS, March 1988
- TR 10024 Information Processing Systems - Data Communications - Operation of an X.25 Interworking Unit, 5 December 1988.
- PDTR 10024♦ Telecommunications and Information Exchange Between Systems - A Formal Description of ISO 8073 in LOTOS, April 1988
- DIS 10025-1♦ Information Processing Systems - Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service (CONS) - Part 1: General Principles, 1989
- DP 10025-2♦ Information Processing Systems - Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service (CONS) - Part 2: Test Suite Structure and Test Principles, 1989
- DP 10025-3♦ Information Processing Systems - Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service (CONS) - Part 3: Abstract Test Suite Specification, 1989
- DIS 10026-1♦ Distributed Transaction Processing (TP) - Part 1: Model, 22 March 1990 [SC21 N 4288, 15 December 1989] (editing meeting November-December 1990; IS text expected June 1991)
- DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Security, WDAMs, January 1990 [SC21 N 4163] (CD text expected June 1992)
- DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Association Management, WDAMs, January 1990 [SC21 N 4164] (CD text expected June 1992)
- DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Heuristic Decisions, WDAMs, January 1990 [SC21 N 4167] (CD text expected June 1992)
- DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Commitment Optimization, WDAMs, January 1990 [SC21 N 4168] (CD text expected June 1991)
- DIS 10026-1/3 Draft Amendments to Parts 1-3: Distributed Transaction Processing Dialogue Recovery and User Suspension of a Dialogue, WDAMs, January 1990 [SC21 N 4170] (CD text expected June 1992)
- DIS 10026-1/3 Draft Amendments to Parts 1-3: Distributed Transaction Processing Savepoints, January 1990 [SC21 N 4171] (new work item; not accepted by JTC1, June 1990)
- DIS 10026-1/3 Draft Amendments to Parts 1-3: Transaction Processing Sub-Transactions, SC21/WG5, WDAMs, July 1990 [SC21 N 5156] (new work item; CD text expected January 1992)
- DIS 10026-1/4 Draft Amendments to Parts 1-3: Transaction Processing Separate Data and Commit Associations, WDAMs, July 1990 [SC21 N 5157] (new work item; CD text expected January 1993)
- DIS 10026-2♦ Information Processing Systems - Open Systems Interconnection - Distributed Transaction Processing (TP) - Part 2: Service Definition, 22 March 1990 [SC21 N 4290] (editing meeting November-December 1990; IS text expected June 1991)
- DIS 10026-3♦ Information Processing Systems - Open Systems Interconnection - Distributed Transaction Processing (TP) - Part 3: Transaction Processing Protocol Specification, 22 March 1990 [SC21 N 4292] (editing meeting November-December 1990) (editing meeting November-December 1990; IS text expected June 1991)
- CD 10026-4 Information Processing Systems - Open Systems Interconnection - Distributed Transaction Processing (TP) - Part 4: PICS Proforma, SC21/WG5, 14 July 1990 [SC21 N 5159] (editing meeting scheduled January 1991; DIS text expected June 1991, IS text in June 1992)

## UNCLASSIFIED

- CD 10026-5 Information Processing Systems - Open Systems Interconnection - Distributed Transaction Processing (TP) - Part 5: Application Context Proforma, SC21/WG5, July 1990 [SC21 N 5160] (CD text expected June 1990, DIS text in June 1991, IS text in June 1992)
- WD 10026-Y Data Transfer for OSI TP - Unstructured Data Transfer, January 1990 [SC21 N 4166] (new work item; CD text expected June 1991)
- WD 10026-Z Data Transfer for OSI TP - Other Transfer Modes, January 1990 [SC21 N 4166] (new work item; CD text expected June 1992)
- ISO 10027 Information Technology - Information Resource Dictionary System (IRDS) Framework, 2 May 1990 [SC21 N 4727]
- DP 10028.2♦ Definition of the Relaying Functions of a Network Layer Intermediate System, June 1989
- TR 10029♦ Information Processing Systems - Data Communications - Operation of an X.25 Interworking Unit, 15 March 1989
- DIS 10030♦ Information Processing Systems - Open Systems Interconnection - End System to Intermediate System Routing Information Exchange Protocol for Use in Conjunction with ISO 8208 (X.25 PLP) [SC6 N 5006], 1989
- DIS 10031-1 Information Processing - Text Communication - Distributed-Office-Applications Model (DOAM) - Part 1: General Model, April 1989
- DIS 10031-2 Information Processing - Text Communication - Distributed-Office-Applications Model (DOAM) - Part 2: Referenced Data Transfer, April 1989
- CD 10032.2♦ Information Processing Systems - Reference Model of Data Management, July 1990 [SC21 N 2641, May 1988] (editing meeting scheduled January 1991)
- DP 10033 Information Processing - Text and Office Systems - Recording of Documents Conforming to ISO 8613 on Flexible Disk Cartridges Conforming to ISO 9293, May 1988
- DTR 10034 Guidelines for the Preparation of Conformity Clauses in Programming Language Standards (Technical Report, Type 3), July 1988
- ISO 10035♦ Information Processing Systems - Open Systems Interconnection Connectionless ACSE Protocol Specification, 1 June 1990 [SC21 N 4938]
- WD 10035-2 Information Processing Systems - Open Systems Interconnection Connectionless ACSE Protocol Specification - Part 2: PICS Proforma for Connectionless ACSE Protocol, July 1989 [SC21 N 3218] (CD text possible in June 1991)
- DTR 10037 Information Processing - SGML and Text-Entry Systems - Guidelines for SGML Syntax-Directed Editing Systems, September 1988
- DP 10038♦ Information Processing Systems - Local Area Networks - MAC Sublayer Interconnection (MAC Bridging), October 1988
- DIS 10039♦ Information Processing Systems - Local Area Networks - MAC Service Definition, September 1989
- DIS 10040♦ Information Processing Systems - Open Systems Interconnection - Systems Management Overview, July 1990 [SC21 N 4865] (IS text expected July 1991)
- DIS 10116 Information Processing - Modes of Operation for an N-bit Block Cipher Algorithm, 1989 [SC27 N 86]
- DIS 10148 Information Processing Systems - Basic Remote Procedure Call (RPC) Using OSI Remote Operations, 9 March 1989 [SC21 N 3463; fast-track ballot failed; DIS 10148 WITHDRAWN; proposal for new work item, SC21 N 4153, January 1990] (CD text for RPC model, service, and protocol now planned for June 1991)

## UNCLASSIFIED

- DIS 10149 Information Processing Systems - Data Interchange on Read-Only 120-mm Optical Data Disks (CD-ROM), August 1988
- DIS 10164-1♦ Information Processing Systems - Open Systems Interconnection - Systems Management - Part 1: Object Management Function, July 1990 [SC21 N 4855] (IS text expected July 1991)
- DIS 10164-2♦ Information Processing Systems - Open Systems Interconnection - Systems Management - Part 2: State Management Function, July 1990 [SC21 N 4068, December 1989] (IS text expected July 1991)
- DIS 10164-3♦ Information Processing Systems - Open Systems Interconnection - Systems Management - Part 3: Relationship Management Function, July 1990 [SC21 N 4069, December 1989] (IS text expected July 1991)
- DIS 10164-4♦ Information Processing Systems - Open Systems Interconnection - Systems Management - Part 4: Alarm Reporting Function, July 1990 [SC21 N 4070, December 1989] (IS text expected July 1991)
- DIS 10164-5♦ Information Processing Systems - Open Systems Interconnection - Systems Management - Part 5: Event Report Management Function, July 1990 [SC21 N 4071, December 1989] (IS text expected July 1991)
- DIS 10164-6♦ Information Processing Systems - Open Systems Interconnection - Systems Management - Part 6: Log Control Function, July 1990 [SC21 N 4063, December 1989] (IS text expected July 1991)
- DIS 10164-7♦ Information Processing Systems - Open Systems Interconnection - Systems Management - Part 7: Security Alarm Reporting Function, July 1990 [SC21 N 4064, December 1989] (IS text expected July 1991)
- CD 10164-8 Information Processing Systems - Open Systems Interconnection - Systems Management - Part 8: Security Audit Trail Function, July 1990 [SC21 N 4955] (DIS text expected April 1991)
- CD 10164-9 Information Processing Systems - Open Systems Interconnection - Systems Management - Part 9: Objects and Attributes for Access Control, July 1990 [SC21 N 4956] (DIS text expected April 1991)
- CD 10164-10 Information Processing Systems - Open Systems Interconnection - Systems Management - Part 10: Accounting Meter Function, July 1990 [SC21 N 4958] (DIS text expected April 1991)
- CD 10164-11 Information Processing Systems - Open Systems Interconnection - Systems Management - Part 11: Workload Monitoring Function, July 1990 [SC21 N 4959] (DIS text expected April 1991)
- WD 10164-X Information Processing Systems - Open Systems Interconnection - Systems Management - Part X: Software Management Function, July 1990 [SC21 N 4978] (CD text expected July 1992)
- WD 10164-Y Information Processing Systems - Open Systems Interconnection - Systems Management - Part Y: Test Management Function, July 1990 [SC21 N 4978] (CD text expected November 1990)
- WD 10164-Z Information Processing Systems - Open Systems Interconnection - Systems Management - Part Z: Confidence and Diagnostic Test Classes, July 1990 [SC21 N 4957] (CD text expected November 1990)
- WD 10164-A Information Processing Systems - Open Systems Interconnection - Systems Management - Part A: Time Management Function, July 1990 [SC21 N 4953] (new work item; standard will have two parts: representation of time and mechanisms for the distribution and synchronization of time; CD text for representation of time expected November 1991)

## UNCLASSIFIED

- WD 10164-B Information Processing Systems - Open Systems Interconnection - Systems Management - Part B: Measurement Summarization Function, Second Working Draft, July 1990 [SC21 N 4972] (CD text expected November 1990)
- DIS 10165-1 ♦ Information Processing Systems - Open Systems Interconnection - Structure of Management Information - Part 1: Management Information Model, July 1990 [SC21 N 4484] (IS text expected July 1991)
- DIS 10165-2 ♦ Information Processing Systems - Open Systems Interconnection - Structure of Management Information - Part 2: Definition of Management Information, July 1990 [SC21 N 4867] (IS text expected August 1991)
- DIS 10165-4 ♦ Information Processing Systems - Open Systems Interconnection - Structure of Management Information - Part 4: Guidelines for the Definition of Managed Objects, July 1990 [SC21 N 4852] (IS text expected July 1991)
- DIS 10166-1 Document Filing and Retrieval (DFR) - Part 1: Abstract Service Definition and Procedures, 14 December 1989 [SC18 N 2069, February 1989]
- DIS 10166-2 Document Filing and Retrieval (DFR) - Part 2: Protocol Specification, 14 December 1989 [SC18 N 2070, February 1989]
- TR 10167 ♦ Information Processing Systems - Open Systems Interconnection - Draft Technical Report on Guidelines for the Application of Estelle, LOTOS, and SDL, 18 January 1990 [SC21 N 4259]
- DIS 10168-1 ♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the Session Protocol - Part 1: Test Suite Structure and Test Purposes, 19 April 1990 [SC21 N 4159, 11 December 1989]
- WD 10168-2 ♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the Session Protocol - Part 2: Generic Test Suite, 1989 (CD text expected June 1992)
- WD 10168-3 ♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the Session Protocol - Part 3: Abstract Test Suite for CS Method, 1989 (CD text June 1991)
- DIS 10168-4 ♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the Session Protocol - Part 4: Session Test Management Protocol Specification, July 1990 [SC21 N 5026] (IS text expected June 1991)
- DIS 10169-1 ♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the ACSE Protocol - Part 1: Test Suite Structure and Test Purposes, February 1989 [SC21 N 3219] (IS text expected June 1991)
- DIS 10170-1 ♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 1: Test Suite Structure and Test Purposes, July 1990 [SC21 N 4181, 11 December 1989] (IS text expected June 1991)
- WD 10170-2 ♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 2: FTAM Abstract Test Suite, June 1989 [SC21 N 3665] (CD text expected June 1991)
- WD 10170-3 ♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 3: ACSE Abstract Test Suite Embedded Under FTAM, 1989 (CD text expected June 1992)
- WD 10170-4 ♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 4: Presentation Abstract Test Suite Embedded Under FTAM, 1989 (CD text expected June 1992)



## UNCLASSIFIED

- WD 10170-5♦ Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 5: Session Abstract Test Suite Embedded Under FTAM, 1989 (CD text expected June 1992)
- DTR 10171♦ List of Standard Data Link Layer Protocols That Utilize HDLC Classes of Procedures, March 1989
- PDTR 10172 Information Processing Systems - Data Communications - Network/Transport Protocol Interworking Specification, 29 March 1990 [SC6 N 5906]
- DP 10173 ISDN Primary Access Connector at Reference Points S and T, July 1989
- ISO 10177 Information Processing Systems - Data Communications - Intermediate-System Support of the OSI Connection-Mode Network Service Using ISO 8208 in Accordance with ISO 10028, 13 October 1989.
- WD 10181-1♦ Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 1: Overview, June 1990 [SC21 N 5044] (CD text expected June 1991)
- DP 10181-2♦ Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 2: Authentication Framework, July 1990 [SC21 N 5044]
- WD 10181-3♦ Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 3: Access Control Framework, July 1990 [SC21 N 5045] (CD text expected October 1990)
- WD 10181-4♦ Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 4: Non-Repudiation Framework, July 1990 [SC21 N 5046] (CD text expected June 1991)
- WD 10181-5♦ Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 5: Confidentiality Framework, June 1990 [SC21 N 5048] (CD text expected June 1991)
- WD 10181-6♦ Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 6: Integrity Framework, July 1990 [SC21 N 5047] (CD text expected June 1991)
- WD 10181-7 Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 7: Audit Trail Framework, December 1988 [SC21 N 3338]
- CD 10184-1 Terminal Management - Model, June 1990 [SC21 N 4176] (editing meeting November 1990)
- WD 10184-2 Terminal Management - Service, June 1990 [SC21 N 4176] (formal WD text expected November 1990, CD text expected November 1991)
- WD 10184-3 Terminal Management - Protocol, June 1990 [SC21 N 4176] (formal WD text expected November 1990, CD text expected November 1991)
- DISP 10607-1 Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 1: Specification of ACSE, Presentation and Session Protocols for the Use by FTAM, 26 April 1990 [SGFS N 210] (submitted by SPAG)
- DISP 10607-2 Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 2: Definition of Document Types, Constraint Sets and Syntaxes, 26 April 1990 [SGFS N 210] (submitted by SPAG)
- DISP 10607-3 Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 3: AFT 11 - Simple File Transfer Service (Unstructured), 26 April 1990 [SGFS N 210] (submitted by SPAG)

## UNCLASSIFIED

- DISP 10607-4 Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 4: AFT 12 - Positional File Transfer Service, 17 July 1990 [SGFS N 246]
- DISP 10607-4 DAD1 Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 4: AFT 12 - Positional File Transfer Service, Addendum 1: Additional Definitions, 17 July 1990 [SGFS N 245]
- DISP 10607-5 Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 5: AFT 22 - Positional File Access Service, 17 July 1990 [SGFS N 247]
- DISP 10607-6 Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 6: AFT 12 - File Management Service, 17 July 1990 [SGFS N 248]
- DP 10646 Information Processing - Multiple Octet Coded Character Set, SC27, 14 November 1989 [SC21 N 4627]
- JTC1 N 474 Proposal for a New Work Item: OSI Upper Layers Security Model, 21 July 1989
- JTC1 N 535 Directives for the Work of ISO/IEC Joint Technical Committee 1 (JTC1) on Information Technology, Secretariat, 31 August 1989
- JTC1 N 598 JTC1 Strategic Plan, Editing Team, 20 November 1989
- SGFS N 151 CCITT Liaison Statement on Work of SGFS, 6 November 1989 (includes X.220)
- SGFS N 201 Information Processing Systems - International Standardized Profiles - Taxonomy Update, ISP Approval, and Maintenance Process, 7 May 1990 (standing SGFS document)
- SGFS N 219 An Example of T-Profiles Multi-Part ISP Structure, 11 June 1990
- SGFS N 224 Documents Relating to Applications Portability Profile Work from JTC1/TSG-1, 11 June 1990
- SGFS N 225 Resolutions of JTC1 Advisory Group, 11 June 1990
- SGFS N 226 Liaison Statement to JTC1 on Multi-Part ISDN ISP Structures, 11 June 1990
- SGFS N 228 Liaison Statement to JTC1 SGFS on the Inclusion of a Profile for MMS in the Taxonomy of Profiles TR 100000-2, 11 June 1990
- SGFS N 229 Resolutions of the 3rd Regional Workshop Coordinating Committee Meeting; AOW - EWOS - NIST OIW, 11 June 1990
- SGFS N 236 EWOS Organization and Activities, 11 June 1990
- SC21 SD-1 Report of the Secretariat to the Plenary Meeting of ISO/IEC JTC1 SC21, 5-6 June 1990, Seoul, Republic of Korea, SC21 Secretariat, 12 April 1990 [SC21 N 4588] (provides terms of reference and points of contact for working groups)
- SC21 SD-2 ISO/IEC JTC1 SC21 Programme of Work (POW) - Target Date Summary for All Active and Published Projects, SC21 Secretariat, April 1990
- SC21 SD-8 SC21 Schedule of Meetings, 19 June 1990 [SC21 N 5216]
- SC21 SD-9 Approved Commentaries on the Basic Reference Model for Open System Interconnection, OSI Reference Model Editor, 19 June 1990 [SC21 N 5217]
- CD xxxx-1♦ Basic Reference Model for Open Distributed Processing - Part 1: Introduction (proposal for new work item, 1987) [SC21 N 1547] (CD text expected June 1994)

UNCLASSIFIED

- CD xxxx-2♦ Basic Reference Model for Open Distributed Processing - Part 2: Concepts and Modelling Tools (proposal for new work item, 1987) [SC21 N 1547] (CD text expected June 1992)
- CD xxxx-3♦ Basic Reference Model for Open Distributed Processing - Part 3: Framework for ODP Standards (proposal for new work item, 1987) [SC21 N 1547] (CD text expected May 1993)
- CD xxxx-4♦ Basic Reference Model for Open Distributed Processing - Part 4: User Guide (proposal for new work item, 1987) [SC21 N 1547] (CD text expected May 1994)
- CD xxxx-1♦ Conformance Test Suite for the Presentation Protocol, Part 1: Test Suite Structure and Test Purposes for the Presentation Protocol, SC21/WG6, July 1990 [SC21 N 5019] (DIS text expected in November 1990, IS text November 1991)
- CD xxxx A Formal Description of the Transport Service Definition in Estelle
- CD xxxx A Formal Description of the Transport Protocol Specification in Estelle
- CD xxxx Transport Layer Management
- CD xxxx Transport Layer Security
- CD xxxx♦ Information Resource Dictionary System (IRDS) Services Interface, July 1990 [SC21 N 5147] (editing meeting January 1991)
- CD xxxx-1 Information Technology - Open Systems Interconnection - Conventions for Service Definitions - Part 1: General Model and Conventions (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supercede TR 8509)
- CD xxxx-2 Information Technology - Open Systems Interconnection - Conventions for Service Definitions - Part 2: Application Layer (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supercede TR 8509)
- CD xxxx-3 Information Technology - Open Systems Interconnection - Conventions for Service Definitions - Part 3: Layers 1-6 (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supercede TR 8509)
- WD xxxx-1 Conformance Test Suite for the TP Protocol, Part 1: Test Suite Structure and Test Purposes, 6th Working Draft, June 1990 [SC21 N 5162] (formal WD text expected in February 1991, CD text in June 1992)
- WD xxxx-2 Conformance Test Suite for the TP Protocol, Part 2: Abstract Test Suites, January 1990 [SC21 N 4172]
- WD xxxx Multi-Party Testing Methodology, SC21/WG1, July 1990 [SC21 N 5076] (CD text expected October 1990)
- WD xxxx Information Resource Dictionary System (IRDS) - Design Support for SQL Applications (CD text expected January 1991)
- WD xxxx Information Resource Dictionary System (IRDS) - Export/Import (CD text expected November 1990)
- WD xxxx Information Resource Dictionary System (IRDS) - Extensions, July 1990 [SC21 N 5139] (CD text expected June 1992)
- WD xxxx Registration of System Titles (DP expected November 1990)
- WD xxxx Service and Protocol for Authentication Exchange Application Service Element (ASE), January 1990 [SC21 N 4110] (WD expected October 1990, CD expected June 1992; collaborative work with CCITT SG VII)
- WD xxxx-1 Cryptographic Mechanisms for Key Management, Part 1: Key Management Overview [SC27/WG2]

## UNCLASSIFIED

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- SC21 N 5016 Meeting Report for SC21/WG1/WG4/WG6/WG7 Joint Meeting on Service Conventions, ODP, and ULA on 29 May 1990, SC21, June 1990
- SC21 N 5017 Relationship Between Concepts and Models for OSI and ODP, SC21/WG6, July 1990
- SC21 N 5049 Guide to Open System Security, SC21, July 1990
- SC21 N 5051 Working Document on ASN.1 Extensions, Character Sets, Version 3, SC21/WG6, 19 July 1990 supercedes N 4141]
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- SC21 N 5056 Call for Comment on Computed Functions, SC21/WG6, 11 July 1990
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SC21 N 5137 Data Management Export/Import for SQL and IRDS, SC21/WG3, July 1990 (new work item)

SC21 N 5138 RDA Support for Shared DBL Statements, SC21/WG3, July 1990 (new work item; rapporteur meeting January 1991)

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- SC21 N 5176 OSI TP Security, New Work Item, June 1990
- SC21 N 5177 OSI TP Association Management - Revised New Work Item, SC21/WG5, June 1990
- SC21 N 5179 Proposed Replacement Text for the NWI Proposal on Commitment Optimizations in SC21 N 4168 (JTC1 N 631), SC21/WG5, June 1990
- SC21 N 5183 Combined Use of CMISE and OSI TP, SC21/WG5, June 1990
- SC21 N 5184 Queued Data Transfer for TP, SC21/WG5, May 1990
- SC21 N 5189 Liaison Statement to JTC1/SWG-EDI on EDIFACT Document Types for FTAM, SC21/WG5, June 1990
- SC21 N 5193 Conceptual Schema HOD/C Meeting report Held on 31 May 1990 in Seoul, July 1990
- SC21 N 5194 Resolutions of the Fourth Plenary Meeting of SC21, 5 June 1990, Seoul, SC21, 5 June 1990
- SC21 N 5196 Report of the Special Meeting on User Requirements, SC21, 7 June 1990
- SC21 N 5197 Report of the Standards Maintenance Group, SC21, 4 June 1990
- SC21 N 5203 SC21/WG1 Convenor's Report to SC21 Plenary Meeting, Seoul, 5-6 June 1990, SC21/WG1, 3 June 1990
- SC21 N 5205 ISO/IEC JTC1/SC21 WG1 Programme of Work, May 1990
- SC21 N 5213 Call for Contributions on Plan for WG4 Systems Management, 5 June 1990
- SC21 N 5219 Draft Management Guidelines for SC21, Rapporteur for Strategic Planning, July 1990
- SC21 N 5222 Working Document on the Extended Directory Information Models, SC21/WG4 and CCITT Collaborative Meeting on Directory, July 1990
- SC21 N 5228 Report of the ISO/IEC JTC1/SC21 Plenary Meeting, 5 June 1990, Seoul, Korea, 30 July 1990
- SC21 N 5228 Proposed Technical Corrigenda to ISO 9595 and ISO 9596
- SC21 N 5229 Report of the JTC1/SC21 Plenary Meeting, 5 June 1990, Seoul, Republic of Korea
- SC21 N 5253 Working Document on Replication and Knowledge Distribution, SC21/WG4 and CCITT Collaborative Meeting on Directory, June 1990
- SC24 N 224 PHIGS Plus, 1989

### New Work Items Approved by JTC1:

- JTC1 N 760 Enhanced Search for Directory, 30 April 1990
- JTC1 N 761 State Tables for CMIP - Addendum to ISO 9596, 30 April 1990
- JTC1 N 762 Systems Management - Part X: Software Management Function, 30 April 1990
- JTC1 N 763 Time Management, 30 April 1990
- JTC1 N 764 Extension to 9545, Application Layer Structure, for Application Layer Recovery Model, 30 April 1990
- JTC1 N 765 Modelling for Communications Aspects of Distributed Applications, 30 April 1990
- JTC1 N 766 Management Information for the OSI Upper Layers, 30 April 1990

## UNCLASSIFIED

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| JTC1 N 767 | Service Definition and Protocol Specification for an "Authentication Exchange ASE," 30 April 1990                    |
| JTC1 N 768 | Additional Resynchronization Functionality, 30 April 1990  |
| JTC1 N 769 | Model, Service, and Protocol for Remote Procedure Call, 30 April 1990  |
| JTC1 N 770 | Conformance Test Suite for ISO 9041, Basic Class VT Protocol - Test Suite Structure and Test Purposes, 30 April 1990 |
| JTC1 N 771 | Enhancements of FTAM Services to Satisfy Additional User Requirements, 30 April 1990                                 |
| JTC1 N 772 | Transaction Processing Security, 30 April 1990   |
| JTC1 N 773 | Transaction Processing Association Management, 30 April 1990   |
| JTC1 N 774 | Application Context Proforma for OSI TP, 30 April 1990   |
| JTC1 N 775 | Data Transfer for OSI TP, 30 April 1990  |
| JTC1 N 776 | Transaction Processing Heuristics Decisions, 30 April 1990   |
| JTC1 N 777 | Transaction Processing Commitment Optimizations, 30 April 1990   |
| JTC1 N 778 | PICS Proforma for OSI Distributed Transaction Processing, 30 April 1990  |
| JTC1 N 779 | Distributed Transaction Processing - Dialogue Recovery and User Suspension of a Dialogue, 30 April 1990              |
| JTC1 N 805 | Conformance Test Suite for the TP Protocol, 30 April 1990  |
| JTC1 N 806 | Conformance Test Suite for the CCR Protocol, 30 April 1990   |
| JTC1 N 807 | Formal Methods in Conformance Testing of OSI Protocols, 30 April 1990  |
| JTC1 N 846 | Extension to ISO 9545 Application Layer Structure for Multi-Level Structures, 18 May 1990                            |
| JTC1 N 847 | OSI Protocol Profile Testing Methodology, Methods of Testing, 18 May 1990; to become ISO 9646-6                      |
| JTC1 N 891 | Standard for Ada/SQL Language Interface, 29 June 1990  |

### New Work Items Proposed for JTC1:

|             |  |
|-------------|--|
| JTC1 N 957  | Systems Management Tutorial (to result in a Technical Report), 3 August 1990 [SC21 N 4942, 5 June 1990]  |
| JTC1 N 958  | Extended Systems Management Architecture (WD 10040-2), 3 August 1990 [SC21 N 4943, 5 June 1990]  |
| JTC1 N 957  | Generic Managed Object (GMO) Specification (WD 10165-X), 3 August 1990 [SC21 N 4944, 5 June 1990]  |
| JTC1 N 960  | Management Information Register (MIR) and Registration Procedures (two new standards), 3 August 1990 [SC21 N 4945, 5 June 1990]  |
| JTC1 N 961  | Requirements and Guidelines for Managed Object Implementation Conformance Statement (MOCS) Proformas (Specification) (addendum to DIS 10165-4), 3 August 1990 [SC21 N 4946, 5 June 1990] |
| JTC1 N 962  | Systems Management Relationship Model (amendment to DIS 10164-3), 3 August 1990 [SC21 N 4948, 5 June 1990]   |
| JTC1 N 963  | Systems Management - Response Time Monitoring Function (new part for DIS 10164), 3 August 1990 [SC21 N 4949, 5 June 1990]  |
| JTC1 N 964  | Test Suites for OSI Directory (new multi-part standard), 3 August 1990 [SC21 N 4951, 5 June 1990]  |
| SC21 N 4951 | Test Suites for OSI Directory, July 1990   |

## II. CCITT RECOMMENDATIONS<sup>3</sup>

### A. F-SERIES TELEMATIC SERVICES

|                           |  |
|---------------------------|--|
| CCITT F.200♦ <sup>4</sup> | Teletex Service  |
| CCITT F.200♦              | Teletex Service, Annex C: Mixed Mode of Operation                  |
| CCITT F.201♦              | Internetworking Between the Teletex Service and the Telex Service  |
| CCITT F.400               | Message Handling System and Service Overview                       |
| CCITT F.401               | Naming and Addressing for Public Message Handling Services         |
| CCITT F.410               | The Public Messaging Transfer Service                              |
| CCITT F.415               | Intercommunication with Public Physical Delivery Services          |
| CCITT F.420               | The Public Interpersonal Messaging (IMP) Service                   |
| CCITT F.421               | Intercommunication Between the IPM Service and the Telex Service   |
| CCITT F.422               | Intercommunication Between the IPM Service and the Teletex Service |
| CCITT F.500               | International Public Directory Services                            |

### B. I- SERIES ISDN SERVICES

|             |  |
|-------------|--|
| CCITT I.110 | General Structure of the I-Series Recommendations  |
| CCITT I.111 | Relationship with Other Recommendations Relevant to ISDNs  |
| CCITT I.112 | Vocabulary of Terms for ISDNs  |
| CCITT I.113 | Vocabulary of Terms for Broadband Aspects of ISDNs   |
| CCITT I.120 | Integrated Service Digital Networks (ISDNs)  |
| CCITT I.121 | Broadband Aspects of ISDNs   |
| CCITT I.122 | Framework for Providing Additional Packet Mode Bearer Services   |
| CCITT I.130 | Attributes for the Characterization of Telecommunications Services Supported by an ISDN and Network Capabilities of an ISDN          |
| CCITT I.140 | Attribute Techniques for the Characterization of Telecommunication Services Supported by an ISDN and Network Capabilities of an ISDN |
| CCITT I.141 | ISDN Network Charging Capabilities Attributes  |
| CCITT I.144 | Number Identification Supplementary Services   |
| CCITT I.200 | Guidance to the I.200 Series of Recommendations  |

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<sup>3</sup> CCITT Recommendations are final versions of 1988 documents (Blue Book) unless otherwise indicated.

<sup>4</sup> The symbol ♦ is used throughout this Section to identify those recommendations included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

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|             |   |
|-------------|---|
| CCITT I.210 | Principles of Telecommunications Services Supported by an ISDN  |
| CCITT I.211 | Bearer Services Supported by an ISDN  |
| CCITT I.212 | Teleservices Supported by an ISDN   |
| CCITT I.220 | Common Dynamic Description of Basic Telecommunication Services  |
| CCITT I.221 | Common Specific Characteristics of Services   |
| CCITT I.230 | Definition of Bearer Service Categories   |
| CCITT I.231 | Circuit-Mode Bearer Service Categories  |
| CCITT I.232 | Packet Mode Bearer Service Categories   |
| CCITT I.240 | Definition of Teleservices  |
| CCITT I.241 | Teleservices Supported by an ISDN   |
| CCITT I.250 | Definition of Supplementary Services  |
| CCITT I.251 | Number Identification Supplementary Services  |
| CCITT I.252 | Call Offering Supplementary Services  |
| CCITT I.253 | Call Completion Supplementary Services  |
| CCITT I.254 | Multiparty Supplementary Services   |
| CCITT I.255 | Community of Interest Supplementary Services  |
| CCITT I.256 | Changing Supplementary Services   |
| CCITT I.257 | Additional Information Transfer Supplementary Services  |
| CCITT I.310 | ISDN - Network Functional Principles  |
| CCITT I.320 | ISDN Protocol Reference Model   |
| CCITT I.324 | ISDN Network Architecture   |
| CCITT I.325 | Reference Configurations for ISDN Connection Types  |
| CCITT I.326 | Reference Configurations for Relative Network Resource Requirements   |
| CCITT I.330 | ISDN Numbering and Addressing Principles  |
| CCITT I.331 | Numbering Plan for the ISDN Era   |
| CCITT I.332 | Numbering Principles for Interworking Between ISDNs and Dedicated Networks with Different Numbering Plans             |
| CCITT I.333 | Terminal Selection in ISDN  |
| CCITT I.334 | Principles Relating ISDN Numbers/Subaddresses to the OSI Reference Model Network Layer Addresses                      |
| CCITT I.335 | ISDN Routing Principles   |
| CCITT I.340 | ISDN Connection Types   |
| CCITT I.350 | General Aspects of Quality of Service and Network Performance in Digital Networks, Including ISDNs                    |
| CCITT I.351 | Recommendations in Other Services Including Network Performance Objectives that Apply at T Reference Point of an ISDN |
| CCITT I.352 | Network Performance Objectives for Connection Processing Delays in an ISDN  |
| CCITT I.410 | General Aspects and Principles Relating to Recommendations on ISDN User-Network Interfaces                            |
| CCITT I.411 | ISDN User-Network Interfaces - Reference Configurations   |
| CCITT I.412 | ISDN User-Network Interfaces - Interface Structures and Access Capabilities   |
| CCITT I.420 | Basic User-Network Interface (ISDN)   |
| CCITT I.421 | Primary Rate User-Network Interface (ISDN)  |



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| CCITT I.430 ♦ | Basic User-Network Interface - Layer 1 Specification (ISDN)   |
| CCITT I.431 ♦ | Primary Rate User-Network Interface - Layer 1 Specification (ISDN)  |
| CCITT I.440   | ISDN User-Network Interface - Data Link Layer General Aspects   |
| CCITT I.441 ♦ | ISDN User-Network Interface - Data Link Layer Specification   |
| CCITT I.450 ♦ | ISDN User-Network Interface - Layer 3 General Aspects (Q.921)   |
| CCITT I.451 ♦ | ISDN User-Network Interface - Layer 3 Specification (Q.931)   |
| CCITT I.452   | ISDN User-Network Interface - Layer 3 Specification - Generic Procedures for the Control of the ISDN Supplementary Services                                   |
| CCITT I.460 ♦ | Multiplexing, Rate Adaptation and Support of Existing Interfaces (ISDN)   |
| CCITT I.461 ♦ | Support of X.21 and X.21 bis Based DTEs by an ISDN (X.30)   |
| CCITT I.462 ♦ | Support of Packet Mode Terminal Equipment by an ISDN (X.31)   |
| CCITT I.463 ♦ | Support of DTEs with V-Series Type Interfaces by an ISDN  |
| CCITT I.464 ♦ | Multiplexing Rate Adaptation and Support of Existing Interfaces for Restricted 64 kbit/s Transfer Capability  |
| CCITT I.500   | General Structure of the ISDN Interworking Recommendations  |
| CCITT I.510   | Definitions and General Principles for ISDN Interworking  |
| CCITT I.511   | ISDN to ISDN Layer 1 Internetwork Interface   |
| CCITT I.515   | Parameter Exchange for ISDN Interworking  |
| CCITT I.520   | General Arrangement for Network Interworking Between ISDNs  |
| CCITT I.530   | Network Interworking Between an ISDN and a Public Switched Telephone Network (PSTN)   |
| CCITT I.540   | General Arrangement for Network Interworking Between Circuit Switched Public Data Networks (CSPDNs) and ISDNs for the Provision of Data Transmission Services |
| CCITT I.550   | General Arrangement for Network Interworking Between Packet Switched Public Data Networks (PSPDNs) and ISDNs for the Provision of Data Transmission Services  |
| CCITT I.560   | Requirements to be Met in Providing the Telex Service Within the ISDN   |
| CCITT I.601   | General Maintenance Principles of ISDN Subscriber Access and Subscriber Installation  |
| CCITT I.602   | Application of Maintenance Principles to ISDN Subscriber Installation   |
| CCITT I.603   | Application of Maintenance Principles to ISDN Basic Accesses  |
| CCITT I.604   | Application of Maintenance Principles to ISDN Primary Rate Accesses   |
| CCITT I.605   | Application of Maintenance Principles to Static Multiplexed ISDN Basic Accesses   |

### C. T-SERIES TELEMATIC SERVICES

|             |  |
|-------------|--|
| CCITT T.0   | Classification of Facsimile Apparatus for Document Transmission Over the Public Networks |
| CCITT T.5 ♦ | General Aspects of Group 4 Facsimile Apparatus   |
| CCITT T.6 ♦ | Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus    |
| CCITT T.50  | International Alphabet No. 5   |

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|----------------|---|
| CCITT T.51 ♦   | Coded Character Sets for Telematic Services   |
| CCITT T.60 ♦   | Terminal Equipment for Use in the Teletex Service   |
| CCITT T.61 ♦   | Character Repertoire and Coded Character Sets for the International Teletex Service                                 |
| CCITT T.62 ♦   | Control Procedures for Teletex and Group 4 Facsimile Services   |
| CCITT T.62 bis | Control Procedures for Teletex and Group 4 Facsimile Services Based on Recommendations X.215/X.225                  |
| CCITT T.63 ♦   | Provision for Verification of Teletex Terminal Compliance   |
| CCITT T.70 ♦   | Network-Independent Basic Transport Service for the Telematic Services  |
| CCITT T.71 ♦   | LAPB Extended for Half-Duplex Physical Level Facility   |
| CCITT T.72 ♦   | Terminal Capabilities for Mixed Mode of Operation   |
| CCITT T.73 ♦   | Document Interchange Protocol for the Telematic Services  |
| CCITT T.90 ♦   | Teletex Requirements for Internetworking with the Telex Service   |
| CCITT T.91 ♦   | Teletex Requirements for Real-Time Internetworking with the Telex Service in a Packet-Switching Network Environment |
| CCITT T.330 ♦  | Telematic Access to Interpersonal Messaging System  |
| CCITT T.400    | Introduction to Document Architecture, Transfer and Manipulation  |
| CCITT T.411    | Open Document Architecture (ODA) and Interchange Format - Introduction and General Principles (see ISO 8613-1)      |
| CCITT T.412    | Open Document Architecture (ODA) and Interchange Format - Document Structures (see ISO 8613-2)                      |
| CCITT T.414    | Open Document Architecture (ODA) and Interchange Format - Document Profile (see ISO 8613-4)                         |
| CCITT T.415    | Open Document Architecture (ODA) and Interchange Format - Open Document Interchange Format (ODIF) (see ISO 8613-5)  |
| CCITT T.416    | Open Document Architecture (ODA) and Interchange Format - Character Content Architectures (see ISO 8613-6)          |
| CCITT T.417    | Open Document Architecture (ODA) and Interchange Format - Raster Graphics Content Architectures (see ISO 8613-7)    |
| CCITT T.418    | Open Document Architecture (ODA) and Interchange Format - Geometric Graphics Content Architectures (see ISO 8613-8) |
| CCITT T.419    | Document Transfer and Manipulation (DTAM) - Composite Graphics Content Architectures                                |
| CCITT T.431    | Document Transfer and Manipulation (DTAM) - Services and Protocols, Introduction and General Principles             |
| CCITT T.432    | Document Transfer and Manipulation (DTAM) - Services and Protocols, Service Definition                              |
| CCITT T.433    | Document Transfer and Manipulation (DTAM) - Services and Protocols, Protocol Specification                          |
| CCITT T.441    | Document Transfer and Manipulation (DTAM) - Operational Structure   |
| CCITT T.501    | Document Application Profile MM for the Interchange of Formatted Mixed Mode Documents (Mixed Mode)                  |
| CCITT T.502    | Document Application Profile PM1 for the Interchange of Processible Form Documents (Teletex Processible Mode)       |

## UNCLASSIFIED

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| CCITT T.503 | A Document Application Profile for the Interchange of Group 4 Facsimile Documents  |
| CCITT T.504 | Document Application Profile for Videotex Interworking   |
| CCITT T.521 | Communication Application Profile BTO for Document Bulk Transfer Based on the Session Service (According to Rules Defined in T.62 bis) |
| CCITT T.522 | Communication Application Profile BT1 for Document Bulk Transfer   |
| CCITT T.523 | Communication Application Profile DM-1 for Videotex Interworking   |
| CCITT T.541 | Operational Application Profile for Videotex Interworking  |
| CCITT T.561 | Terminal Characteristics for Mixed Mode of Operation MM  |
| CCITT T.562 | Terminal Characteristics for Teletex Processing Mode PM1   |
| CCITT T.563 | Terminal Characteristics for Group 4 Facsimile Apparatus   |
| CCITT T.564 | Gateway Characteristics for Videotex Interworking  |

### D. V-SERIES

|                   |  |
|-------------------|--|
| CCITT V.5         | Standardization of Data Signalling Rates for Synchronous Data Transmission in the General Switched Telephone Network   |
| CCITT V.6         | Standardization of Data Signalling Rates for Synchronous Data Transmission on Leased Telephone-Type Circuits   |
| CCITT V.10/X.26 ♦ | Electrical Characteristics for Unbalanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communication   |
| CCITT V.11/X.27 ♦ | Electrical Characteristics for Balanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communications  |
| CCITT V.20 ♦      | Telex and Gentex Signalling on Radio Channels (Synchronous 7-Unit Systems Affording Error Correction by Automatic Repetition)  |
| CCITT V.24 ♦      | List of Definitions for Interchange Circuits Between DTE and DCE   |
| CCITT V.25 ♦      | Automatic Answering Equipment and/or Parallel Automatic Calling Equipment on the General Switched Telephone Network Including Procedures for Disabling of Echo Control Devices for Both Manually and Automatically Established Calls |
| CCITT V.25 bis ♦  | Automatic Calling and/or Answering Equipment on the General Switched Telephone Network (GSTN) Using the 100-Series Interchange Circuits  |
| CCITT V.28 ♦      | Electrical Characteristics for Unbalanced Double-Current Interchange Circuits  |
| CCITT V.31 ♦      | Electrical Characteristics for Single-Current Interchange Circuits Controlled by Contact Closure   |
| CCITT V.31 bis ♦  | Electrical Characteristics for Single-Current Interchange Circuits Using Opto Couplers   |
| CCITT V.35 ♦      | Data Transmission at 48 Kilobits per Second Using 60-108 kHz Group Band Circuits   |
| CCITT V.36 ♦      | Modems for Synchronous Data Transmission Using 60-108 kHz Group Band Circuits  |
| CCITT V.37 ♦      | Synchronous Data Transmission at a Data Signalling Rate Higher than 72 kbit/s Using 60-108 kHz Group Band Circuits   |
| CCITT V.54        | Loop Test Devices for Modems   |

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## E. X-SERIES PUBLIC DATA NETWORKS

- CCITT X.1 International User Classes of Service in Public Data Networks and Integrated Services Digital Networks (ISDNs)
- CCITT X.3♦ Packet Assembly/Disassembly Facility (PAD) in a Public Data Network (PDN).
- CCITT X.4 General Structure of Signals of International Alphabet No. 5 Code for Data Transmission Over Public Data Networks
- CCITT X.10 Categories of Access for DTE to Public Data Transmission Services Provided by PDNs and/or ISDNs through Terminal Adaptors
- CCITT X.20♦ Interface Between DTE and DCE for Start-Stop Transmission Services on Public Data Networks
- CCITT X.20 bis Use on Public Data Networks of DTE Which Is Designed for Interfacing to Asynchronous Duplex V-Series Modems
- CCITT X.21♦ Interface Between DTE and DCE for Synchronous Operation on Public Data Networks
- CCITT X.21 bis♦ Use on Public Data Networks of DTE Which Is Designed for Interfacing to Synchronous V-Series Modems
- CCITT X.22♦ Multiplex DTE/DCE Interface for User Classes 3-6
- CCITT X.24♦ List of Definitions for Interchange Circuits Between DTE and DCE on Public Data Networks
- CCITT X.25-84♦ Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit, 1984
- CCITT X.25-88 Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit, 1988
- CCITT X.28♦ DTE/DCE Interface for a Start/Stop Mode DTE Accessing the PAD in a PDN Situated in the Same Directory (Country)
- CCITT X.29♦ Procedures for the Exchange of Control Information and User Data Between a PAD and a Packet Mode DTE or Another PAD
- CCITT X.31♦ Support of Packet Mode Terminal Equipment by an ISDN
- CCITT X.32♦ Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Accessing a Packet Switched PDN Through a Public Switched Telephone Network or a Circuit Switched PDN
- CCITT X.75-84♦ Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between PSDNs
- CCITT X.75-88 Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between PSDNs
- CCITT X.110 International Routing Principles and Routing Plan for Public Data Networks
- CCITT X.141 General Principles for the Detection and Correction of Errors in Public Data Networks
- CCITT X.150 Principles of Maintenance Testing for Public Data Networks Using DTE and DCE Test Loops
- CCITT X.200 Reference Model of OSI for CCITT Applications (see ISO 7498)
- CCITT X.208 Specification of Abstract Syntax Notation One (ASN.1) (see ISO 8824, Revised Edition)

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| CCITT X.209 | Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1) (see ISO 8825, Revised Edition)  |
| CCITT X.210 | OSI Layer Service Definition Conventions (see ISO TR 8509)  |
| CCITT X.211 | Physical Service Definition for OSI for CCITT Applications (see DIS 10022)  |
| CCITT X.212 | Data Link Service Definition for OSI for CCITT Applications (see ISO 8886)  |
| CCITT X.213 | Network Service Definition for OSI for CCITT Applications (see ISO 8348, 8348/AD2, and 8348/AD3)  |
| CCITT X.214 | Transport Service Definition for OSI for CCITT Applications (see ISO 8072, 1986)  |
| CCITT X.215 | Session Service Definition for OSI for CCITT Applications (see ISO 8826 and 8326/AD2)   |
| CCITT X.216 | Presentation Service Definition for OSI for CCITT Applications (see ISO 8822)   |
| CCITT X.217 | Association Control Service Definition for OSI for CCITT Applications (see ISO 8649)  |
| CCITT X.218 | Reliable Transfer: Model and Service Definition (see ISO 9066-1)  |
| CCITT X.219 | Remote Operations: Model, Notation and Service Definition (see ISO 9072-1)  |
| CCITT X.220 | Use of X.200 Series Protocols in CCITT Modifications  |
| CCITT X.223 | Use of X.25 to Provide the OSI Connection-Mode Network Service for CCITT Applications (see ISO 8878, 1987)  |
| CCITT X.224 | Transport Protocol Specification for OSI for CCITT Applications (see ISO 8073)  |
| CCITT X.225 | Session Protocol Specification for OSI for CCITT Application (see ISO 8327 and 8327/AD2)  |
| CCITT X.226 | Presentation Protocol Specification for OSI for CCITT Application (see ISO 8823)  |
| CCITT X.227 | Association Control Protocol Specification for OSI for CCITT Applications (see ISO 8650)  |
| CCITT X.228 | Reliable Transfer: Protocol Specification (see ISO 9066-2)  |
| CCITT X.229 | Remote Operations: Protocol Specification (see ISO 9072-2)  |
| CCITT X.244 | Procedure for the Exchange of Protocol Identification During Virtual Call Establishment on Packet Switched Public Data Networks   |
| CCITT X.250 | Formal Description Techniques for Data Communications Protocols and Services  |
| CCITT X.290 | OSI Conformance Testing Methodology and Framework for Protocol Recommendations for CCITT Applications (see DIS 9646-1 and DIS 9646-2)   |
| CCITT X.300 | General Principles and Arrangements for Interworking Between Public Data Networks, and Between PDNs and Other Public Networks   |
| CCITT X.301 | Description of the General Arrangement for Call Control Within a Subnetwork and Between Subnetworks for the Provision of Data Transmission  |
| CCITT X.302 | Description of the General Arrangement for Internal Network Utilities Within a Subnetwork and Immediate Utilities Between Subnetworks for the Provision of Data Transmission Services |
| CCITT X.305 | Functionalities of Subnetworks Relating to the Support of the OSI Connection-Mode Network Service   |
| CCITT X.310 | Procedures and Arrangements for DTE Accessing Circuit Switched Digital Data Services Through Analogue Telephone Networks  |
| CCITT X.320 | General Arrangements for Interworking Between ISDNs for the Provision of Data Transmission Services   |
| CCITT X.321 | General Arrangements for Interworking Between Circuit Switched Public Data Networks (CSPDNs) and ISDNs for the Provision of Data Transmission Services                                |

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| CCITT X.322  | General Arrangements for Interworking Between Packet Switched Public Data Networks (PSPDNs) and CSPDNs for the Provision of Data Transmission Services |
| CCITT X.323  | General Arrangements for Interworking Between PSPDNs   |
| CCITT X.324  | General Arrangements for Interworking Between PSPDNs and Public Mobile Systems for the Provision of Data Transmission Services                         |
| CCITT X.325  | General Arrangements for Interworking Between PSPDNs and ISDNs for the Provision of Data Transmission Services   |
| CCITT X.326  | General Arrangements for Interworking Between PSPDNs and Common Channel Signalling Network (CCSN)  |
| CCITT X.327  | General Arrangements for Interworking Between PSPDNs and Private Data Networks for the Provision of Data Transmission Services                         |
| CCITT X.353  | Routing Principles for Interconnecting the Maritime Satellite Data Transmission System with Public Data Networks                                       |
| CCITT X.400♦ | Message Handling Systems (MHSs): System Model - Service Elements (see ISO 10021-1, MOTIS)  |
| CCITT X.401♦ | MHSs - Basic Service Elements and Optional User Facilities   |
| CCITT X.402♦ | MHSs - Overall Architecture (ISO 10021-2, MOTIS)   |
| CCITT X.403♦ | MHSs - Conformance Testing   |
| CCITT X.407♦ | MHSs - Abstract Service Definition Conventions (ISO 10021-3, MOTIS)  |
| CCITT X.408♦ | MHSs - Encoded Information-Type Conversion Rules   |
| CCITT X.409♦ | MHSs - Presentation Transfer Syntax and Notation [replaced by X.208 (ISO 8824 with DAD1) and X.208 (ISO 8825 with DAD1)]                               |
| CCITT X.410♦ | MHSs - Remote Operations and Reliable Transfer Server [replaced by X.218 (ISO 9066-1), X.219 (ISO 9072-1), X.228 (ISO 9066-2), and X.229 (ISO 9072-2)] |
| CCITT X.411♦ | MHSs - Message Transfer Layer (see ISO 10021-4, MOTIS)   |
| CCITT X.413♦ | MHSs - Message Store: Abstract Service Definition (ISO 10021-5, MOTIS)   |
| CCITT X.419♦ | MHSs - Protocol Specifications (ISO 10021-6, MOTIS)  |
| CCITT X.420♦ | MHSs - Interpersonal Messaging User Agent Layer (ISO 10021-7, MOTIS)   |
| CCITT X.430♦ | MHSs - Access Protocol for Teletex Terminals   |
| CCITT X.500  | The Directory - Overview of Concepts, Models, and Service (see ISO 9594-1)   |
| CCITT X.501  | The Directory - Models (see ISO 9594-2)  |
| CCITT X.509  | The Directory - Authentication Framework (see ISO 9594-8)  |
| CCITT X.511  | The Directory - Abstract Service Definition (see ISO 9594-3)   |
| CCITT X.518  | The Directory - Procedures for Distributed Operation (see ISO 9594-4)  |
| CCITT X.519  | The Directory - Protocol Specifications (see ISO 9594-5)   |
| CCITT X.520  | The Directory - Selected Attribute Types (see ISO 9594-6)  |
| CCITT X.521  | The Directory - Selected Object Classes (see ISO 9594-7)   |

### F. Z-SERIES

|             |   |
|-------------|---|
| CCITT Z.100 | Specification and Description Language (SDL)                            |
| CCITT Z.110 | Criteria for the Use and Applicability of Formal Description Techniques |

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|             |   |
|-------------|---|
| CCITT Z.200 | CCITT High Level Language (CHILL) [see DIS 9496.2]  |
| CCITT Z.301 | Introduction to the CCITT Man-Machine Language (MML)  |
| CCITT Z.302 | The Meta-Language for Describing MML Syntax and Dialogue Procedures                         |
| CCITT Z.311 | Introduction to Syntax and Dialogue Procedures (MML)  |
| CCITT Z.312 | Basic Format Layout (MML)   |
| CCITT Z.314 | The Character Set and Basic Elements (MML)  |
| CCITT Z.315 | Input (Command) Language Syntax Specification (MML)   |
| CCITT Z.316 | Output Language Syntax Specification (MML)  |
| CCITT Z.317 | Man-Machine Dialogue Procedures (MML)   |
| CCITT Z.321 | Introduction to the Extended MML for Visual Display Terminals                               |
| CCITT Z.322 | Capabilities of Visual Display Terminals (VDTs)   |
| CCITT Z.323 | Man-Machine Interaction   |
| CCITT Z.331 | Introduction to the Specification of the Man-Machine Interface                              |
| CCITT Z.332 | Methodology for the Specification of the Man-Machine Interface - General Working Procedures |
| CCITT Z.333 | Methodology for the Specification of the Man-Machine Interface - Tools and Methods          |
| CCITT Z.341 | Glossary of Terms (MML)   |

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E-52

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APPENDIX F

ORGANIZATIONS FOR STANDARDIZATION

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## ORGANIZATIONS FOR STANDARDIZATION

### 1. INTRODUCTION

(U) This appendix provides an overview of NATO organizations and other bodies with responsibility for standardization in the fields of communications and information systems. Eventually, this appendix is intended to be expanded to show specific responsibilities of each of the standards bodies. Where appropriate, the charts show the class of STANAGs or other standards maintained by each organization. The emphasis in this appendix is on technical standards for data communications.

### 2. NATO STANDARDS BODIES

(U) Figure F-1 (foldout) identifies the NATO bodies with responsibility for standardization in communications and information systems. The chart only shows the NATO bodies for which staff support is provided by the NATO Headquarter's staffs, with the exception of those associated with the NATO Communications and Information Systems Organization (NACISO). Operational requirements are the responsibility of the Military Committee, primarily through the Military Agency for Standardization (MAS). Procedural standards are the responsibility of the Allied Data Systems Interoperability Agency (ADSIA), which reports to the Military Committee through the NACISO. Technical standards are the responsibility of the Tri-Service Group on Communications and Electronic Equipment (TSGCEE).

#### 2.1 NATO Technical Standards Bodies

(U) TSGCEE has created a number of subgroups (SGs) and Project Groups (PGs) to develop and maintain technical standards for NATO. The subgroups and selected working groups (WGs) are:<sup>1</sup>

- SG1 on Tactical Area Communications; seeks cooperation among the NATO nations in the development and procurement of tactical area communications for national forces
- SG2 on Tactical Communications Equipment; seeks standardization and interoperability of single-channel communications, excluding those covered by SG1 and SG8
  - WG2 on Narrowband Speech
  - WG3 on Secure Submarine/Air/Surface Communications
  - WG4 on Tactical Communications Equipment for Use in the Air Environment
  - WG5 on Interoperability Standards for Electronic Counter-Countermeasures (ECCM); seeks ECCM interoperability for tactical single-channel radios in the HF, VHF, and UHF bands
  - WG8 on Short-Range Low-Probability-of-Intercept Communications
- SG4 on Navigation and Position Finding
- SG5 on Identification; seeks to enhance the interoperability of current identification equipment and to ensure the standardization, where necessary, to the NATO Identification System (NIS)

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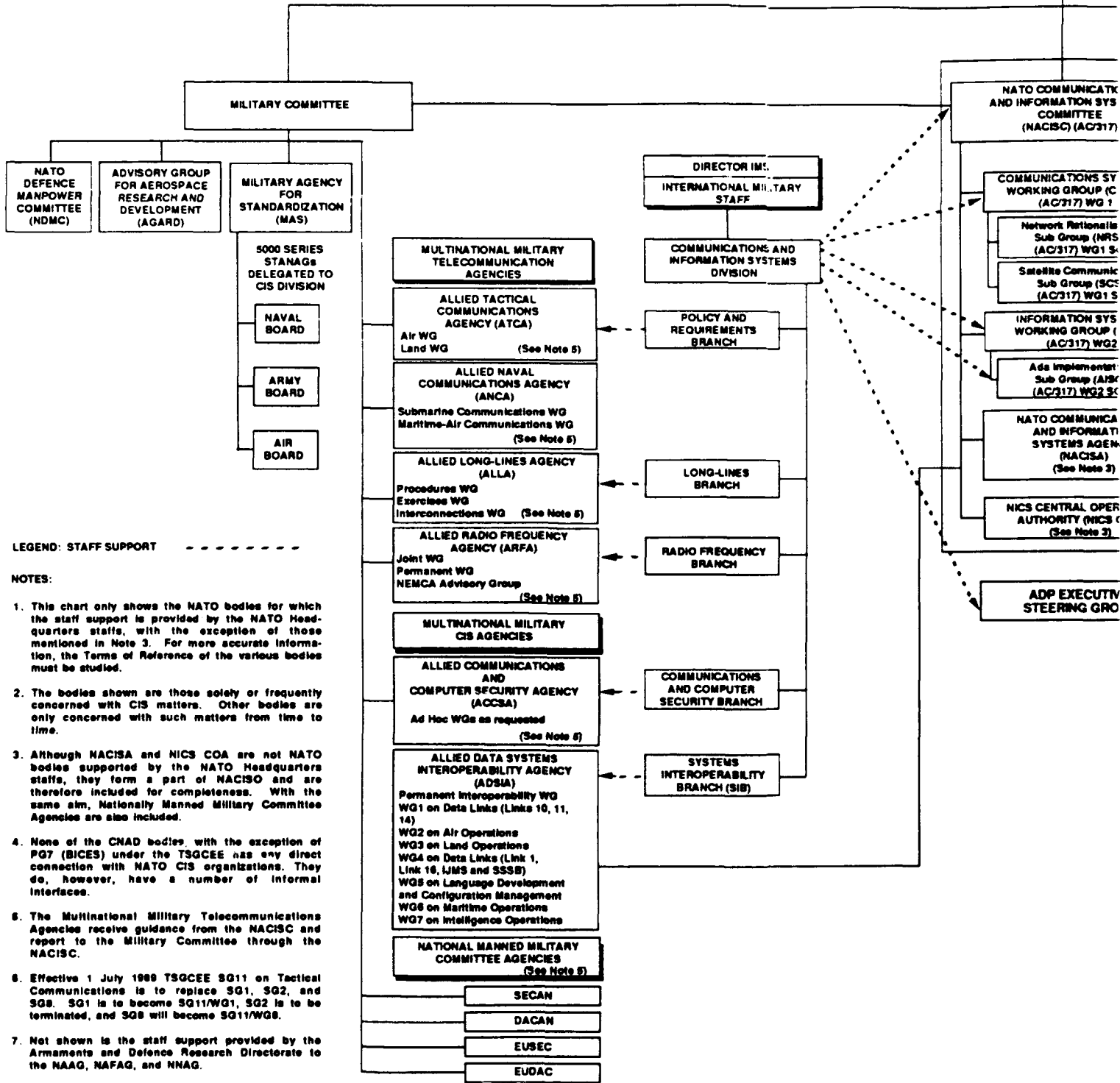
<sup>1</sup> (U) *NATO Bodies in the Fields of Communications and Information Systems*, AC/317-D/23, NACISC, April 1988, NATO UNCLASSIFIED; and *USMCEB Directory--US Participants in the International C3 Fora*, Military Communications Electronics Board, Joint Staff, March 1989, UNCLASSIFIED.

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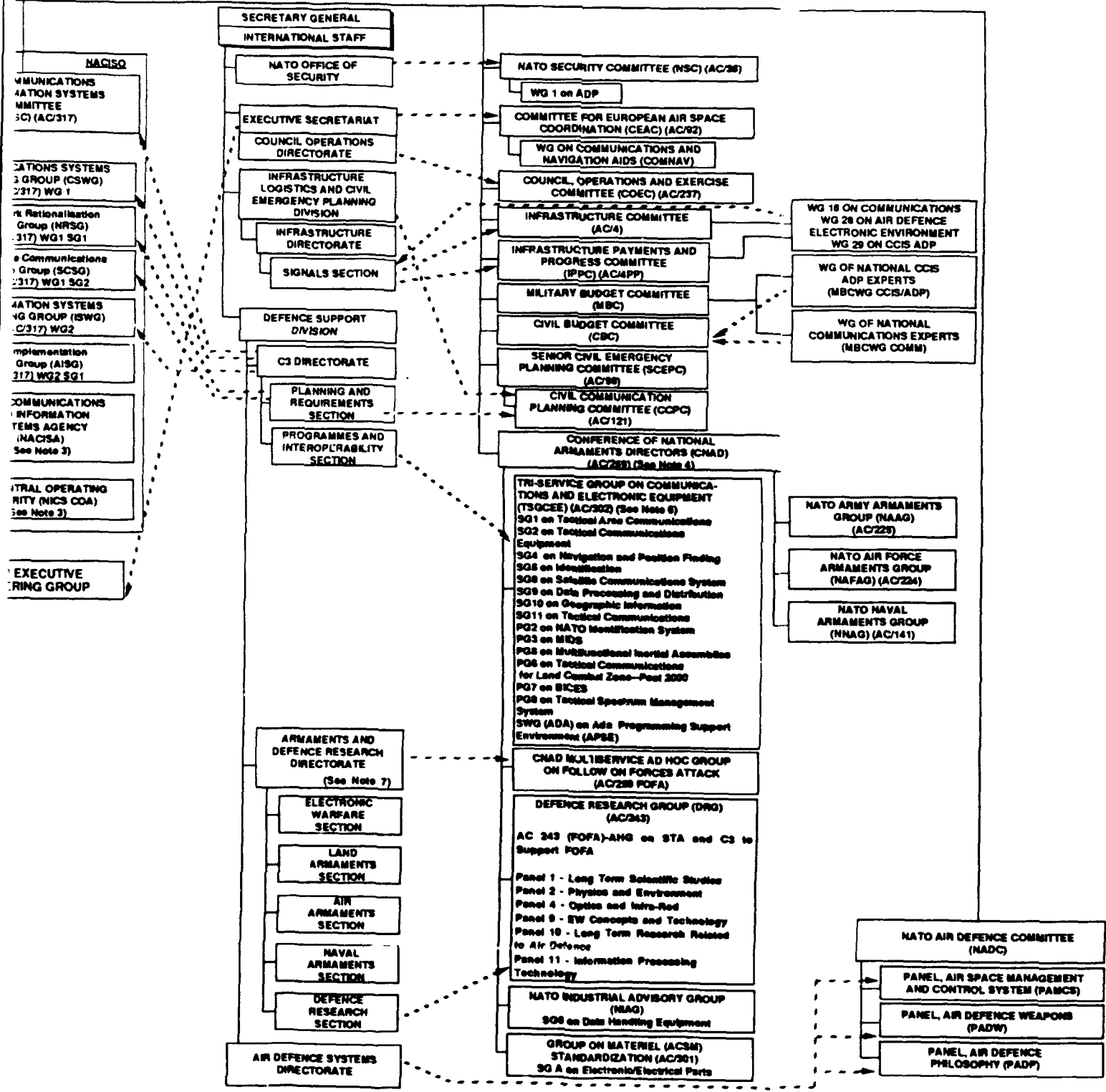


LEGEND: STAFF SUPPORT - - - - -

NOTES:

1. This chart only shows the NATO bodies for which the staff support is provided by the NATO Headquarters staffs, with the exception of those mentioned in Note 3. For more accurate information, the Terms of Reference of the various bodies must be studied.
2. The bodies shown are those solely or frequently concerned with CIS matters. Other bodies are only concerned with such matters from time to time.
3. Although NACISA and NICS COA are not NATO bodies supported by the NATO Headquarters staffs, they form a part of NACISO and are therefore included for completeness. With the same aim, Nationally Manned Military Committee Agencies are also included.
4. None of the CNAD bodies, with the exception of PG7 (BICES) under the TSGCEE has any direct connection with NATO CIS organizations. They do, however, have a number of informal interfaces.
5. The Multinational Military Telecommunications Agencies receive guidance from the NACISC and report to the Military Committee through the NACISC.
6. Effective 1 July 1989 TSGCEE SG11 on Tactical Communications is to replace SG1, SG2, and SG8. SG1 is to become SG11/WG1, SG2 is to be terminated, and SG8 will become SG11/WG8.
7. Not shown is the staff support provided by the Armaments and Defence Research Directorate to the NAAO, NAFAG, and NNAG.

NTIC COUNCIL  
AC)  
ING COMMITTEE  
2C)  
(See Notes 1 & 2)



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- WG4 on Question and Answer (Q&A) System Interoperability; dedicated to Mark X/Mark XII issues, but will consider issues affecting the optimum implementation of the NATO Q&A
- WG5 on Transition to the NIS Q&A
- WG6 on Data Processing
- SG8 on Satellite Communications (SATCOM) Systems; seeks SATCOM interoperability between NATO and national military SATCOM systems
- SG9 on Data Processing and Distribution; focuses on the development of data communications protocols, specifically for the NATO OSI Reference Model
  - WG1 on OSI Layers 1-4--standards and functional profiles
  - WG2 on OSI Layer 5-7--standards and functional profiles
  - WG3 on Communications System/Network Interoperability (CSNI)
  - Ad Hoc Working Group (AHWG) on Security
  - AHWG on Integrated Services Digital Network (ISDN)
  - AHWG on OSI Management
- SG10 on Geographic Information
- SG11 on Tactical Communications (newly formed).

Effective 1 July 1989, TSGCEE SG11 replaced SG1, SG2, and SG8. SG1 became WG1 of SG11, SG2 was terminated, and SG8 became WG8 of SG11.

(U) The Project Groups of SG9 are:

- PG2 on NATO Identification System (not currently active; see SG5)
- PG3 on Multinational Information Distribution System (MIDS)
  - WG1 on the MIDS STANAG 4175
  - WG2 on the MIDS Terminal Development
- PG5 on Multifunctional Inertial Sensor Assemblies
- PG6 on Tactical Communications Systems for the Land Combat Zone--Post 2000; seeks, through a coordinated program, tactical communications systems designed to common standards
- PG7 on Battlefield Information and Exploitation Systems (BICES); WG1 is working on a NATO ESM System
- PG8 on a Tactical Spectrum Management System, planned to support management of radio frequencies in the combat zone.

Liaison among these bodies (e.g., PG6 and SG9) is normally at the Secretary level. Plans are coordinated in annual meetings of the Secretaries and Action Officers of the Allied Tactical Communications Agency (ATCA), the Allied Naval Communications Agency (ANCA), the Allied Communications and Computer Security Agency (ACCSA), and the communications subordinate groups of TSGCEE.<sup>2</sup>

(U) To a limited degree, technical standards are also being addressed in the NATO Industrial Advisory Group (NIAG), specifically in SG6 on Compatibility of Naval Data Handling Equipment. NIAG SG6 is making recommendations on standards to be used in shipboard combat systems for data distribution, such as the Network Independent Interface (NIIF).

(U) Table F-1 and Figure F-2 highlight the relationships among the NATO standards bodies whose responsibilities be discussed in a chart that follows. To clarify the relationships among the organizations and to emphasize those bodies concerned with technical standards, some of the NATO bodies

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<sup>2</sup> (U) "Working Relationships," Note by the Secretary, AC/317-N/185, NACISC, 24 February 1989, NATO UNCLASSIFIED.

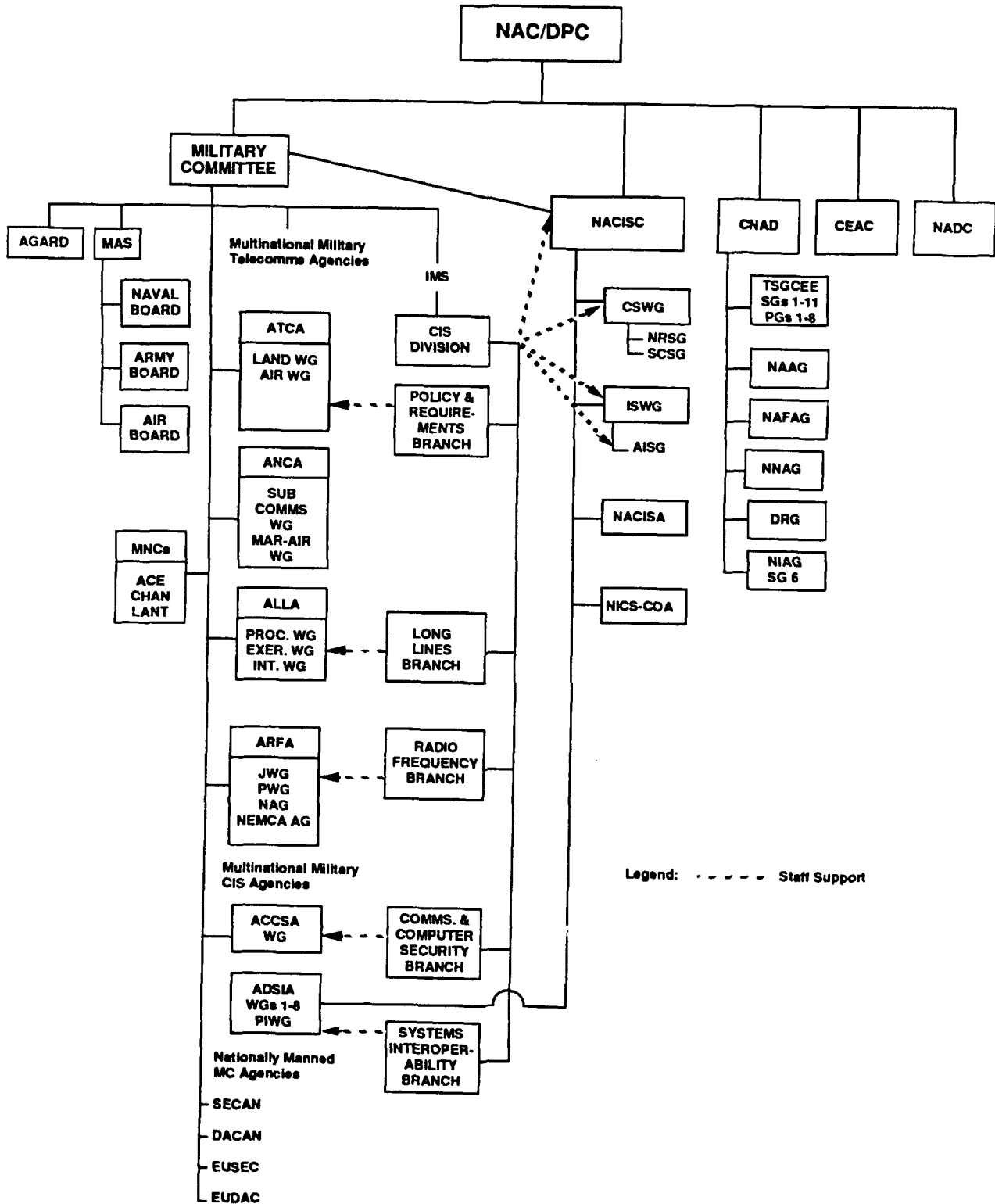
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*Table F-1. (U) Acronyms and Titles of Key NATO Bodies  
in the Fields of Communications and Information Systems*

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| Acronym  | Name   |
|----------|--|
| NAC      | North Atlantic Council                                       |
| DPC      | Defence Planning Committee                                   |
| MC       | Military Committee   |
| AGARD    | Advisory Group for Aerospace Research and Development        |
| MAS      | Military Agency for Standardization                          |
| MNCs     | Major NATO Commands  |
| ACE      | Allied Command Europe  |
| CHAN     | Allied Channel Command                                       |
| LANT     | Allied Command Atlantic                                      |
| ATCA     | Allied Tactical Communications Agency                        |
| ANCA     | Allied Naval Communications Agency                           |
| ALLA     | Allied Long Lines Agency                                     |
| ARFA     | Allied Radio Frequency Agency                                |
| ACCSA    | Allied Communications and Computer Security Agency           |
| ADSI     | Allied Data Systems Interoperability Agency                  |
| SECAN    | Communications Security and Evaluation Agency                |
| DACAN    | Distribution and Accounting Agency                           |
| EUSEC    | European Security and Evaluation Committee                   |
| EUDAC    | European Distribution and Accounting Agency                  |
| IMS      | International Military Staff                                 |
| CIS DIV  | Communications and Information Systems Division              |
| NACISO   | NATO Communications and Information Systems Organization     |
| NACISC   | NATO Communications and Information Systems Committee        |
| CSWG     | Communications Systems Working Group                         |
| NRS      | NATO Rationalization Subgroup                                |
| SCSG     | Satellite Communications Subgroup                            |
| ISWG     | Information Systems Working Group                            |
| AISG     | Ada Implementation Subgroup                                  |
| NACISA   | NATO Communications and Information Systems Agency           |
| NICS-COA | Central Operating Authority                                  |
| CNAD     | Conference of NATO Armaments Directors                       |
| TSGCEE   | Tri-Service Group on Communications and Electronic Equipment |
| NAAG     | NATO Army Armaments Group                                    |
| NAFAG    | NATO Air Force Armaments Group                               |
| NNAG     | NATO Navy Armaments Group                                    |
| DRG      | Defence Research Group                                       |
| NIAG     | NATO Industrial Advisory Group                               |
| CEAC     | Committee for European Airspace Coordination                 |
| NADC     | NATO Air Defence Committee                                   |

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Legend: - - - - - Staff Support

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Figure F-2. (U) NATO Standards Bodies for Communications and Information Systems

F-7

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have been left out and most of the names have been replaced with acronyms. Table F-1 provides the definitions of the acronyms for Figure F-2.

### 2.2 NATO OSI Standards Bodies

(U) TSGCEE SG9 has responsibility for the NATO OSI Reference Model and developing OSI STANAGs. SG9 also maintains the *NTIS Transition Strategy* [Ref. 4] that contains intercept recommendations.

(U) TSGCEE SG9 meets biannually, usually in March and October. Beginning in 1990, SG9 will meet approximately 6 to 8 weeks after the fall meetings of WG1 and WG2, to allow time for the nations to coordinate positions on issues developed by the working groups. Thus, the next meeting of SG9 is December 1990, while WG1 and WG2 will meet in October 1990. AHWGs meet approximately quarterly.

### 2.3 Standards Responsibilities of Selected NATO Bodies

(U) Table F-2 is an incomplete first draft of an effort to identify the specific responsibilities of NATO organizations for technical standards. Eventually, this and similar tables for other groups of standards bodies will be analysed to identify overlaps as well as possible gaps in the standards coverage.

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*Table F-2. (U) Responsibility for Standards in NATO Bodies*

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| NATO Organization | Title                                     | Standards Responsibility                           |
|-------------------|---|--|
| CNAD              | Conf of Nat'l Armaments Directors         |  |
| TSGCEE            | Tri-Serv Group Comm-Electron Equipment    | Technical Standards                                |
| SG1               | Tactical Area Communications              | STANAGs 4206-4214, 4249, 4290, 4295, 5000-5018     |
| SG2               | Tactical Radio Equipment                  | STANAGs 4197-4205, 4245-46, 4285-92, 4335-39, 5020 |
| SG3               | Multi-Functional Info Distribution        |  |
| SG4               | Navigation and Position Finding           |  |
| SG5               | Identification                            |  |
| SG7               | Channel Eval Tech in HF Communications    |  |
| SG8               | Tactical SATCOM Terminal                  | STANAGs 4231-33, 4271                              |
| SG9               | Data Processing and Distribution          | NATO OSI Standards; STANAG 4250                    |
| AHWG-Security     | OSI Security                              | NATO OSI Standards (Annex B)                       |
| AHWG-OM           | OSI Network Management                    | NATO OSI Standards (e.g., Net Mgmt)                |
| AHWG-ISDN         | Integrated Services Digital Network       | ISDN Standards for Open Systems                    |
| WG1               | Lower 4 Layers of Reference Model         | STANAGs 4251-54, 4261-64                           |
| WG2               | Upper 3 Layers of Reference Model         | STANAGs 4255-56, 4258-59, 4265-66                  |
| AHWG-MMHS         | Military Msg Handling System              | STANAG 4257  |
| WG3               | Comm System/Network Interoperability      | MOU for Multinational Programme                    |
| SG10              | Geographic Information                    |  |
| PG2               | NATO Identification System                |  |
| PG3               | MIDS                                      |  |
| PG4               | Low Cost INS for Ships                    |  |
| PG5               | Multi-Functional Inertial Sensor Assembly |  |
| PG6               | Tac Comm Post 2000-Land Combat            |  |
| PG7               | BICES                                     |  |
| PG8               | Tactical Spectrum Mgmt System             |  |
| OGN               | Conformance Testing                       |  |
| NIAG              | NATO Industrial Advisory Group            | Functional Profiles                                |
| SG6               | Naval Data Handling Equipment             | Oversight for Procedural Standards                 |
| NACISC            | NATO Comm and Info Sys Committee          |  |
| CSWG              | Comm Systems Working Group                |  |
| ISWG              | Information Systems Working Group         |  |
| AISG              | Ada Implementation Subgroup               |  |
| NACISA            | NATO Comm and Info Sys Agency             |  |
| NICS-COA          | Central Operating Authority               |  |
| MC                | Military Committee                        |  |
| IMS               | International Military Staff              |  |
| CCCS Div          | Command, Control and Comm System          | STANAGs 5000-6999                                  |
| CISD              | Comm and Info Systems Division            |  |
| SIB               | Systems Interoperability Branch           |  |
| MAS               | Military Agency for Standardization       | Operational Standards (STANAGs 1000-3999)          |
| Air Board         | Air Board                                 | STANAGs 8000-8999                                  |
| ACCSA             | Allied Comm and Comp Sec Agency           |  |
| PSN WG            | Packet Switched Network                   |  |
| ADSIA             | Allied Data Systems Interop Agency        | Procedural Standards                               |
| PIWG              | Permanent Interoperability WG             |  |
| WG1               | Maritime TDS Interoperability Standards   | Data Links 10, 11, and 14                          |
| WG2               | Air Operations                            |  |
| WG3               | Land Forces TDSs                          |  |
| WG4               | Inter-Service Data Systems                | Data Links 1, 16; LIMS, SSSB; STANAG 5516          |
| WG5               | Character-Oriented                        | Language Development and Configuration Mgmt        |
| WG6               | Maritime Operations                       |  |
| WG7               | Intelligence Operations                   | Intelligence Messages                              |
| WG8               | Common Operational Vocabulary             |  |
| SECAN             | Comm Security and Eval Agency             |  |

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## 3. INTERNATIONAL STANDARDS BODIES

(U) Table F-3 identifies standards bodies from CCITT, ISO, and ECMA that recommend, develop, and maintain technical standards for communications and information processing. The primary international bodies are described below.<sup>3</sup> National standards bodies are identified in Chapter 4 of this appendix.

### 3.1 ISO/IEC

(U) The International Organization for Standardization (ISO) has 89 members representing national standards bodies (e.g., AFNOR in France, JISC in Japan, ANSI in the United States, BSI in the United Kingdom). The International Electrotechnical Commission (IEC)<sup>4</sup> is a federation of more than 200 national committees working in the area of electronics and electrical standards with specific interest in information processing. ISO and IEC have formed a joint committee, Joint Technical Committee One (JTC1), to develop standards for information processing systems.

### 3.2 CCITT/CCIR

(U) The Comite Consultatif International pour le Telephone et le Telegraph (CCITT) is the permanent organ of the Union Internationale des Telecommunications (UIT), which groups all the Postal Telephone Telegraph (PTT) administrations of the world's countries. CCITT develops standards in 4-year cycles and works closely with ISO to harmonize results. The Comite Consultatif International pour les Radiocommunications (CCIR) and the International Frequency Registration Board (IFRB) are the other two standards organs of the UIT; together with the CCITT, they are all based in Geneva.

### 3.3 CEN/CENELEC

(U) The Comite Europeen de Normalisation (CEN) is a grouping of the national organizations of 16 countries of the European Community (EC) and the European Free Trading Association (EFTA).<sup>5</sup> CEN works in cooperation with the Comite Europeen de Normalisation Electrotechnique (CENELEC) to develop and publish European standards [normes europeennes (ENs)]. CENELEC deals exclusively with electrotechnical standards and CEN works with standards in all other areas. Based in Brussels, CEN/CENELEC works to harmonize standards that are established by its members and to create European standards where no other appropriate standards exist. CEN/CENELEC members include AFNOR (France), UNI (Italy), DIN (Germany), BSI (United Kingdom), IBN (Belgium), DCQ (Portugal), and SIS (Sweden).

(U) CEN/CENELEC standards are initially distributed for comment by member bodies in the form of an experimental standard (ENV<sup>6</sup>) or a European prestandard (prENV). Future technical work in developing proposals for ENVs has now been taken over by the European Workshop for Open Systems

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<sup>3</sup> (U) "La Galaxie de la Normalisation," Telecoms Magazine, 1989; *The OMNICON Index of Standards for Distributed Information and Telecommunication Systems*, OMNICON, 1987; and "The Value and Use of IT Standards in Public Procurement," PPSC-IT N268.1, Commission of the European Communities, August 1988, UNCLASSIFIED.

<sup>4</sup> (U) The IEC is also known as the Commission Electrotechnique Internationale (CEI).

<sup>5</sup> (U) The EFTA is also known as the Association Europeenne de Libre Exchange (AELE).

<sup>6</sup> (U) The "V" in ENV is for "Vornorm," and indicates a standard based on DIS or other draft standards that are not completely stable; modifications to ENV standards may eventually be required to bring them in line with international standards. ENVs are valid for 3 years--they are reviewed after 2 years and may then become an EN, be prolonged for another 2 years, be replaced by another ENV, or be withdrawn.

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*Table F-3. (U) Responsibilities for Communications and Information Processing  
in International Civil Standards Bodies*

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| International Organization | Title  | Standards Responsibility                |                                       |
|----------------------------|--|---|---------------------------------------|
| CCITT                      | International Consult Comm Telephone Telegrams         |   |                                       |
| SG I                       | Definitions, Operation & Quality of Service            |   |                                       |
| SG II                      | Operation of Telecommunication Network & ISDN          |   |                                       |
| SG III                     | General Tariff Principles                              |   |                                       |
| SG IV                      | Transmission Maintenance                               |   |                                       |
| SG VII                     | Data Communication Networks                            | OSI standards; facilities, VFs          |                                       |
| WG1                        | Network Services, Facilities, Prototypes               |   |                                       |
| WG2                        | Network Access Interfaces                              |   |                                       |
| WG3                        | Internetworking, Switching, Signal                     |   |                                       |
| WG4                        | Transmission & Message Handling                        |   |                                       |
| WG5                        | Routing, Numbering, Layered Model                      |   |                                       |
| SR ISDN                    | ISDN-Related Issues                                    |   |                                       |
| SR DEFs                    | Terms and Definitions                                  |   |                                       |
| SG VIII                    | Telematic Services                                     |   | OSI standards; FAX, teletex, videotex |
| WG1                        | Terminal Characteristics                               |   |                                       |
| WG2                        | Common Protocols & Internetworking                     |   |                                       |
| SG IX                      | Telegraph Networks & Terminal Equipment                |   |                                       |
| SG X                       | Languages & Methodology for Telecom Applications       |   |                                       |
| SG XI                      | ISDN & Telephone Network Switching                     |   |                                       |
| SG XII                     | Transmission Performance of Telephone Network          |   |                                       |
| SG XV                      | Transmission Systems                                   |   |                                       |
| SG XVII                    | Data Transmission over Telephone Network               |   |                                       |
| SG XVIII                   | Digital Networks including ISDN                        | OSI standards for ISDN                  |                                       |
| CCIR                       | International Radio Consultant Committee               |   |                                       |
| CEN                        | European Communications for Standardization            |   |                                       |
| CENELEC                    | European Communications for Telecom Standardization    |   |                                       |
| CEPT                       | European Conf of Postal & Telecom Administration       |   |                                       |
| CCH                        | Harmonization Coordination Committee                   |   |                                       |
| CAC                        | Commercial Action Committee                            |   |                                       |
| CLTA                       | Liaison Committee for Transatlantic Telecommunications |   |                                       |
| ECMA                       | European Computer Manufacturing Association            |   |                                       |
| TC29                       | Text Preparation & Interchange                         | Telematic services; text/office systems |                                       |
| TC32                       | Communications, Networks & Systems Interconnection     | OSI standards                           |                                       |
| TG1                        | Public Data Networks                                   |   |                                       |
| TG3                        | Local Area Networks                                    |   |                                       |
| TG6                        | Interfaces to Private Switching Networks               |   |                                       |
| TG7                        | Transport & Network Layers                             | Layer 3 and Layer 4 OSI standards       |                                       |
| COS                        | Corporation for Open Systems                           |   |                                       |
| COSINE                     | Corporation for Open Systems in Europe                 |   |                                       |
| EMUG                       | European MAP User Group                                |   |                                       |
| ETSI                       | European Telecommunication Standards Institute         |   |                                       |
| EWOS                       | European Workshop on Open Systems                      |   |                                       |

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*Table F-3. (U) (Continued)*

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| International Organization  | Title  | Standards Responsibility   |
|---|--|--|
| ISO<br>JTC1 (TC97)<br>TSG-1<br>SC1<br>SC2<br>SC6<br>WG1<br>WG2<br>WG3<br>WG4<br>WG5<br>SC7<br>WG2<br>WG3<br>SC11<br>SC13<br>SC14<br>SC15<br>SC17<br>SC18<br>WG4<br>WG9<br>SC20<br>SC21<br>WG1<br>WG3<br>WG4<br>WG5<br>WG6<br>WG7<br>SC22<br>WG15<br>SC23<br>SC24<br>SC47B<br>SC83 | International Organization for Standardization<br>Technology Committee on Information Processing Systems<br>Tech Study Group on IAP<br>Vocabulary<br>Character Sets & Information Coding<br>Telecommunications and Info Exchange Between Systems<br>Data Link Layer<br>Network Layer<br>Physical Layer<br>Transport Layer<br>Architecture, Layers 1-4<br>Software Development & Systems Documentation<br>Documentation<br>Software Quality Characteristics<br>Flexible Magnetic Media<br>Interconnection of Equipment<br>Representation of Data Elements<br>Labelling and File Structure<br>Identification and Credit Cards<br>Text and Office Systems<br>Text Interchange<br>User System Interfaces & Symbols<br>Data Cryptographic Techniques<br>Information Retrieval, Transfer, & Management<br>OSI Architecture<br>Database (not part of OSI)<br>OSI Management<br>Specific Application Services<br>Session & Presentation Layers; ASCEs<br>Open Distribution Procedures (not part of OSI)<br>Languages<br>POSIX<br>Optical Digital Data Disks<br>Computer Graphics<br>Microprocessor Systems<br>Information Technology Equipment | Promote standards worldwide<br>Interfaces for Application Portability<br><br>OSI standards<br>Layer 2 OSI standards<br>Layer 3 OSI standards<br>Layer 1 OSI standards<br>Layer 4 OSI standards<br>OSI Architecture<br><br><br>Message handling protocols<br>MOTIS<br><br>OSI and other standards<br>OSI architecture, concept schema<br><br>Layer 7 (TM, FTAM, JTM, VT)<br>Layer 5 and layer 6 OSI standards<br><br>(Work formerly done by SC21/WG2) |
| IEC<br>IFIP<br>ITSTC<br>OSITOP<br>OSF<br>POSI<br>SOGITS<br>SOGT<br>SPAG<br>UER<br>X/OPEN  | International Electrotechnical Commission<br>International Federation for Information Processing<br>Information Technology Steering Technology Committee<br>OSI for Technical & Office Protocol<br>Open Software Foundation<br>Promotion Conference for OSI<br>Senior Official Group for Info Tech Standardization<br>Senior Official Group on Telecommunications<br>Standards Application & Promotion Groups<br>European Union on Radiobroadcasting<br>X/OPEN   | <br><br><br><br>Asia-Oceania workshop/standards forum<br>Commission of European Communities<br>Commission of European Communities  |

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(EWOS). When proposed international standards are harmonized with national standards, harmonized documents (HDs) are produced. When adopted, an HD must be used and national deviations can only exist temporarily. European norms (ENs) must be adopted as national standards, and any conflicting national standards must be withdrawn. An example standard is ENV 41201, Private Message Handling System. A second class of standards promulgated by CEN/CENELEC are the Telecommunications European Norms (NETs), which are common technical specifications covering access to networks and equipment. Examples are NET2 (X.25 Access) and NET3 (ISDN Basic Access).

(U) CEN/CENELEC standards originate as draft documents, standards proposals, and implementors guides developed by various standards promoting organizations. When stable, these documents are reviewed and coordinated by the European Telecommunications Standards Institute (ETSI) and EWOS and are issued for comment as functional specifications, recommendations, and technical specifications. When the review is complete, they are forwarded to CEN/CENELEC, or to the Conference Europeenne des Postes et Telecommunications (CEPT), for final standards development.<sup>7</sup>

### 3.4 ECMA

(U) The European Computer Manufacturer Association (ECMA) represents a group of about 30 manufacturers in Europe. ECMA, based in Geneva, acts as observer at ISO and as a consultant at CCITT. ECMA takes an active role in the definition of functional profiles with EWOS.

### 3.5 SPAG

(U) The Standards Application and Promotion Group (SPAG), based in Brussels, was created by 12 major European manufacturers (e.g., Bull, ICL, Siemens). SPAG seeks to accelerate standardization by selecting, among all OSI standards, a limited number for implementation. The stacks of standards are called profiles and are developed toward supporting complete applications, such as FTAM. SPAG has made a major contribution to the rapid progress of European experimental standards (ENVs) and standards (ENs).

### 3.6 OSITOP

(U) Open Systems Interconnection for Technical and Office Protocol (OSITOP) is an association of users (such as BNP, EDF/GDF) for the promotion of ISO functional profiles and the concept of TOP.

### 3.7 EMUG

(U) The European Manufacturing Automation Program (MAP) User Group (EMUG) was created in 1985 by a large group of manufacturers. It aims to promote the MAP standards in Europe. Specific groups in the nations, such as the Club Informatique des Grandes Entreprises Francaises (CIGREF) in France, are appointed to be EMUG's representatives. A key element of MAP, the Manufacturing Message Specification (MMS) has reached DIS status (DIS 9506).

### 3.8 EWOS

(U) The European Workshop on Open Systems (EWOS) promulgates harmonized technical proposals for functional profiles of OSI standards and corresponding conformance test specifications. EWOS has been given the responsibility for technical work in developing proposals for ENVs, with increased involvement of users. When complete, the proposals are submitted to CEN/CENELEC. The founding members of EWOS include CEN, CENELEC, ECMA, EMUG, OSITOP, Reseaux Associes pour le Recherche Europeenne (RARE, Association of European Research Networks), and the Corporation for

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<sup>7</sup> (U) Briefing on EUROPE 92--The European Community's Approach to Integration in the Information Technology Area, Fred Griefenstein, Softsiel Corporation, San Diego, 15 May 1989.

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Open Systems Interconnection Networking in Europe (COSINE). The member bodies of EWOS have agreed not to undertake on their own any new work on the development of functional standards.

### 3.9 Support to the Commission of the European Community (CEC)

(U) The Senior Official Group for Information Technology Standardization (SOGITS) and the Senior Official Group on Telecommunications (SOGT) assist the CEC in the implementing legislation for information technology standards. The Public Procurement Subcommittee in the Information Technology Sector (PPSC-IT) enforces the role of standards in public procurement for the CEC.

### 3.10 ITSTC

(U) The Information Technology Steering Technical Committee (ITSTC) provides recommendations for European members in three areas: standards (the Information Technology Ad-hoc Expert Group for Standards), manufacturing/automation (the Information Technology Ad-hoc Expert Group for Manufacturing), and certification (the Information Technology Ad-hoc Expert Group for Certification). While the ITSTC does not produce standards, it does define programmes for European standards and organizes and coordinates the work.

### 3.11 CEPT/ETSI/UER

(U) Three consortia represent the interests of public telecommunication administrations of European countries, including France, the United Kingdom, and Germany. The Conference Europeenne des Postes et Telecommunications (CEPT) coordinates political aspects and prepares technical specifications for member administrations (but does not produce any standards). The CEPT has 20 member countries and works closely with CEN/CENELEC. The European Telecommunications Standards Institute (ETSI) is an organization created within CEPT to prepare specifications concerning public telecommunications networks. The Union Europeenne de Radiodiffusion (UER) is a technical committee with the aim of harmonizing radio broadcasting system standards; its proposals are transmitted to the CCIR and the IEC. The UER has 32 countries actively participating and 45 associated member bodies.

### 3.12 COS/COSINE

(U) The Corporation for Open Systems (COS) and the Corporation for Open Systems Interconnection Networking in Europe (COSINE) participate in the development of functional profiles for OSI and plays an active role in setting standards for testing OSI products for conformance to the international standards and profiles. COS is based in Vienna, Virginia, in the United States, and COSINE is based in Paris. COS has over 60 member organizations, both vendors and users.

(U) COSINE is a project established by the CEC to promote internetworking facilities between industrial and academic research and development communities throughout Europe. Participating countries are Austria, Belgium, Denmark, Finland, France, West Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and Yugoslavia. COSINE has been working closely with RARE in specifying standards initially to be used in a pan-European networking infrastructure.

### 3.13 X/OPEN

(U) X/OPEN is a non-profit consortium developing extensions to UNIX SVID operating system standards to support a distributed transaction processing environment that meets OSI standards. X/OPEN is developing a Common Applications Environment to promote software portability. Alignment of both activities with the emerging POSIX standards is planned.

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## 3.14 OSF

(U) Created in 1988, the Open Software Foundation (OSF) is a group of over 90 information systems companies (including International Business Machines) for the promotion of standards, such as the POSIX standard for operating system interfaces.

## 3.15 IFIP

(U) The International Federation for Information Processing (IFIP) is a group of international experts drawn principally from universities and also from some industries (e.g., Xerox, Bell). IFIP has contributed to the work of ISO on the OSI model and, more recently, to the work on X.400-type message handling systems.

## 3.16 POSI

(NU) Created by six major vendors in Japan and the Nippon Telephone and Telegraph (NTT), the Promotion Conference for Open Systems Interconnection (POSI) is the equivalent to SPAG in Europe and to COS in the United States. POSI is an Asia-Oceania regional forum for the international workshops on OSI, and as such, seeks agreements among vendors to ensure interoperability and compatibility of products. The POSI regional workshop is known as the Asia-Oceania Workshop (AOW).

## 4. NATIONAL STANDARDS BODIES

(U) This section identifies national standards bodies and their responsibilities for standards development or use.<sup>8</sup> Additional contributions to this section would be welcomed.

### 4.1 Belgium

(U) The Institut Belge de Normalisation (IBN) is the primary standards body for Belgium.

### 4.2 Canada

(U) The Canadian Standards Association (CSA) is responsible for the development of OSI standards in Canada. The Standards Council of Canada (SCC) is a Canadian national non-governmental agency that develops standards policy. The SCC provides coordination and support for the National Standards System (NSS) and supports Canada's participation in international standards work.

### 4.3 Denmark

(U) Danish Standards Association (Dansk Standardiseringsrad) is the ISO member body from Denmark. It is also the member body for CEN.

### 4.4 France

(U) The Association Francaise de Normalisation (AFNOR) is the French official organization for normalization/standardization and the French member body for ISO. It works with manufacturers, users, and administration. It promulgates international standards in France, chooses working groups in which France is to take an active part, manages French technical experts, and defines/coordinates the proposals they must put forward in discussions. The AFNOR role also includes giving information--it sends out literature on national and international standards and answers questions from manufacturers and users. AFNOR standards are classified according to the activity to which they relate. For example, Class Z corresponds to data processing. The Union Technique de l'Electricite (UTE) is the member of CENELEC

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<sup>8</sup> (U) *The OMNICON Index of Standards for Distributed Information and Telecommunication Systems*, OMNICON, 1987, UNCLASSIFIED.



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from France and an active participant in AFNOR for the development and exploitation of standards for electricity and electronics.

### 4.5 Germany

(U) The Deutsches Institut für Normung (DIN) is the official organization for standardization for the Federal Republic of Germany and Berlin (West) and is the member body of ISO and CEN.

### 4.6 Netherlands

(U) The Nederlands Normalisatie-Instituut (NNI) is the ISO member body for the Netherlands. When ISO or CCITT standards are translated or modified, they are issued by NNI as NENs. For example, NEN-ISO 3309 is a translation of an ISO HDLC standard.

### 4.7 United Kingdom

(U) The British Standards Institute (BSI) is the UK member of ISO and the recognized body for the preparation and promulgation of British national standards.

### 4.8 United States

(U) The American National Standards Institute (ANSI) is the US member of ISO and a US clearinghouse for voluntary standards.

(U) Table F-4 identifies ANSI and other standards bodies<sup>9</sup> in the United States, both civil and military, that recommend, develop, manage, and maintain technical standards for communications and information processing.

(NU) Table F-5 identifies all the current Technical Committees (TCs) currently active in ANSI for Information Processing Systems (X3).

### 4.9 Standards Bodies in Non-NATO Nations

(U) Finland is represented in ISO and IEC by the Suomen Standardisoimisliitto (SFS).

(U) Sweden is represented in ISO by the Standardiseringskommisionen i Sverige (SIS). SIS coordinates with the Swedish Electrical Commission (SEK) and the Swedish Mechanical Standardization (SMS).

(U) The Irish member of ISO and CEN is the National Standards Authority of Ireland (NSAI), an autonomous unit of the Institute for Industrial Research and Standards (IIRS).

(U) The Japanese Industrial Standards Committee (JISC) oversees the Japanese Industrial Standards (JISs). The JISC is attached to the Agency of Industrial Science and Technology, Ministry of International Trade and Industry (MITI). JISC members include representatives from manufacturers, consumers, and knowledgeable individuals. Texts of standards approved by the relevant Minister and announced in the Government Gazette are published by the Japanese Standards Association (JSA). An Information Technology Standardization Technology Committee (INSTAC) within the Japanese Standards Association, the Telecommunications Technology Committee (TTC), the Interoperability Database System Development Project, and the Interoperability Association for Information Processing (INTAP) were established in 1985 to promote interoperability technology. INTAP has the responsibility to develop functional standards and conformance tests for OSI in Japan.

(U) The Saudi Arabian Standards Organization (SASO) represents Saudi Arabia in ISO and IEC.

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<sup>9</sup> (U) Similar tables need to be developed for standards bodies in other nations. Additional contributions will be included in future editions of this working paper.

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*Table F-4. (U) Responsibilities for Communications and Information Processing in US Standards Bodies*

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| U.S. Organization   | Title  | Standards Responsibility   |
|---|--|--|
| ANSI X3<br>X3S3<br>X3S3.1<br>X3S3.2<br>X3S3.3<br>X3S3.4<br>X3S3.5<br>X3S3.7<br>X3T1<br>X3T2<br>X3T5<br>X3T5.1<br>X3T5.4<br>X3T5.5<br>X3T9<br>X3T9.2<br>X3T9.3<br>X3T9.5<br>X3V1 | Information Processing<br>Technology Committee (TC) on Data Communications<br>Task Group on Data Communications Planning<br>Task Group on Communications Vocabulary<br>Task Group on Network & Transport Layers<br>Task Group on Data Link Layer<br>Task Group on Quality of Service<br>Task Group on Public Data Network Access<br>Technology Committee on Data Encryption<br>Technology Committee on Data Exchange<br>Technology Committee on OSI<br>OSI Architecture; Reference Model<br>Task Group on OSI Management Protocols<br>Session, Presentation, Application--Upper 3 Layers<br>Technology Committee on I/O Interface<br>Task Group on lower level interface<br>Task Group on device level interface<br>Task Group on local distribution data interface<br>Office and Publishing Systems | Devel of US OSI standards; input to ISO JTC1/SC21<br>General standardization efforts<br>Data transmission vocabulary<br>Directory, management, routing, ISDN<br>Protocols, procedures, & management; X.25<br>Nomenclature, presentation & performance measurement<br>ISDNs, gateways (X3.100, X.25, X.75, X.32)<br><br>Development of US OSI standards; input to ISO JTC1/SC21<br>FDTs; Conf Testing; Sec. Open Distributed Proc<br>Management, MIS, directory service<br>CL mode, VT, ANS.1 |
| USCCITT<br>NC<br>GS-A<br>SG-B<br>SG-C<br>SG-D<br>JWP  | US Organization for CCITT<br>National Committee<br>Telecommunication policies & services<br>WATTC-1988<br>Worldwide telephone network<br>Data and ISDN<br>Joint Working Party on ISDN  |  |
| IEEE<br>802<br>Ad-hoc<br>802.1<br>802.1A<br>802.1B<br>802.2 x<br>802.3<br>802.4<br>802.5<br>802.6<br>802.7<br>802.8<br>802.10<br>P1003  | Institute for Electrical and Electronic Engineering<br>Committee on Local Area Networks<br>Study Group on Functional Requirements<br>Overall architecture of LANs/internetwork<br>Glossary<br>Network Management<br>Logical link control<br>CSMA/CD<br>Token-passing bus access methodology<br>Token ring access methodology<br>Metropolitan area networks<br>Broadband tech adv group<br>Fiber-optics tech adv group<br>Secure local area networks<br>POSIX   |  |
| COS<br>X/OPEN<br>NIST<br>Workshops  | Corporation for Open Systems<br>X/OPEN<br>National Institute for Standards & Technology<br>Implementation Workshops  | Promote OSI; conformance testing<br>Promote portability and use of OSI<br>Standards development and coordination; conformance<br>Develop design-to functional profiles   |
| ASD(C3I)<br>DASD C3<br>T&TC3<br>IS<br>ASD(P&L)<br>S&DS  | Asst Sec Def C3I<br>Deputy Assistant Secretary of Defense C3<br>Theater and Tactical C3<br>Information Systems<br>Production and Logistics<br>Standardization & Data Management  | Interoperability of C3 systems<br>DoD transition to GOSIP<br><br>Distribution of standards   |

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*Table F-4. (U) (Continued)*

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| U.S. Organization  | Title   | Standards Responsibility  |
|--|---|---|
| DIA<br>DCA<br>DCS Organ<br>DCEC<br>JTC3A<br>JINTACCS<br>JMSWG<br>FSSG<br>JITF<br>JITC<br>JDSSC<br>WIS<br>JSC<br>PSSG<br>TP               | Defense Intelligence Agency<br>Defense Communications Agency<br>Defense Communications System Organization<br>Defense Communications Engineering Center<br>Joint Tactical C3 Agency<br>Joint Interoperability Tactical C2 Systems Program<br>JTIDS Message System WG<br>Fire Support Subgroup<br>Joint Interface Test Force<br>Joint Interoperability Test Center<br>Joint Data Systems Support Center<br>WWMCCS Information System<br>Joint Steering Committee<br>Protocol Standards Steering Group<br>Technical Panel | DoD Executive Agent for data comm protocol standards<br><br>Lead on standards for long haul communications<br>Lead for tactical communication technical standards<br>Joint message standards<br>TADIL J; J-Series messages and protocols<br>K-Series messages (and protocols)<br>Testing Joint interfaces<br>Testing Joint interfaces<br><br>Develop common interoperability standards<br>Primary advisory body for standards policy issues |
| DLA<br>DMSSO<br>NSA<br>JCS<br>J-6J<br>MCEB   | Defense Logistics Agency<br>Defense Materiel Specifications & Standards Office<br>National Security Agency<br>Joint Tactical C3 Systems Division<br>Military Communications-Electronics Board   | Ensure interoperability of TDSs<br>Coordinate representation to international standards bodies  |
| USA<br>DISC4<br>SAIS-ADO<br>DCSOPS<br>PEO CCS<br>PEO Comm<br>AMC<br>ICP-M<br>CECOM<br>ISD<br>TRADOC<br>CACDA<br>SIGCEN<br>USAISC<br>ISEC | Director, Information Systems for C4<br>RSI-Rationalization, Standards, & Interoperability<br>International RSI<br>PEO Command & Control Systems<br>PEO Communications<br>Army Materiel Command<br>Office of International Cooperative Programs<br>Communications & Electronics Command<br>Interoperability & Standardization Directorate<br>Training and Doctrine Command<br>Combined Arms Combined Development Activity<br>Signal Center<br>Information Systems Command<br>Information Systems Engineering Command    | Technical requirements, interoperability<br>Interoperability and standards<br>Operational requirements, interoperability<br>Interoperability of Army Tactical C2 Systems<br>Interoperability of Communications Systems<br>Materiel standards<br><br>Technical support and POC for standards<br><br>Operational and procedural standards<br>Communications standards   |
| USN<br>Info MGT<br>ASN RE&S/C3I&Space<br>CNO/SPAWAR<br>CNO/Space,C2<br>OP-945<br>NAVDAC  | Information Management<br>C3I and Space<br>Space & Naval Warfare Systems Command<br>Space & C2<br>Information Management Support<br>Naval Data Automation Command   |   |
| USMC<br>MCRDAC<br>SI<br>MCCDC-WC<br>D4 Div<br>P&I  | Systems Integration<br>Warfighting Center<br>Planning and Interoperability  | Standards<br>Requirements<br>Standards coordination   |
| USAF<br>AQ/DAS C4<br>ACS C4 Sys<br>AF Comm Cmd<br>AFSC<br>ESD<br>RADC<br>TAC<br>DRI  | Acquisitions-C4<br>C4 Systems<br>Communications Command<br>Air Force Systems Command<br>Electronic Systems Division<br>Rome Air Development Center<br>Tactical Air Command  |   |

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*Table F-5. (U) ANSI X3 Technical Committees*

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|       |                               |       |                                   |
|-------|-------------------------------|-------|-----------------------------------|
| X3A1  | Optical Character Recognition | X3J11 | C                                 |
| X3B5  | Digital Magnetic Tape         | X3J12 | DIBOL                             |
| X3B6  | Instrumentation Tape          | X3J13 | LISP                              |
| X3B7  | Magnetic Disks                | X3J14 | FORTH                             |
| X3B8  | Flexible Disk Cartridges      | X3J15 | DATABUS                           |
| X3B9  | Paper/Forms Layout            | X3K1  | Computer Documentation            |
| X3B10 | Credit/Identificaton Cards    | X3K5  | Vocabulary                        |
| X3B11 | Optical Digital Data Disks    |       |                                   |
| X3H2  | Database                      | X3L2  | Codes & Character Sets            |
| X3H3  | Computer Graphics             | X3L8  | Data Representation               |
| X3H4  | Information Resource          | X3S3  | Data Communications               |
| X3J1  | PL/1                          | X3T1  | Data Encryption                   |
| X3J2  | BASIC                         | X3T2  | Data Interchange                  |
| X3J3  | FORTTRAN                      | X3T3  | Open Distributed Processing       |
| X3J4  | COBOL                         | X3T5  | Open Systems Interconnection      |
| X3J7  | APT                           | X3T9  | I/O Interface                     |
| X3J9  | PASCAL                        |       |                                   |
| X3J10 | APL                           | X3V1  | Text: Office & Publishing Systems |

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F-20

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**APPENDIX G**

**STATUS OF OPEN SYSTEMS STANDARDS  
DEVELOPMENT IN ISO/IEC**

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**STATUS OF OPEN SYSTEMS STANDARDS  
DEVELOPMENT IN ISO/IEC**

**1. INTRODUCTION**

(U) This appendix provides an overview of the work plans of selected technical committees and working groups in ISO/IEC. The purpose is to illustrate how rapidly international civil standards are being progressed in those areas applicable to ATCCIS. A compilation of ISO/IEC and CCITT standards relevant to ATCCIS is provided in Appendix D (by layer of the OSI Reference Model) and Appendix E (numerical listing). An overview of international standards bodies and their responsibilities for standards development is provided in Appendix F.

**2. INFORMATION PROCESSING STANDARDS (JTC1)**

(U) Table G-1 provides an overview of the work plans for the major working groups of ISO/IEC JTC1 SC21, whose responsibility is Information Retrieval, Transfer, and Management for OSI. The standards bodies included in this table are:

- WG1 on OSI Architecture
- WG3 on Database
- WG4 on OSI Management
- WG5 on Specific Application Services
- WG6 on Session and Presentation Layers
- WG7 on Open Distributed Processing.

(U) The symbols used in Table G-1 show the progress of a standard from its submission as a working draft (circulated to SC21), through the intermediate stages of committee draft (CD) or draft proposal (DP) and draft international standard (DIS), in becoming an international standard. In many areas, balloting as an international standard is planned for 1992 or earlier.

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*Table G-1. (U) Status of Standards Development in ISO/IEC JTC1*

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| WG1 OSI ARCHITECTURE                                 | CURRENT STANDARD | 1990      | 1991      | 1992      |
|--|------------------|-----------|-----------|-----------|
| Database Management Systems                          | ?                |           |           |           |
| OSI Basic Reference Model                            | ISO 7498         | □         | ▣         | ■         |
| Connectionless data transmission                     | AD1              |           |           |           |
| Multipeer data transmission (MPDT)                   | DAD2             | SUSPENDED |           |           |
| OSI Service conventions                              | TR 8509          | □         | ▣         | ■         |
| Security architecture                                | ISO 7498-2       |           |           |           |
| Naming and addressing                                | DIS 7498-3       |           |           |           |
| Formal Description Techniques (FDTs)                 | -                |           |           |           |
| Estelle  | IS 9074          |           |           |           |
| LOTOS  | ISO 8807         |           |           |           |
| Conformance Testing Methodology and Framework        | DIS 9646         |           |           |           |
| Part 1: General aspects                              | DIS 9646-1       | ■         |           |           |
| Part 2: Abstract test suite specifications           | DIS 9646-2       | ■         |           |           |
| Part 3: TTCN   | DIS 9646-3       |           | ■         |           |
| Part 4: Test realisation                             | DIS 9646-4       | ■         |           |           |
| Part 5: Requirements on Test Labs. and clients       | DIS 9646-5       | ■         |           |           |
| Part 6: Multipart test tools and methods             | DP 9646-6        | □         | ▣         | ■         |
| Architectural Semantics for FDTs                     | SC21 N5116       | □         | ▣         | ■         |
| Guidelines for Application of Estelle, LOTOS and SDL | DTR 10167        | ▣         |           |           |
| Security Frameworks in Open Systems                  | DP 10181         | □ - - - - | ▣ - - - - | ■ - - - - |

| WG3 DATABASE                                   | CURRENT STANDARD | 1990      | 1991 | 1992 |
|--|------------------|-----------|------|------|
| Database Languages:                            | -                |           |      |      |
| NDL  | ISO 8907         |           |      |      |
| SQL  | ISO 9075         |           |      |      |
| SQL Addendum 1                                 | AD1              |           |      |      |
| SQL 2  | CD 9075.2        | ▣         |      | ■    |
| SQL 3  | WD 9075.3        |           | □    | □    |
| Information Resource Dictionary System (IRDS): | -                |           |      |      |
| Framework                                      | IS 10027         | ■         |      |      |
| Services Interface                             | SC21 N5147       | □         | □    | ▣    |
| Export/import                                  | SC21 N5137       | □         | □    | ▣    |
| Command language and panel interface           | DP 8800-1        | SUSPENDED |      |      |
| Support for SQL 1 with integrity enhancement   | ISO 9075         |           |      |      |
| Reference Model of Data Management             | CD 10032.2       | □         | ▣    | ■    |
| Technical report on model of data magement     | SC21-4119        |           | □    | □    |
| Remote Database Access (RDA)                   | DP 9579-1        |           | ▣    | ■    |
| SQL specialization                             | DP 9579-2        |           | ▣    | ■    |
| SQL 2 specialization                           | WDAM-1           |           | □    | □    |
| Tutorial                                       | SC21 N3343       |           | □    | ▣    |

Key: □ WD                      ▣ DIS  
 □ DP/CD                      ■ ISO

Sources: Alan Paton, "Standard Status - SC21 Information Retrieval, Transfer, and Management for OSI," *OSN: The Open System Newsletter*, Volume 2, Issue 5, Technology Appraisals, Limited, London, July 1988 (used with permission); work plans provided in SC21 documents through July 1990; and private communication with Alan Paton, 19 July 1990.



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Table G-1. (U) (Continued)

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| WG4 OSI MANAGEMENT  | CURRENT STANDARD | 1990  | 1991  | 1992                                |
|---|------------------|---|---|-------------------------------------|
| OSI Management  |                  |   |   |                                     |
| OSI systems management tutorial   | SC21 N 4942      | <input type="checkbox"/>                          |   |                                     |
| OSI Management Information Service:   |                  |   |   |                                     |
| System Management (SM) Overview   | DIS 10040        | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/>               |                                     |
| Structure of management information   | DIS 10165        | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/>               |                                     |
| Common information management service (CMIS)                                    | ISO 9595         | <input checked="" type="checkbox"/>               |   |                                     |
| Addendum 1,2: Cancel Get, Add/Remove  | DAD 1,2          | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/>               |                                     |
| Common info management protocol (CMIP)  | ISO 9596         | <input checked="" type="checkbox"/>               |   |                                     |
| Addendum 1,2: Cancel Get, Add/Remove  | WDAD 1,2         | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/>               |                                     |
| SM: Configuration management  | DIS10164-1,2,3   | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/>               |                                     |
| SM: Fault management  | DIS 10164-4-6    | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/>               |                                     |
| SM: Accounting management   | DIS 10164-10     | <input type="checkbox"/>                          | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/> |
| SM: Performance management  | DIS 10164-11     | <input type="checkbox"/>                          | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/> |
| SM: Security management   | DIS 10164-7,8,9  | <input type="checkbox"/>                          | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/> |
| SM: Software management   | DIS 10164-X      |   | <input type="checkbox"/>                          | <input type="checkbox"/>            |
| OSI The Directory   | ISO 9594         |   |   |                                     |
| Part 1: Overview  | ISO 9594-1       |   |   |                                     |
| Part 2: Information framework   | ISO 9594-2       |   |   |                                     |
| Part 3: Abstract service definition   | ISO 9594-3       |   |   |                                     |
| Part 4: Distributed operations  | ISO 9594-4       |   |   |                                     |
| Part 5: Protocol specification  | ISO 9594-5       |   |   |                                     |
| Part 6: Selected attribute types  | ISO 9594-6       |   |   |                                     |
| Part 7: Selected object classes   | ISO 9594-7       |   |   |                                     |
| Part 8: Authentication-framework  | ISO 9594-8       |   |   |                                     |
| Part 9: DIT structure and naming  | WD 9594-9        | <input type="checkbox"/> <input type="checkbox"/> | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/> |
| Part 10: Replication and knowledge management and addendum to parts 2, 3, 4, 5. | WD 9594-10       | <input type="checkbox"/> <input type="checkbox"/> | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/> |
| Addendum to Parts 1-7; support of nameform 2                                    | PCDAMs           |   | <input type="checkbox"/> <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Addendum to Parts 2, 5, 6, 7: schema  | PCDAMs           | <input type="checkbox"/> <input type="checkbox"/> | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/> |
| Addendum to Parts 2,3, 4, 5: access control                                     | PCDAMs           | <input type="checkbox"/>                          | <input checked="" type="checkbox"/>               | <input checked="" type="checkbox"/> |

| WG7 OPEN DISTRIBUTED PROCESSING               | CURRENT STANDARD | 1990                         | 1991 | 1992 |
|---|------------------|------------------------------|------|------|
| Open Distributed Processing (Reference Model) | SC21 N3192       | (CD text expected June 1994) |      |      |

Key:  WD  DIS  
 DP/CD  ISO

Sources: Alan Paton, "Standard Status - SC21 Information Retrieval, Transfer, and Management for OSI," *OSN: The Open System Newsletter*, Volume 2, Issue 5, Technology Appraisals, Limited, London, July 1988 (used with permission); work plans provided in SC21 documents through July 1990; and private communication with Alan Paton, 19 July 1990.

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Table G-1. (U) (Continued)

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| WG5 SPECIFIC APPLICATION SERVICES                    | CURRENT STANDARD | 1990      | 1991 | 1992 |
|--|------------------|-----------|------|------|
| Operating System Command and Response Language       | DP xxxx          | INACTIVE  |      |      |
| OSCRL Overview                                       | ?                |           |      |      |
| OSCRL Specification                                  | ?                |           |      |      |
| Virtual Terminal Services and Protocols (VT)         | -                |           |      |      |
| Basic class VT service                               | ISO 9040.2       | ■         |      |      |
| Add. 1 on extended facility set                      | AD 1             | ■         |      |      |
| Add. 2 on additional functional units                | PDAD 2           | ☐         | ■    |      |
| Basic class VT protocol                              | ISO 9041.2       | ■         |      |      |
| Add. 1 on extended facility set                      | AD1              | ■         |      |      |
| Add. 2 on additional functional units                | PDAD 2           | ☐         | ■    |      |
| Register of VT profiles                              | DIS 9834-4       | ☐ - - ☐   |      | ■    |
| Register of VT control objects                       | DIS 9834-5       | ☐ - - ☐   |      | ■    |
| File Transfer, Access and Management (FTAM)          | ISO 8571         |           |      |      |
| Part 1: General description                          | ISO 8571-1       |           |      |      |
| Part 2: Virtual filestore                            | ISO 8571-2       |           |      |      |
| Part 3: File service definition                      | ISO 8571-3       |           |      |      |
| Part 4: File protocol specification                  | ISO 8571-4       |           |      |      |
| FTAM overlapped access - Parts 1,2,3,4,5             | PDAD 2           | □         | ☐    | ■    |
| FTAM Filestore management- Parts 1,2,3,4,5           | DAM1             |           | ☐    |      |
| FTAM PICS proforma                                   | ISO 8571-5       | ■         |      |      |
| Job Transfer and Manipulation (JTM)                  | -                |           |      |      |
| Concepts and Services                                | ISO 8831         |           |      |      |
| Basic class protocol                                 | ISO 8832         |           |      |      |
| Full class protocol                                  | DAM1             | ☐         |      | ■    |
| Checkpointing addendum                               | ?                | INACTIVE  |      |      |
| Registration of document types                       | DIS 9834-2       | ☐ - - ☐   |      | ■    |
| Transaction Processing (TP)                          | DIS 10026        |           |      |      |
| Model  | DIS 10026-1      | ☐         |      | ■    |
| Service  | DIS 10026-2      | ☐         |      | ■    |
| Protocol   | DIS 10026-3      | ☐         |      | ■    |
| Terminal Management (TM)                             | CD 10184         |           |      |      |
| Model  | CD 10184-1       | □         | ☐    | ■    |
| Service  | WD 10184-2       | □ - - - □ | ☐    | ■    |
| Protocol   | WD 10184-3       | □ - - - □ | ☐    | ■    |
| Conformance Test Suites for FTAM                     | DIS 10170        |           |      |      |
| Test suite structure and purpose                     | DIS 10170-1      | ☐         |      | ■    |
| Abstract test suite                                  | WD 10170-2       | □         | ☐    | ■    |
| Abstract test suite embedded under FTAM              | WD 10170-3       |           | □    | □    |
| Presentation abstract test suite embedded under FTAM | WD 10170-4       |           | □    | □    |
| Session abstract test suite embedded under FTAM      | WD 10170-5       |           | □    | □    |

Key: □ WD      ☐ DIS  
 □ DP/CD      ■ ISO

Sources: Alan Paton, "Standard Status - SC21 Information Retrieval, Transfer, and Management for OSI," *OSN: The Open System Newsletter*, Volume 2, Issue 5, Technology Appraisals, Limited, London, July 1988 (used with permission); work plans provided in SC21 documents through July 1990; and private communication with Alan Paton, 19 July 1990.

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Table G-1. (U) (Continued)

**UNCLASSIFIED**

| WG6 OSI SESSION, PRESENTATION, AND APPLICATION SERVICE ELEMENTS | CURRENT STANDARD | 1990     | 1991 | 1992 |
|---|------------------|----------|------|------|
| Data Descriptive File for Information Interchange               | ISO 8211         |          |      |      |
| Upper Layer Architecture Addendum (ULA) to ISO 7498-1           | PDAD3            |          |      |      |
| Session Layer Services and Protocols:                           | -                |          |      |      |
| Service definition  | ISO 8326         | ■        |      |      |
| Protocol specification  | ISO 8327         | ■        |      |      |
| Formal description of session                                   | TR 9571, 72      |          |      |      |
| Symmetric sync addendum   | AD 1             | ■        |      |      |
| Unlimited user data addendum                                    | AD 2             | ■        |      |      |
| Session PICS proforma   | CD 8327-2        | ◻ ◻      | ■    |      |
| Presentation Layer Services and Protocols:                      | -                |          |      |      |
| Service definition  | ISO 8822         |          |      |      |
| Protocol specification  | ISO 8823         |          |      |      |
| Specification for ASN.1   | ISO 8824         |          |      |      |
| Addendum 1 to specifications for ASN.1                          | AD1              |          |      |      |
| Basic encoding rules for ASN.1                                  | ISO 8825         |          |      |      |
| Addendum 1 to basic encoding rules                              | AD 1             |          |      |      |
| Symmetric synchronisation                                       | WDAM 2           | ◻ ◻      | ◻    | ■    |
| PICS proforma   | DIS 8823-2       | ◻        |      | ■    |
| Registration Authority Procedures                               | DIS 9834         |          |      |      |
| Part 1: General procedures                                      | DIS 9834-1       | ◻ --- ◻  | ■    |      |
| Part 2: OSI document types                                      | DIS 9834-2       | ◻ --- ◻  | ■    |      |
| Part 3: Object identifies component values                      | ISO 9834-3       | ■        |      |      |
| Part 4: VTE profiles  | DIS 9834-4       | ◻ --- ◻  | ■    |      |
| Part 5: VT control objects                                      | DIS 9834-5       | ◻ --- ◻  | ■    |      |
| Association Control Service Element (ASCE):                     | -                |          |      |      |
| Application layer structure (ALS)                               | ISO 9545         | ■        |      |      |
| Addendum for connectionless (CL) mode                           | WDAD 1           | ◻        | ◻    | ◻    |
| Service definition for ACSE                                     | ISO 8649         |          |      |      |
| Addendum on authentication                                      | AD 1             | ■        |      |      |
| Addendum on A-context management                                | AM 2             | ■        |      |      |
| Commitment concurrency and recovery service (CCR)               | ISO 9804.2       | ■        |      |      |
| Addendum on enhancements  | CDAD 1           | ◻        | ◻    | ■    |
| Addendum on restart   | WDAD 3           |          | ◻    | ◻    |
| Specification of Protocols for ACSE:                            | -                |          |      |      |
| Protocol specification for ACSE                                 | ISO 8650         |          |      |      |
| Addendum covering Authentication                                | DAD 1            | ■        |      |      |
| Addendum covering A-context management                          | AM 2             |          |      |      |
| Protocol amendment for PICS                                     | DIS 8650-2       | ◻        | ■    |      |
| Protocol amendment for application titles                       | DP 9834-6        | ◻        |      | ■    |
| Commitment concurrency and recovery protocol (CCR)              | ISO 9805.2       | ■        |      |      |
| Add. for checkpointing to CCR global restart points             | AD 1             |          |      |      |
| Presentation of Numerical Values in Character Strings           | ?                | INACTIVE |      |      |
| Conformance Test Suites:  | DIS 10168        |          |      |      |
| Session Part 1: Test suite structure and purposes               | DIS 10168-1      | ◻        | ■    |      |
| Session Part 2: Generic test suite                              | WD 10168-2       |          |      | ◻    |
| Session Part 3: Abstract test suite for CS Method               | WD 10168-3       |          | ◻    | ◻    |
| Presentation Part 1: test suite structure and purpose           | SC21 N5019       | ◻ ◻      | ■    |      |
| ACSE Part 1: Test suite structure and purpose                   | DIS 10169-1      |          | ■    |      |
| Session CL Protocol to Provide CL Mode                          | ISO 9548         |          |      |      |
| CL Addendum to the Session Service                              | ISO 8326 AD3     |          |      |      |
| CL Addendum to the Presentation Service                         | DIS 8822 AD1     | ■        |      |      |
| CL Presentation Protocol  | ISO 9576         | ■        |      |      |

Key: ◻ WD                          ◻ DIS  
          ◻ DP/CD                     ■ ISO

Sources: Alan Paton, "Standard Status - SC21 Information Retrieval, Transfer, and Management for OSI," OSN: *The Open System Newsletter*, Volume 2, Issue 5, Technology Appraisals, Limited, London, July 1988 (used with permission); work plans provided in SC21 documents through July 1990; and private communication with Alan Paton, 19 July 1990.

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G-6

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**APPENDIX H**

**INTERNATIONAL MILITARY AND OTHER  
STANDARDS FOR OPEN SYSTEMS**

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## INTERNATIONAL MILITARY AND OTHER STANDARDS BASED ON OSI STANDARDS OR USED IN OPEN SYSTEMS PROFILES

### I. NATO STANDARDS

#### A. OSI STANAGs

- STANAG 4250 ♦ NATO Reference Model for OSI, NATO UNCLASSIFIED
- STANAG 4250-1 ♦ Part 1--General Description, Revised Draft, May 1990, NATO UNCLASSIFIED
- STANAG 4250-2 ♦ Part 2--Security, Draft (SANISI Document), NATO SECRET
- STANAG 4250-3 ♦ Part 3--Naming and Addressing, Draft (Working Paper), NATO UNCLASSIFIED
- STANAG 4250-4 ♦ Part 4--Management, Draft (Working Document), NATO UNCLASSIFIED
- STANAG 4250-5 ♦ Part 5--Military Features, Draft (Working Document), NATO UNCLASSIFIED
- STANAG 4251 ♦ NATO Reference Model for OSI - Layer 1 (Physical Layer) Service Definition, Draft, 13 July 1990, NATO UNCLASSIFIED
- STANAG 4252 ♦ NATO Reference Model for OSI - Layer 2 (Data Link Layer) Service Definition, Draft, 6 July 1990, NATO UNCLASSIFIED
- STANAG 4253 ♦ NATO Reference Model for OSI - Layer 3 (Network Layer) Service Definition, Draft, July 1990, NATO UNCLASSIFIED (Appendix B is NATO CONFIDENTIAL)
- STANAG 4254 ♦ NATO Reference Model for OSI - Layer 4 (Transport Layer) Service Definition, Draft, July 1990, NATO UNCLASSIFIED
- STANAG 4255 ♦ NATO Reference Model for OSI - Layer 5 (Session Layer) Service Definition, Draft, 12 April 1990, NATO UNCLASSIFIED
- STANAG 4256 ♦ NATO Reference Model for OSI - Layer 6 (Presentation Layer) Service Definition, Draft, 19 January 1990, NATO UNCLASSIFIED
- STANAG 4257 ♦ NATO Standard Profile on Military Message Handling System (MMHS), Draft, 16 February 1990, NATO UNCLASSIFIED
- STANAG 4258 ♦ Specification of ASN.1, Draft, 15 January 1990, NATO UNCLASSIFIED
- STANAG 4259 ♦ Specification of Basic Encoding Rules for ASN.1, Draft, 15 January 1990, NATO UNCLASSIFIED
- STANAG 4261 ♦ NATO Reference Model for OSI - Layer 1 (Physical Layer) Protocol Specification, Draft, 13 July 1990, NATO UNCLASSIFIED
- STANAG 4262 ♦ NATO Reference Model for OSI - Layer 2 (Data Link Layer) Protocol Specification, Draft, 6 July 1990, NATO UNCLASSIFIED
- STANAG 4263 ♦ NATO Reference Model for OSI - Layer 3 (Network Layer) Protocol Specification, Draft, July 1990, NATO UNCLASSIFIED
- STANAG 4264 ♦ NATO Reference Model for OSI - Layer 4 (Transport Layer) Protocol Specification, Draft, July 1990, NATO UNCLASSIFIED

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- STANAG 4265 ♦ NATO Reference Model for OSI - Layer 5 (Session Layer) Protocol Specification, Draft, 12 April 1990, NATO UNCLASSIFIED
- STANAG 4266 ♦ NATO Reference Model for OSI - Layer 6 (Presentation Layer) Protocol Specification, Draft, 19 January 1990, NATO UNCLASSIFIED
- STANAG xxxx ♦ NATO Standard Profile on R.131(M), Draft, 1989, NATO UNCLASSIFIED
- STANAG xxxx ♦ NATO Standard Profile on TC 111(M) - Connection-Mode Transport Service Over Connection-Mode Network Service - Permanent Access to a Packet Switched Data Network (Military), Draft, Version 1.3, 13 July 1990, NATO UNCLASSIFIED
- STANAG xxxx ♦ NATO Standard Profile on TA 51(M) - Interface Between a Reference End System That Provides the Connection-Mode Transport Service (CO-TS) Over the Connectionless-Mode Network Service (CL-NS) and a CSMA/CD LAN of Types 10Base2 and 10Base5, Draft, Version 2.0, 23 July 1990, NATO UNCLASSIFIED

### B. OTHER STANAGs

- STANAG 4146 Interim Specifications for Input/Output Interfaces in NATO Naval Data Handling Equipment
- STANAG 4153 Standard Specification for an Asynchronous Serial Data Interface for Point to Point Connections and for Connection to Data Networks in NATO Naval Systems
- STANAG 4156 Standard Specification for a Serial Data Interface for Synchronous Connections to a Data Network
- STANAG 4175 Multi-Functional Information Distribution System
- STANAG 4197 Modulation and Coding Characteristics that must be Common to Assure Interoperability of 2400 BPS Linear Predictive Encoded Digital Speech Transmitted Over HF Radio Facilities
- STANAG 4198 Parameters and Coding Characteristics That Must Be Common to Assure Interoperability of 2400 BPS Linear Predictive Encoded Digital Speech
- STANAG 4199 Uniform System of Exchange of Materiel Management Data
- STANAG 4202 Transmission Envelope Characteristics for High Reliability Data Exchange between Land Tactical Data Processing Equipment Over Single Channel Radio Links
- STANAG 4203 Technical Standards for Single Channel HF Radio Equipment
- STANAG 4204 Technical Standards for Single Channel VHF Radio Equipment
- STANAG 4205 Technical Standards for Single Channel UHF Radio Equipment
- STANAG 4206 The NATO Multichannel Tactical Digital Gateway-System Standards
- STANAG 4207 The NATO Multi-Channel Tactical Digital Gateway - Multiplex Group Framing Standards
- STANAG 4208 The NATO Multi-Channel Tactical Digital Gateway - Signalling Standards
- STANAG 4209 The NATO Multi-Channel Tactical Digital Gateway - Standards for Analogue to Digital Conversion of Speech Signals
- STANAG 4210 The NATO Multi-Channel Tactical Digital Gateway - Cable Link Standards
- STANAG 4211 The NATO Multi-Channel Tactical Digital Gateway - System Control Standards
- STANAG 4212 The NATO Multi-Channel Tactical Digital Gateway - Radio Relay Link Standards
- STANAG 4213 The NATO Multi-Channel Tactical Digital Gateway - Data Transmission Standards
- STANAG 4214 International Routing and Directory for Tactical Communication Systems
- STANAG 4231 Digital Interoperability Between UHF Tactical Satellite Communications Terminals
- STANAG 4232 Digital Interoperability Between SHF Tactical Satellite Communications Terminals
- STANAG 4233 Digital Interoperability Between EHF Tactical Satellite Communications Terminals

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STANAG 4234 Radio Frequency Environmental Conditions Affecting the Design of Materiel for Use by NATO Forces

STANAG 4245 Secure and ECM Resistant HF Low Speed Digital Data Communications System

STANAG 4246 Have Quick and UHF Secure Jam Resistant Communications Equipment

STANAG 4249 NATO Multi-Channel Tactical Digital Gateway - Data Transmission Standards (Packet Switching Service)

STANAG 4250 The NATO Reference Model for Open Systems Interconnection - Overview

STANAG 4261 The NATO Reference Model for Open Systems Interconnection- Layer 1 (Physical Layer) Protocol Specification

STANAG 4262 The NATO Reference Model for Open Systems Interconnection - Layer 2 (Data Link Layer) Protocol Specification

STANAG 4263 The NATO Reference Model for Open Systems Interconnection - Layer 3 (Network Layer) Protocol Specification

STANAG 4271 ECM Resistant Digital Traffic Exchange Between Tactical Satellite Communications Terminals

STANAG 4285 Characteristics of a 1200/2400 Bits Per Second Single Tone Modulator/Demodulator for HF Radio Links

STANAG 4290 NATO Multi-Channel Tactical Digital Gateway - Cable Link (Optical) Standards

STANAG 4291 Modulation and Coding Characteristics that must be Common To Assure Interoperability of 2400 BPS Wireline Modems for Use in Narrow-Band Secure Voice Systems

STANAG 4292 Standards to Achieve Communications Between Tactical Combat Net Radio Equipment Designed to STANAG 4202 and Frequency Hopping Radios Operating in the Same VHF Band

STANAG 4295 Significant Data and Telegraph Signalling Conditions

STANAG 5000 Interoperability of Tactical Digital Facsimile Equipment

STANAG 5004 Military Characteristics for Field Telephone Sets (Minimum Standard)

STANAG 5009 (Exact Title Unknown - Relates to Naval Gunfire Support Using HF Radio)

STANAG 5018 NATO Manual Interface Between the Manual Switched Telecommunications Systems of the Combat Zone

STANAG 5020 Interoperability of Aircraft UHF Multi-Frequency Transceiver Installation and Compatible Ground Transmitters and Receivers

STANAG 5026 Military Characteristics for Facsimile Equipment To Meet Meteorological Requirements

STANAG 5028 Significant Telegraph Signalling Conditions in Automatic Telegraphy [Morse and International Alphabet (IA) No. 2]

STANAG 5030 Single and Multichannel VLF and LF On-Line Broadcast and Off-Line OOK Systems

STANAG 5031 Introduction of Modern Audio Equipment for Naval HF-MF and LF Shore-to-Ship Broadcasts

STANAG 5032 HF Single Sideband Single Channel Voice Communications (exact title unknown)

STANAG 5035 Introduction of an Improved System for Maritime Air Communications on HF, LF and UHF

STANAG 5036 Parameters and Practices for the Use of the NATO 7-Bit Code

STANAG 5038 Interoperability of Ship UHF Transmitting and Receiving Systems

STANAG 5040 NATO Automatic and Semi-Automatic Interfaces Between the National Switched Telecommunications Systems of the Combat Zone and Between These Systems and the NICS from 1979 to the 1990's



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STANAG 5501 Point-to-Point Digital Data Link - Link 1  
STANAG 5504 Tactical Data Link for the Control of Aircraft - Link 4  
STANAG 5505 NATO Standard Bit Fields, Bit Field Fillers and Codes  
STANAG 5506 Link 6 SAM/NADGE Link  
STANAG 5507 Link 7 Airspace/Air Traffic  
STANAG 5510 Maritime Tactical Data Exchange - Link 10  
STANAG 5511 Tactical Data Exchange - Link 11  
STANAG 5514 Tactical Data Broadcasting - Link 14  
STANAG 5516 Tactical Data Exchange - Link 16  
STANAG 5550 NATO Standard Data Elements, Data Items and Codes  
STANAG 5601 Standards for Interface of NATO Data - Links 1, 11, 14, and TADIL B Through A Ship/Shore/Ship Buffer  
STANAG 5620 Standards for the Interoperability of ADP Fire Support Systems  
STANAG 5621 Standards for the Interoperability of NATO Land Combat and Combined Operations Systems  
STANAG 5622 Air Operations System  
STANAG 5623 Standards for Interoperability of Maritime Operations Systems

### C. OTHER NATO DOCUMENTS

ACP 127 Message Relay Procedures  
ACP 167(F) Glossary of Communications-Electronics Terms, NATO, August 1981, UNCLASSIFIED  
ADatP-2(D) NATO Glossary of Automatic Data Processing (ADP) Terms and Definitions, December 1985, NATO UNCLASSIFIED  
ADatP-3 (STANAG 5500) NATO Message Text Formatting Systems, Part IV, Catalog of Standard Field Formats, December 1986, NATO UNCLASSIFIED  
AM 96-1-4 Data Management, SHAPE, 30 October 1988, NATO UNCLASSIFIED  
Classification Guide NATO Network Security Information Classification Guide (NU), Version 1.0, TSGCEE SG9, February 1989, NATO RESTRICTED  
MC<sup>1</sup> 203/2 The Operational Requirements for the Interoperability of the Communications Between Different National Component Land Forces in the Combat Zone and the Communication Used in Provision of Air and Naval Support to These Forces  
MC 277 The Operational Requirements for the Interoperability of Tactical Communication Systems for Use by the NATO Nations in the Land Combat Zone - Post 1985  
MC 283 The Military Police for ECCM Applied to Tactical Communications in the Combat Zone  
MC 284 The NATO Military Requirement for ECM Resistant and Secure Communications (NR)  
NIMP NATO Interoperability Management Plan (NIMP), Third Endorsement Edition, ADSIA-RCU-D/1 (Revised), Allied Data Systems Interoperability Agency, 1 July 1988, NATO UNCLASSIFIED  
NIPD Vol. 1 NATO Interoperability Planning Document (NIPD), Volume 1, Introduction to Information Systems Interoperability Including the Allied Data Systems Interoperability Agency and the Organization of and Coordination Among NATO

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<sup>1</sup> MC: Military Characteristic

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- Bodies Involved in NATO Common Interoperability Standards Development and Configuration Management, Second Draft, ADSIA-RCA-WP/76, 20 April 1990, NATO UNCLASSIFIED
- NIPD Vol. 2 NATO Interoperability Planning Document (NIPD), Volume 2, Formal Specification of Information Exchange Requirements, Draft, ADSIA-RCA-WP/72, February 1990, NATO UNCLASSIFIED
- NIPD Vol. 3 NATO Interoperability Planning Document (NIPD), Volume 3, Plan for Development of NATO Common Interoperability Standards (NCIS), Revised Draft, ADSIA-RCA-WP/73 (First Revise), February 1990, NATO UNCLASSIFIED
- NIPD Vol. 4 NATO Interoperability Planning Document (NIPD), Volume 4, NATO Common Interoperability Standards Configuration Management Plan (NCISCMP), Revised Draft, ADSIA-RCA-WP/32 (5th Revise), August 1989, NATO UNCLASSIFIED
- NIPD Vol. 5 NATO Interoperability Planning Document (NIPD), Volume 5, NATO Common Interoperability Standards Testing Concept, First Draft, ADSIA-RCA-WP/75, February 1990, NATO UNCLASSIFIED
- NIPD Vol. 6 NATO Interoperability Planning Document (NIPD), Volume 6, Documentation Plan for NATO Common Interoperability Standards, First Draft, ADSIA-RCA-D-15-90, 13 June 1990, NATO UNCLASSIFIED
- NOSA NATO OSI Security Architecture (NOSA), Ad Hoc Working Group on Security, TSGCEE SG9, Draft Version 2.1, March 1988, NATO UNCLASSIFIED
- NTIS Transition Strategy NATO Technical Interface Standards (NTIS) Transition Strategy, Fifth Edition, AC/259-D/1218(Revised), Conference of National Armaments Directors (CNAD), Tri-Service Group on Communications and Electronic Equipment (TSGCEE), NATO, Brussels, 30 November 1989, NATO UNCLASSIFIED
- SANISI Security Architecture for NATO Information Systems Interconnection (SANISI) (NU), Version 2.0, Ad Hoc Working Group on Security, TSGCEE SG9, AC/302(SG/9)D/53, 14 April 1989, NATO CONFIDENTIAL
- STAMINA 4.0 Standard Automated Message Interface for NATO ACCIS (STAMINA), Version 4.0, NACISA, April 1990, NATO UNCLASSIFIED
- TM-776 Data Management Standardisation for ACE ACCIS, TM-776, SHAPE Technical Centre, July 1985, NATO UNCLASSIFIED.

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H-6

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## II. U.S. MILITARY STANDARDS

DoD-STD-1467 Software Support Environment, 18 January 1985

DoD-STD-1700 Data Management Program, 28 September 1987

DoD-STD-1703 Software Product Standards, 12 February 1987

DoD-STD-1838 Common Ada Programming Support Environment (APSE) Interface Set (CAIS), 9 October 1987

DoD-STD-2167A Defense System Software Development

MIL-A-89007 Presentation Manager

MIL-C-28748A Connectors, Electrical, Rectangular, Rack and Panel, Solder-Type and Crimp-Type Contacts, February 1985

MIL-D-28000 Digital Representation for Communication of Product Data: IGES Application Subsets, 22 December 1987 with Amendment 1 of 20 December 1988 (used in CALS for computer-aided design and vector graphics (e.g., in technical manual illustrations, engineering diagrams)

MIL-D-28003 Digital Representation for Communication of Illustration Data: CGM Application Profile, 20 December 1988 (based on CGM; used in CALS for vector graphics in technical manual illustrations)

MIL-D-89000 Digital Terrain Elevation Data

MIL-HDBK-59 CALS Program Implementation Guide, 20 December 1988

MIL-HDBK-782 Software Support Environment Acquisition Implementation Guide for DoD-STD-2167, 29 February 1988

MIL-M-28001 Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text and Amendment 1, 1988 (based on ISO 8879, SGML)

MIL-R-28002 Requirements for Raster Graphics Representation in Binary Format, 20 December 1988 (based on GRP 4 Raster de facto industrial standards; used in CALS for raster-scanned images in engineering drawings and technical manual illustrations)

MIL-STD-188-114A Electrical Characteristics of Digital Interface Circuits, July 1984

MIL-STD-188C Military Communication System Technical Standards, November 1969

MIL-STD-188-100 Common Long-Haul and Tactical Communication System Technical Standards, November 1972

MIL-STD-188-148(S) Interoperability Standards for Anti-Jam Communications in the HF Band (U)

MIL-STD-1388-2B DoD Requirements for a Logistic Support Analysis Record

MIL-STD-1777 Internet Protocol (IP), August 1983

MIL-STD-1778 Transmission Control Protocol (TCP), August 1983

MIL-STD-1779 Interfaces for High Capacity C3 Local Area Networks, November 1983

MIL-STD-1780 File Transfer Protocol (FTP), May 1984

MIL-STD-1781 Simple Mail Transfer Protocol (SMTP), May 1984

MIL-STD-1782 TELENET Protocol, May 1984

MIL-STD-1840A Automated Interchange of Technical Information, 1987

MIL-STD-1815A Ada Programming Language (ISO 8652)

MIL-STD-1840A Automated Interchange of Technical Information, 22 December 1987 with Change Notice 1 of 20 December 1988

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|               |  |
|---------------|--|
| RFC 742       | Finger Protocol  |
| RFC 768       | User Datagram Protocol (UDP)   |
| RFC 783       | Trivial File Transfer Protocol (TFTP)                                  |
| RFC 792       | Internet Control Message Protocol (ICMP)                               |
| RFC 822       | Format of Electronic Mail Messages                                     |
| RFC 826       | Address Resolution Protocol (ARP)                                      |
| RFC 862       | Echo Protocol  |
| RFC 863       | Discard Protocol   |
| RFC 864       | Character Generator Protocol   |
| RFC 866       | Active Users Protocol  |
| RFC 867       | Daytime Protocol   |
| RFC 868       | Time Server Protocol   |
| RFC 877       | Internet Protocol on X.25 Networks                                     |
| RFC 891       | Internet Protocol on DC Networks                                       |
| RFC 894       | Internet Protocol on Ethernet Networks                                 |
| RFC 903       | A Reverse Address Resolution Protocol (RARP)                           |
| RFC 904       | Exterior Gateway Protocol (EGP)  |
| RFC 907       | Internet Protocol on Wideband Networks                                 |
| RFC 919       | Internet Protocol Broadcast Datagrams                                  |
| RFC 922       | Internet Protocol Broadcast Datagrams With Subnets                     |
| RFC 950       | Internet Protocol Subnet Extension                                     |
| RFC 951       | Bootstrap Protocol (BOOTP)   |
| RFC 954       | Whois Protocol   |
| RFC 1001-1002 | NetBIOS Service Protocol   |
| RFC 1009      | Gateway Requirements   |
| RFC 1010      | Assigned Numbers   |
| RFC 1034-1035 | Domain Name System   |
| RFC 1042      | Internet Protocol on IEEE 802  |
| RFC 1044      | Internet Protocol on Hyperchannel Networks                             |
| RFC 1048      | Bootstrap Protocol (BOOTP)   |
| RFC 1054      | Internet Group Multicast Protocol (IGMP)                               |
| RFC 1055      | Transmission of IP Over Serial Lines                                   |
| RFC 1058      | Routing Information Protocol (RIP)                                     |
| RFC 1059      | Network Time Protocol  |
| RFC 1065      | Structure of Management Information (SMI)                              |
| RFC 1066      | Management Information Base (MIB)                                      |
| RFC 1084      | Bootstrap Protocol (BOOTP)   |
| RFC 1088      | Transmission of IP Over NetBIOS  |
| RFC 1095      | Common Management Information Services and Protocol Over TCP/IP (CMOT) |
| RFC 1098      | Simple Network Management Protocol (SNMP)                              |
| RFC xxxx      | Requirements for Internet Hosts - Communications Layer                 |
| RFC xxxx      | Requirements for Internet Hosts - Application Layer                    |

III. AGREEMENTS FROM REGIONAL WORKSHOPS

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| EWOS xxxx                | EWOS Technical Guide on Lower Layer Relays, Final Draft, EWOS, 1990  |
| EWOS/ETG003              | EWOS/EG FT, File Transfer Access and Management - FTAM Remote Actions (RA) Service and Protocol, 24 January 1990   |
| EWOS/EG VT/89            | Application Function A/4121, Basic Class VT S-Mode Forms Functional Standard, Part 1: Virtual Terminal Service, EWOS/EG VT/89/53, Part 2: VT Protocol Check List, EWOS/EG VT/89/59, and Part 3: Underlying Layers Check List, EWOS/EG VT/89/60, Final Text, prENV 41 208 |
| Profile RC p,q           | X.25 Protocol Relaying, Draft, EWOS/EGLL/2990/81, EWOS, 9 May 1990   |
| ECMA TR/46               | Security in Open Systems--A Security Framework, ECMA TR/46, European Computer Manufacturers Association, July 1988   |
| NIST SP 500-177          | Stable Implementation Agreements for Open Systems Interconnection Protocol, Version 3, Edition 1, Proceedings of the December 1989 NIST OSI Implementor's Workshop (NOIW), March 1990  |
| NISTIR 88-4017           | Standards for the Interchange of Large Format Tiled Raster Documents, U.S. NIST, December 1988   |
| ENV <sup>2</sup> 41 101♦ | LANs: Provision of the OSI Connection-Mode Transport Service (COTS) Service Using the Connectionless-Mode Network Service (CLNS) on a CSMA/CD Single LAN, June 1986  |
| ENV 41 102♦              | LANs: Provision of the OSI COTS and the CLNS on a CSMA/CD Single or Multiple LAN Configuration, June 1986  |
| ENV 41 103♦              | LANs: Provision of the OSI COTS and the Connection-Mode Network Service (CONS) in an End System on a CSMA/CD LAN, December 1987  |
| ENV 41 104               | Packet Switched Data Networks: Permanent Access, August 1987   |
| ENV 41 105♦              | Packet Switched Data Networks: Switched Access, June 1988  |
| ENV 41 106♦              | Digital Data Circuit (CSDN) - Provision of the OSI COTS in the T.70 Case for Telematic End Systems, June 1988  |
| ENV 41 107♦              | Digital Data Circuit (CSDN) - Provision of the OSI COTS and the OSI CONS, June 1988  |
| ENV 41 108♦              | LANs: Provision of the OSI COTS and CONS in an End System on a Token Ring LAN, May 1988  |
| ENV 41 109♦              | LANs: Provision of the OSI COTS Using CLNS on a Token Ring Single LAN, February 1988   |
| ENV 41 110♦              | LANs: Provision of the OSI COTS Using CLNS in an End System on a Token Ring LAN in a Single or Multiple LAN Configuration, February 1988   |
| ENV 41 201               | Private Message Handling System - User Agent and Message Transfer Agent; Private Management Domain to Private Management Domain, June 1986   |

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<sup>2</sup> ENV indicates a standard approved by the Joint European Standards Institution (CEN/CENELEC) and the European Workshop for Open Systems (EWOS).

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ENV 41 202      Message Handling Systems; User Agent and Message Transfer Agent: Access to an Administration Management Domain (ADMMD), August 1987

ENV 41 203      Exchange of Telex Documents Between Two End Systems, Which May Be Teletex Terminals, June 1988

ENV 41 204♦      FTAM: Simple File Transfer, June 1988

ENV 41 205♦      FTAM: File Management, June 1987

ENV 41 901      X.29-Mode Procedures Between a Packet Mode DTE or a PAD and a PAD via a Public or Private X.25 Packet Switched Network or ISO 8208 Packet Level Entity and ISO 7776 Link Level Entity, June 1987

M-IT-02      Directory of Functional Standards (For Interworking in an OSI Environment) Adopted by the CEN/CENELEC/CEPT/ITSTC, March 1987

Proposed NIST OIW ISP on Directory [SGFS N 216, 11 June 1990]:

- Part 1: [Title to be taken from FTAM ISP, adding ROSE]
- Part 2: ADI 11, Directory User Agent (DUA) Basic Operation
- Part 3: ADI 12, DUA Secure Operation
- Part 4: ADI 13, DUA Operation in Distributed Environment
- Part 5: ADI 211, Directory Service Agent (DSA) - DUA Basic Operation Interaction
- Part 6: ADI 212, DSA - DUA Secure Operation Interaction
- Part 7: ADI 221, DSA - DSA Basic Operation Interaction
- Part 8: ADI 222, DSA - DSA Secure Operation Interaction
- Part 9: ADI 131, Common Use Directory Information
- Part 10: ADI 132, Strong Authentication Directory Information

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IV. U.K. BSI STANDARDS AND PAPERS

- IST/21: 1914 Delegates Report of the ISO/IEC JTC1 SC21/WG4 Plenary, OSI Management and Directory Services, Florence, 31 October to 9 November 1989
- IST/21:2160 Report on SC21 Plenary, Held in Seoul, BSI IST/21, 5-6 June 1990, 13 July 1990
- IST/21:2161 Report of SC21/WG1 Meeting, Seoul, Korea, 23-31 May 1990, BSI, IST 21, 27 July 1990
- IST/21:2162 Report of SC21/WG3 Database Meeting, Seoul, Korea, 21 May to 1 June 1990, BSI, IST 21, 27 July 1990
- IST/21:2164 OSI Specific Applications Services, ISO/IEC JTC1/SC21 WG5 Meeting, Seoul, Korea, 24 May to 1 June 1990, BSI, IST 21, 10 July 1990
- IST/21:2165 Report of Seventh Meeting of SC21/WG6, Seoul, Korea, 23 May to 1 June 1990, BSI, IST 21, 3 August 1990
- IST/21:2170 JTC1 Workshop on Security, London, 5-7 November 1990, BSI IST21, 29 June 1990
- IST/21:2187 IST/21 Activities 1989-1990, 27 July 1990
- IST/21:2236 Report of SC21/WG1/FDT Meeting, Seoul, Korea, 23 May to 31 May 1990, BSI, IST 21, 30 July 1990
- IST/21:2237 Security Liaison Requirements, 27 July 1990
- IST/21:2249 Current and Recent Ballots, 10 August 1990
- U.K. GOSIP Vol. 1 U.K. Government OSI Profile, Volume I, Introduction, Version 3.1, Central Computer and Telecommunications Agency, London, 1990
- U.K. GOSIP Vol. 2 U.K. Government OSI Profile, Volume II, Specification, Version 3.1, Central Computer and Telecommunications Agency, London, 1990
- U.K. GOSIP Vol. 3 U.K. Government OSI Profile, Volume III, Procurement Handbook, Version 3.1, Central Computer and Telecommunications Agency, London, 1990
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H-12

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| ANSI X3.4     | Coded Character Sets - 7-Bit American National Standard Code for Information Exchange (7-Bit ASCII), 1986   |
| ANSI X3.9     | Programming Language FORTRAN, 1978 (revised 1989) (ISO 1539)  |
| ANSI X3.15    | Bit Sequencing of the American National Standard Code for Information Exchange in Serial-By-Bit Data Transmission, 1976 (FIPS 16-1)                         |
| ANSI X3.23    | Programming Language COBOL, 1985 (ISO 1989)   |
| ANSI X3.23A   | Addendum to ANSI X3.23-1985, Programming Language COBOL, 1989   |
| ANSI X3.32    | Graphic Representation of the Control Characters of American Standard Code for Information Exchange, 1973   |
| ANSI X3.41    | Code Extension Techniques for Use with the 7-Bit Coded Character Set of American National Standard Code for Information Exchange, 1974 (FIPS 35, WITHDRAWN) |
| ANSI X3.53    | Programming Language PL/1, 1976 (ISO 6160)  |
| ANSI X3.42    | Representation of Numeric Values in Character Strings for Information Interchange, 1975   |
| ANSI X3.66    | Advanced Data Communication Control Procedures (ADCCP), 1979 (FIPS 71)  |
| ANSI X3.74    | Programming Language PL/1 General Purpose Subset, 1981 (ISO 6522)   |
| ANSI X3.83    | Sponsorship Procedures for ISO Registration According to ISO 2375, November 1988  |
| ANSI X3.91M   | Interfaces, Storage Module, 1987  |
| ANSI X3.92    | Data Encryption Algorithm, 1981   |
| ANSI X3.97    | Programming Language Pascal, 1983 (ISO 7185)  |
| ANSI X3.98    | Text Information Interchange in Page Image Format (PIF), 1983   |
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| ANSI X3.105   | Information Systems - Data Link Encryption, 1983  |
| ANSI X3.106   | Information Systems - Data Encryption Algorithm - Modes of Operation, 1983  |
| ANSI X3.107   | Data Link Layer Protocol for Local Distributed Data Interfaces (LDDI), August 1982 (DP)   |
| ANSI X3.108   | Information Systems - Local Distributed Data Interfaces (LDDI) - Physical Layer Interface to Nonbranching Coaxial Cable Bus, 1988                           |
| ANSI X3.109   | Physical Layer Protocol for Local Distributed Data Interfaces (LDDI), 1982 (DP)   |
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| ANSI X3.113   | Full BASIC, 1987 (FIPS 68-2)  |
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| ANSI X3.122   | Computer Graphics Metafile (CGM) for the Storage and Transfer of Picture Description Information, 1986 (ISO 8632)   |
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- ANSI X3.124.1 Computer Graphics - Graphical Kernel System (GKS) FORTRAN Language Binding, 1985 (ISO 8651-1)
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- ANSI X3.140 Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Layer Protocol Specification, 1986 (ISO 8072 and 8073)
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| ANSI X3.159        | Information Systems - Languages - Programming Language C, 1988 (DP)  |
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| ANSI X3.168        | Information Systems - Language - Embedding of SQL Statements into Programming Languages, 1988 (DP)   |
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| IEEE 770           | Programming Language Pascal, 1983  |
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**APPENDIX I**

**BACKGROUND, OBJECTIVE, AND  
STATEMENT OF WORK**

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**APPENDIX I**

**BACKGROUND, OBJECTIVE, AND  
STATEMENT OF WORK**

(U) This IDA Document was written in response to Task Order T-J1-246 and Amendment No. 8. Those portions of the task order that pertain to the background and objectives of the task, and the additional guidance provided therein by the sponsoring office, are reprinted here.

2. BACKGROUND:

The tactical ADP portion of the NATO Long Term Defense Program (LDTP) proposed that command and control systems be built to common specifications. The Deputy SACEUR initiated a study to determine the feasibility of the nations in the Central Region commonly developing an Automated Army Tactical Command and Control Information System (ATCCIS) for deployment in the post-1955 timeframe. Commitments for supporting this effort were obtained from US, UK, and FRG Army Chiefs of Staff. These nations provided information on their operational doctrine, procedures, functions, and information exchange requirements for their maneuver forces, as well as their operational requirements for an automated CCIS and information on the ADP systems that they are currently developing to support their maneuver forces. This information was used in the initial phase of the study to determine the extent to which similarities and differences in national requirements for automated CCISs would indicate that a commonly developed system is potentially feasible. The results of this initial phase were positive. SHAPE has requested that the nations complete the study and has received US, UK, FR and FRG Army Chiefs of Staff commitments.

3. OBJECTIVE:

The objective of this phase II effort of the study is to assist SHAPE in defining the military objectives and basic operational requirements for a common ATCCIS that achieves interoperability to ADP systems. The capabilities of ADP systems are to be compared to the concept of operations

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of each of the nations to determine the extent to which such a common ATCCIS could accommodate the requirements of each of the nations and to identify issues remaining to be resolved before such a system could be employed in the Central Region in post-1995 time period.

4. STATEMENT OF WORK:

The FY 1990 task includes:

- f. Perform additional analysis, as appropriate, and address specific topics identified as a result of the NATO TSGCEE review of draft edition 1.2, Architectural Standards (Working Paper 25).



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APPENDIX J

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J-20

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References 18

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## GLOSSARY

|         |  |
|---------|--|
| A       | Application (profile)  |
| AC      | Armament Committee (NATO)  |
| ACBA    | Allied Command Baltic Approaches                                       |
| ACC     | Access Control Center (US DoD, BLACKER)                                |
| ACCIS   | Automated Command and Control Information System                       |
| ACCS    | Air Command and Control System   |
| ADCCP   | Advanced Data Communications Control Procedures (ANSI X3.66)           |
| ACE     | Allied Command Europe  |
| ACIS    | Access Control Information System (SDNS)                               |
| ACK     | Acknowledgement  |
| ACP     | Allied Communications Publication                                      |
| ACSE    | Association Control Service Element (OSI Layer 7)                      |
| AD      | Addendum (ISO)   |
| ADI     | Directory Application (ISP)  |
| ADMD    | Administration Management Domain                                       |
| ADP     | Automated (Automatic) Data Processing                                  |
| ADS     | Automated Data System  |
| ADSIA   | Allied Data Systems Interoperability Agency                            |
| ADatP   | Allied Data Publication  |
| AE      | Application Element (OSI)  |
| AEP     | Application Environment Profile (POSIX)                                |
| AFCENT  | Allied Forces Central Europe   |
| AFNOR   | Association Francaise de Normalisation (France)                        |
| AHWG    | Ad Hoc Working Group   |
| AHWG-FP | Ad Hoc Working Group on Functional Profiles (TSGCEE SG9)               |
| AHWG-OM | Ad Hoc Working Group on OSI Management (TSGCEE SG9)                    |
| AI      | Artificial Intelligence  |
| AIE     | Ada Integrated Environment   |
| ALF     | Application-Level Facility (ATCCIS)                                    |
| ALS     | Application Layer Structure (OSI); Ada Language System                 |
| AM      | ACE Manual   |
| AMH     | Automated Message Handling; Message Handling Application Profile (ISP) |
| ANCA    | Allied Naval Communications Agency (NATO)                              |
| ANS     | ANSI National Standard (United States)                                 |
| ANSI    | American National Standards Institute                                  |

Glossary-1

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|         |   |
|---------|---|
| AOM     | OSI Management Application Profile (ISP)  |
| AOW     | Asia-Oceania Workshop (Sponsored by POSI)   |
| APDU    | Application Protocol Data Unit  |
| API     | Applications Programming Interface  |
| APP     | Applications Portability Profile (NIST)   |
| APSE    | Ada Programming Support Environment   |
| AR      | U.S. Army Regulation  |
| ARD     | Remote Data Access Application Profile (ISP)  |
| ARPANET | Advanced Research Projects Agency Network (United States)                                   |
| ASCII   | American Standard Code for Information Exchange   |
| ASD     |   |
| ASE     | Application Service Element (OSI)   |
| ASME    | American Society for Mechanical Engineers   |
| ASN     | Abstract Syntax Notation (OSI)  |
| ATACC   | Advanced Tactical Command and Control Center (US DoD)                                       |
| ATCA    | Allied Tactical Communications Agency (NATO)  |
| ATCCIS  | Army Tactical Command and Control Information System  |
| ATCCS   | U.S. Army Tactical Command and Control System   |
| ATLR    | Active Transport Layer Relay  |
| ATOC    | Allied Tactical Operations Centre   |
| ATP     | Allied Tactical Publication; Transaction Processing Application Profile (ISP)               |
| AUTODIN | Automatic Digital Network (US DoD)  |
| AVT     | Virtual Terminal Application Profile (ISP)  |
| AWHQ    | Alternate War Headquarters  |
|         |   |
| B       | ISDN B Service (64 kbit/second)   |
| BASE    | Baseband  |
| BER     | Basic Encoding Rules (ASN.1)  |
| BFA     | Battlefield Functional Area   |
| BFE     | BLACKER Front End (US DoD)  |
| BICES   | Battlefield Information Collection and Exploitation Systems                                 |
| BIH     | Bureau International de l'Heure   |
| BPS     | BICES Pilot Study   |
| BROAD   | Broadband   |
| BSI     | British Standards Institute (United Kingdom)  |
|         |   |
| C2      | Command and Control   |
| C3      | Command, Control, and Communications; Consultation, Command, and Control (NATO Master Plan) |
| C3I     | Command, Control, Communications, and Intelligence  |
| CAD     | Computer Aided Design   |

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|         |  |
|---------|--|
| CAE     | Common Applications Environment (X/Open)   |
| CAIS    | Common APSE Interface Set  |
| CALS    | Computer Acquisitions and Logistics Support (United States)  |
| CAM     | Computer Aided Manufacturing   |
| CASE    | Common Application Service Elements (OSI Layer 7); Computer-Aided Software Engineering   |
| CCIS    | Command, Control, and Information System   |
| CCITT   | Comite Consultatif International de Telegraphique et Telephonique (International Telegraph and Telephone Consultative Committee) |
| CCR     | Commitment, Concurrency, and Recovery (OSI Layer 7)  |
| CCS     | Calculus of Communicating Systems (LOTOS)  |
| CCTA    | Central Computer and Telecommunications Agency (United Kingdom)  |
| CD      | Committee Draft (ISO)  |
| CDAD    | Committee Draft Addendum   |
| CDAM    | Committee Draft Amendment  |
| CDTR    | Committee Draft Technical Report   |
| CEC     | Commission of the European Community   |
| CECOM   | Communications-Electronics Command (US Army)   |
| CEN     | Comite Europeen de Normalisation (European Committee for Standardization)  |
| CENELEC | Comite Europeen de Normalisation Electrotechnique (European Committee for Electrotechnical Standardization)                      |
| CEPT    | Conference Europeenne des Postes et Telecommunications   |
| CER     | Confidential Encoding Rules (ASN.1)  |
| CGI     | Computer Graphics Interface (Interfacing)  |
| CGM     | Computer Graphics Metafile   |
| CGMIF   | Computer Graphics Metafile Interchange Format  |
| CHILL   | CCITT High Level Language  |
| CHS     | Common Hardware and Software (US Army)   |
| CIEG    | Common Information Exchange Glossary   |
| CIGOS   | Canadian Interest Group on Open Systems  |
| CIGREF  | Club Informatique des Grandes Entreprises Francaises (France)  |
| CIS     | Communications and Information Systems   |
| CL      | Connectionless (mode)  |
| CLNP    | Connectionless Network Protocol (OSI)  |
| CLNS    | Connectionless Network Service (OSI)   |
| CLTS    | Connectionless Transport Service (OSI)   |
| CMB     | Configuration Management Board   |
| CMIP    | Common Management Information Protocol (OSI)   |
| CMIS    | Common Management Information Service (OSI)  |
| CMISE   | Common Management Information Service Element (OSI)  |
| CNAD    | Conference of National Armaments Directors (NATO)  |

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|          |   |
|----------|---|
| CNET     | Centre National d'Etude des Telecommunications (France)                     |
| CNR      | Combat Net Radio  |
| CO       | Connection Oriented (mode)  |
| COLOC    | Change of Location of Command   |
| COMPUSEC | Computer Security   |
| CONP     | Connection-Oriented Network Protocol (OSI)                                  |
| CONS     | Connection-Oriented Network Service (OSI)                                   |
| COS      | Corporation for Open Systems  |
| COSINE   | Corporation for Open Systems Interconnection Networking in Europe (COSINE)  |
| CONP     | Connection-Oriented Transport Protocol (OSI)                                |
| COTS     | Connection-Oriented Transport Service (OSI); Commercial Off-the-Shelf       |
| CR       | Central Region (NATO)   |
| CS       | Circuit Switched  |
| CSA      | Canadian Standards Association  |
| CSMA/CD  | Carrier Sense Multiple Access/Collision Detection                           |
| CSDN     | Circuit Switched Data Network   |
| CSN      | Circuit Switched Network  |
| CSNI     | Communications System/Network Interoperability                              |
| CSP      | Communicating Sequential Processes (LOTOS)                                  |
| CSPDN    | Circuit Switched Public Data Network  |
| CSWG     | Communications Systems Working Group (NACISA)                               |
| CTS-WAN  | Conformance Testing Services-Wide Area Network                              |
|          |   |
| D        | ISDN D Service (16 kbit/second)   |
| DAD      | Draft Addendum (ISO)  |
| DAF      | Framework for the Support of Distributed Applications (CCITT)               |
| DAFTG    | Database Architecture Framework Task Group (ANSI)                           |
| DAM      | Draft Amendment (ISO)   |
| DAO      | Document Architecture Operations  |
| DAP      | Document Application Profile  |
| DAPWG    | DFTS Architecture and Procurement Working Group (UK MoD)                    |
| DARPA    | Defense Advanced Research Projects Agency (US DoD)                          |
| DBMS     | Database Management System  |
| DCA      | Defense Communications Agency (United States DoD)                           |
| DCE      | Data Circuit-Terminating Equipment; Distributed Computing Environment (OSF) |
| DCF      | Data Communications Function (CCITT M.30)                                   |
| DCT      | Digital Communications Terminal (US DoD)                                    |
| DDL      | Data Definition Language  |
| DDN      | Defense Data Network (US DoD)   |
| DEC      | Digital Equipment Corporation   |

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|        |   |
|--------|---|
| DED    | Digital Entry Device  |
| DER    | Distinguished Encoding Rules (ASN.1)  |
| DFR    | Document Filing and Retrieval   |
| DFTS   | Defence Fixed Telecommunications System (UK MoD)  |
| DGITS  | Directorate General of Information Technology Systems (UK MoD)                              |
| DGIWG  | Digital Geographic Information Working Group  |
| DIB    | Directory Information Base (CCITT X.500)  |
| DIN    | Deutsches Institut fur Normung (Federal Republic of Germany)                                |
| DIR    | Directory (CCITT X.500)   |
| DIS    | Draft International Standard (ISO)  |
| DISA   | Data Interchange Standards Association  |
| DISC4  | US Army Directory of Information Systems Command, Control, Communications, and Intelligence |
| DISNET | Defense Integrated Secure Network (US DoD)  |
| DISP   | Draft International Standardized Profile  |
| DIT    | Directory Information Tree (CCITT X.500)  |
| DMA    | Defense Mapping Agency  |
| DMF    | Data Management Facility (ATCCIS)   |
| DML    | Data Manipulation Language  |
| DMRM   | Data Management Reference Model   |
| DMS    | Data Management Subsystem (ACE CCISs); Defense Message System (US DoD)                      |
| DNS    | Domain Name System (US DoD)   |
| DOA    | Distributed Office Applications   |
| DOAM   | Distributed Office Applications Model   |
| DoD    | Department of Defense (United States)   |
| DoDCSC | US Department of Defense Computer Security Center   |
| DP     | Draft Proposal (ISO)  |
| DPSN   | Digital Packet Switched Network; Defence Packet Switched Network (UK MoD)                   |
| DQDB   | Distributed Queue Dual Bus (local area network)   |
| DSA    | Directory Service Agent (CCITT X.500)   |
| DSG    | Distributed System Gateway  |
| DTAM   | Document Transfer and Manipulation  |
| DTE    | Data Terminal Equipment   |
| DTED   | Digital Terrain Elevation Data  |
| DTR    | Draft Technical Report (ISO)  |
| DVI    | Digital Video Interactive   |
| EC     | European Community  |
| ECCM   | Electronic Counter-Countermeasures  |
| ECMA   | European Computer Manufacturers Association   |
| ED&C   | Error Detection and Correction  |

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|           |  |
|-----------|--|
| EDI       | Electronic Data Interchange  |
| EDIFACT   | Electronic Data Interchange for Administration, Commerce, and Transport            |
| EDIMS     | Electronic Data Interchange Messaging System                                       |
| EESP      | End-to-End Security Protocol   |
| EFTA      | European Free Trading Association  |
| EG        | Expert Group   |
| EIA       | Electronic Industries Association  |
| E-Mail    | Electronic Mail  |
| EMUG      | European Manufacturing Automation Program (MAP) User Group                         |
| EN        | European Norm (European Standard) (CEN/CENELEC)                                    |
| ENV       | European Norm Vornorm (European Experimental Standard) (CEN/CENELEC)               |
| EPA       | Environmental Protection Agency  |
| EPHOS     | European Procurement Handbook for Open Systems                                     |
| ES-IS     | End System to Intermediate System  |
| ESPRIT    | European Strategic Programme of Research and Development in Information Technology |
| ETSI      | European Telecommunications Standards Institute                                    |
| EUROCOM   | Eurogroup on Cooperation of Tactical Communications Systems                        |
| EWOS      | European Workshop for Open Systems   |
|           |  |
| FCG       | Computer Graphics Interchange Format (ISP)   |
| FCS       | Frame Check Sequence   |
| FD        | Formal Description   |
| FDDI      | Fiber Distributed Data Interface   |
| FDI       | Directory Data Definitions (ISP)   |
| FDT       | Formal Description Technique   |
| FEC       | Forward Error Correction   |
| FIMS      | Forms Interface Management System  |
| FIPS      | Federal Information Processing Standard (United States)                            |
| FLTSATCOM | Fleet Satellite Communications   |
| FOD       | Office Document Interchange Format (ISP)   |
| FOIRL     | Fiber Optic Inter-Repeater Link  |
| FORMETS   | Message Text Formatting System (NATO)  |
| FORTTRAN  | Formula Translation (programming language)   |
| FRP90     | Frigate Replacement Program for the 1990s (NATO)                                   |
| FSG       | SGML Document Interchange Format (ISP)   |
| FTAM      | File Transfer, Access and Management (OSI Layer 7)                                 |
| FTP       | File Transfer Protocol (US DoD)  |
| FUI       | Flow (Control) Unnumbered Information  |

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|         |   |
|---------|---|
| G-LOTOS | Graphical Representation of LOTOS   |
| GAN     | Global Area Network   |
| GDMI    | Generic Definition of Management Information (OSI)  |
| GEADGE  | German Air Defense Ground Environment   |
| GEMINI  | General Expert System Methods Initiative (United Kingdom)                                       |
| GKS     | Graphics Kernel System  |
| GKS-3D  | Graphics Kernel System for Three Dimensions   |
| GOSIP   | Government Open Systems Interconnection Profile   |
| GSTN    | General Switched Telephone Network  |
| GUI     | Graphical User Interface  |
|         |   |
| HCI     | Human-Computer Interface  |
| HD      | Harmonized Document (CEN/CENELEC)   |
| HDLC    | High-Level Data Link Control (OSI Layer 2)  |
| HEROS   | Heeres-Fuehrungsinformationssystem fur die rechnergestuetzte<br>Operations- fuehrung in Staeben |
| HQDA    | Headquarters, Department of the Army (US DoD)   |
|         |   |
| IAB     | Internet Activities Board (US DoD)  |
| IAP     | Interfaces for Applications Portability (ISO/IEC JTC1)  |
| IBN     | Institut Belge de Normalisation (Belgium)   |
| ICD     | Interface Control Document  |
| ICSI    | International Coding System Identifier  |
| ICT     | Intercept Recommendation (TSGCEE SG9)   |
| ID      | Identification  |
| IDN     | Interface Definition Notation (RPC)   |
| IEC     | International Electrotechnical Commission   |
| IEE     | Institution of Electrical Engineers (United Kingdom)  |
| IEEE    | Institute of Electrical and Electronics Engineers (United States)                               |
| IEPG    | Independent European Programme Group  |
| IER     | Information Exchange Requirement  |
| IFIP    | International Federation for Information Processing   |
| IFRB    | International Frequency Registration Board (UIT)  |
| IFU     | Interworking Functional Unit (OSI Relay)  |
| IGES    | Initial Graphics Exchange Specification   |
| IIRS    | Institute for Industrial Research and Standards (Ireland)                                       |
| IJMS    | Interim JTIDS Message Standard  |
| INSTAC  | Information Technology Standardization Technology Committee                                     |
| INTAP   | Interoperability Technology Association for Information Processing<br>(Japan)                   |
| IOF     | Input-Output Facility (ATCCIS)  |
| IP      | Internet Protocol; Interoperability Parameter; Internetwork Protocol                            |

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|          |   |
|----------|---|
| IPM      | Interpersonal Messaging (MHS Service)                                   |
| IRD      | Information Resource Dictionary   |
| IRDS     | Information Resource Dictionary System                                  |
| ISAM     | Indexed Sequential Access Method  |
| ISDN     | Integrated Services Digital Network                                     |
| IS       | International Standard (ISO); Intermediate System (OSI)                 |
| ISO      | International Organization for Standardization; International Standard  |
| ISODE    | ISO Development Environment   |
| ISP      | International Standardized Profile                                      |
| ISWG     | Information Systems Working Group (NACISA)                              |
| IT       | Information Technology  |
| ITDN     | Integrated Tactical-Strategic Digital Network (US DoD)                  |
| ITI      | Industrial Technology Institute   |
| ITS      | Integrated Tool Set (COS)   |
| ITSTC    | Information Technology Steering Technical Committee (UK)                |
| IUKADGE  | Improved United Kingdom Air Defence Ground Environment                  |
| IVD      | Integrated Voice and Data (local area network)                          |
| IWU      | Interworking Unit (OSI for relay functional profiles)                   |
|          |   |
| JINTACCS | Joint Interoperability of Tactical Command and Control Systems (US DoD) |
| JIS      | Japanese Industrial Standard  |
| JISC     | Japanese Industrial Standards Committee                                 |
| JPEG     | Joint Photographic Experts Group  |
| JSA      | Japanese Standards Association  |
| JTC1     | Joint Technical Committee One (ISO/IEC)                                 |
| JTM      | Job Transfer and Manipulation (OSI Layer 7)                             |
|          |   |
| KAPSE    | Kernel Ada Programming Support Environment                              |
| KBS      | Knowledge-Based System  |
| KDC      | Key Distribution Center (BLACKER, US DoD)                               |
| KG       | Encryption Key Generator  |
| KIT      | KAPSE Interface Team  |
| KITIA    | KAPSE Interface Team from Industry and Academia                         |
| KMAE     | Key Management Application Entity                                       |
| KMAP     | Key Management Application Process                                      |
| KMASE    | Key Management Application Service Element                              |
|          |   |
| LAN      | Local Area Network  |
| LAP B    | Link Access Procedure, Balanced   |
| LAP D    | Link Access Procedure, Version D (used for ISDN)                        |

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|         |   |
|---------|---|
| LDDI    | Local Distributed Data Interfaces (ANSI X3.107-109)                 |
| LLC     | Logical Link Control (OSI Network Layer)                            |
| LOCE    | Limited Operational Capability-Europe                               |
| LOTOS   | Language of Temporal Ordering of Specification                      |
| LTDP    | Long-Term Defence Plan  |
| MAC     | Media Access Control  |
| MACF    | Multiple Association Control Function                               |
| MAN     | Metropolitan Area Network   |
| MAP     | Manufacturing Automation Protocol                                   |
| MAPSE   | Minimum Ada Programming Support Environment                         |
| MAS     | Military Agency for Standardization                                 |
| MCS     | Maneuver Control System (US Army)                                   |
| MF      | Mediation Function (CCITT M.30)                                     |
| MHS     | Message Handling System (OSI Layer 7)                               |
| MIB     | Management Information Base   |
| MIDLA   | Media-Independent Data Link Architecture (TSGCEE)                   |
| MIDS    | Multinational Information Distribution System (NATO)                |
| MIL-STD | Military Standard (US DoD)  |
| MIM     | Management Information Model (DIS 10165-1)                          |
| MILNET  | Military Network (United States)                                    |
| MISD    | Management Information Service Definition (see CMIS)                |
| MIPS    | Management Information Protocol Specification (see CMIP)            |
| MIS     | Management Information Service (OSI); Management Information System |
| MIT     | Massachusetts Institute of Technology                               |
| MTI     | Ministry of International Trade and Industry (Japan)                |
| MM      | Mixed Mode (of Operations in DTAM)                                  |
| MMHS    | Military Message Handling System (see CCITT X.400-1988)             |
| MMI     | Man-Machine Interface   |
| MML     | Man-Machine Language (CCITT Z.300 Series)                           |
| MMS     | Manufacturing Message Specification (MAP)                           |
| MNC     | Major NATO Command  |
| MOCS    | Managed Object Conformance Statement                                |
| MOD     | Ministry of Defence   |
| MODITSB | UK MoD Information Technology Standards Board                       |
| MOTIS   | Message-Oriented Text Interchange System (OSI Layer 7)              |
| MOU     | Memorandum of Understanding   |
| MPC     | Multi-Party Communications  |
| MPDT    | Multipeer Data Transmission (OSI)                                   |
| MPEG    | Moving Picture Experts Group  |
| MPTM    | Multi-Party Test Methods  |



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|        |   |
|--------|---|
| MROC   | Multicommand Required Operational Capability                                |
| MS     | Message Store (MHS)   |
| MSC    | Major Subordinate Command (NATO)  |
| MSE    | Mobile Subscriber Element (US Army)   |
| MSDSG  | Multi-System Distributed System Gateway                                     |
| MSP    | Message Security Protocol (SDNS)  |
| MT     | Message Transfer  |
| MTA    | Message Transfer Agent (MHS)  |
| MTS    | Marine Tactical Systems (US DoD)  |
|        |   |
| N      | Notice (ISO Working Paper)  |
| NACISA | NATO Communications and Information Systems Agency                          |
| NACISC | NATO Communications and Information Systems Committee                       |
| NACISO | NATO Communications and Information Systems Organization                    |
| NAEW   | NATO Airborne Early Warning   |
| NBS    | US National Bureau of Standards (now NIST)                                  |
| NBSIR  | NBS Interim Report  |
| NCC    | National Computing Centre   |
| NCIS   | NATO Common Interoperability Standards                                      |
| NDI    | Nondevelopmental Item   |
| NDL    | Network Database Language (OSI)   |
| NEC    | Northern European Command   |
| NEF    | Network Element Function (CCITT M.30)                                       |
| NET    | Telecommunications European Norm  |
| NFR90  | NATO Frigate Replacement for the 1990s                                      |
| NFS    | Network File Service  |
| NIAG   | NATO Industrial Advisory Group  |
| NIIF   | Network Independent Interface (NIAG SG6)                                    |
| NIIS   | NATO Interconnected Information System                                      |
| NILS   | Network Internal Layer Structure  |
| NIMP   | NATO Interoperability Management Plan                                       |
| NIPD   | NATO Interoperability Planning Document                                     |
| NIS    | NATO Identification System  |
| NIST   | US National Institute of Standards and Technology                           |
| NLR    | Network Layer Relay   |
| NM     | Network Management  |
| NMICC  | NATO Maritime Interface Coordination Centre                                 |
| NMOS   | NATO Maritime Operational Intelligence Support                              |
| NMSIG  | Network Management Special Interest Group (NIST OSI Implementor's Workshop) |
|        |   |
| NNI    | Nederlands Normalisatie-Instituut (Netherlands)                             |
| NOIW   | NIST OSI Implementor's Workshop   |

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|        |   |
|--------|---|
| NOSA   | NATO OSI Security Architecture                                      |
| NPICS  | NATO Protocol Implementation Conformance Statement                  |
| NPDU   | Network Protocol Data Unit  |
| NPS    | Nuclear Planning System   |
| NSA    | National Security Agency (United States)                            |
| NSAI   | National Standards Authority of Ireland                             |
| NSAP   | Network Service Access Point (OSI)                                  |
| NSS    | National Standards System (Canada)                                  |
| NST    | NATO Staff Target   |
| NTIS   | NATO Technical Interoperability Standards                           |
| NTP    | Network Time Protocol   |
| NWI    | New Work Item   |
|        |   |
| ODA    | Office Document Architecture  |
| ODIF   | Office Document Interchange Format                                  |
| ODL    | Office Document Language  |
| ODP    | Open Distributed Processing   |
| OM     | OSI Management  |
| OSCRL  | Operating System Command and Response Language                      |
| OSE    | Open System Environment (NIST)                                      |
| OSF    | Open Software Foundation; Operation System Function<br>(CCITT M.30) |
| OS     | Operating System  |
| OSI    | Open Systems Interconnection  |
| OSITOP | Open Systems Interconnection for Technical and Office Protocol      |
| OSN    | Open System Newsletter (London)                                     |
|        |   |
| PAD    | Packet Assembly/Disassembly   |
| PCDAM  | Proposed Committee Draft Amendment (ISO)                            |
| PCNCEP | Political Consultation and NATO Civil Emergency Planning            |
| PCTE   | Portable Common Tool Environment                                    |
| PER    | Packed Encoding Rules (ASN.1)                                       |
| PDAD   | Proposed Draft Addendum (ISO)                                       |
| PDAM   | Proposed Draft Amendment (ISO)                                      |
| PDIF   | Product Definition Interchange Format                               |
| PDISP  | Proposed Draft International Standardized Profile                   |
| PDL    | Page Description Language   |
| PDN    | Public Data Network   |
| PDTR   | Proposed Draft Technical Report                                     |
| PDU    | Protocol Data Unit  |
| PHIGS  | Programmer's Hierarchical Interactive Graphics System               |
| PHY    | Physical  |

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|         |   |
|---------|---|
| PICS    | Protocol Implementation Conformance Statement   |
| PIF     | Page Image Format (ANSI X3.98)  |
| PLP     | Packet Level Protocol (X.25)  |
| PLPS    | Presentation Level Protocol Specification   |
| PM      | Processable Mode (of Operations in DTAM)  |
| PMD     | Physical Layer Medium Dependent   |
| POSI    | Promoting Conference for OSI (Asia-Oceania Regional Workshop)                             |
| POSIX   | Portable Operating System Interface for Computer Environments                             |
| PPSC-IT | Public Procurement Subcommittee in the Information Technology Sector (CEC)                |
| prENV   | Draft European Prestandard  |
| PRMD    | Private Management Domain   |
| PSC     | Principal Systems Command; Principal Subordinate Command                                  |
| PSDN    | Packet Switched Digital Network   |
| PSPDN   | Packet Switched Public Data Network   |
| PSSG    | Protocol Standards Technical Panel (US DoD)   |
| PSTN    | Public Switched Telephone Network   |
| PSSG    | Protocol Standards Steering Group (US DoD)  |
| PTI     | Public Tool Interface   |
| PTLR    | Passive Transport Layer Relay   |
| PTT     | Post, Telephone, and Telegraph  |
| PVC     | Permanent Virtual Circuit   |
| PWG     | Permanent Working Group   |
| Q&A     | Question and Answer (NATO Identification System)  |
| QIP     | Quadrilateral Interoperability Programme  |
| QoS     | Quality of Service  |
| QSTAG   | Quadrilateral Standardization Agreement   |
| QTDMF   | Quadrilateral Test and Demonstration Management Plan                                      |
| QTIDP   | Quadrilateral Technical Interface Design Plan   |
| QTIR    | Quadrilateral Technical Interface Requirements  |
| R       | Relay (profile)   |
| RA      | CLNS Relay Profile (ISP)  |
| RACWG   | Requirements and Design Criteria Working Group  |
| RARE    | Reseaux Associes pour le Recherche Europeenne (Association of European Research Networks) |
| RB      | CONS Relay Profile (ISP)  |
| RC      | X.25 Relay Profile (ISP)  |
| RD      | MAC Relay Profile Using Transport Bridging (ISP)  |
| RDA     | Remote Data Access (OSI)  |
| RDT     | Referenced Data Transfer  |

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|        |   |
|--------|---|
| RE     | MAC Relay Profile Using Source Routing (ISP)                            |
| RFC    | Request for Comment   |
| RFT    | Request for Technology  |
| RM     | Reference Model   |
| RO     | Remote Operations   |
| RODE   | Remote Open Document Editing  |
| ROS    | Remote Operation Service (OSI)  |
| ROSE   | Remote Operation Service Element (OSI)                                  |
| RPC    | Remote Call Procedure   |
| RT     | Reliable Transfer   |
| RTS    | Reliable Transfer Service (OSI)   |
| RTSE   | Reliable Transfer Service Element                                       |
| RTTS   | Real-Time Transport Service   |
| RWS-CC | Regional Workshop Coordinating Committee                                |
| RZ     | CLNS to CONS Relay Profile (ISP)  |
|        |   |
| SANISI | Security Architecture for NATO Information Systems Interconnection      |
| SACF   | Single Association Control Function                                     |
| SAO    | Single Association Object   |
| SAP    | Service Access Point; Subnetwork Access Protocol (Network Layer)        |
| SASO   | Saudi Arabian Standards Organization                                    |
| SATCOM | Satellite Communications  |
| SC     | Sub-Committee (ISO); Study Committee                                    |
| SCARS  | Status Control Alerting and Reporting System                            |
| SCC    | Standards Council of Canada   |
| SCF    | Service Control Facility (ATCCIS)                                       |
| SCSI   | Small Computer System Interface   |
| SD&IC  | System Design and Integration Contract (ACE ACCIS)                      |
| SDCP   | Subnetwork Dependent Convergence Protocol (OSI Network Layer)           |
| SDIF   | SGML Document Interchange Format  |
| SDL    | System Development Language (FDT)                                       |
| SDNS   | Secure Data Network System (U.S. National Security Agency)              |
| SDTS   | Spatial Data Transfer Specification                                     |
| SECAN  | Military Committee Communications Security and Evaluation Agency (NATO) |
| SFS    | Suomen Standardisoimisliitto (Finland)                                  |
| SG     | Subgroup  |
| SGFS   | Special Group on Functional Standardization (ISO/IEC JTC1)              |
| SGML   | Standard Generalized Markup Language                                    |
| SHAPE  | Supreme Headquarters Allied Powers Europe                               |

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|           |  |
|-----------|--|
| SICF      | Systeme Informatique de Commandement des Forces Terrestres (Information System for Command of Ground Forces, France) |
| SICP      | Subnetwork Independent Convergence Protocol (OSI Network Layer)  |
| SIG       | Special Interest Group (NIST OSI Implementor's Workshop)   |
| SILS      | Standard for Interoperable LAN Security  |
| SINCGARS  | Single-Channel Ground/Air Radio System (US DoD)  |
| SIS       | Standardiseringskommisionen i Sverige (Sweden)   |
| SMF       | System Management Facility (ATCCIS)  |
| SMI       | Structure of Management Information (OSI)  |
| SMS       | Swedish Mechanical Standardization   |
| SMTP      | Simple Mail Transfer Protocol (US DoD)   |
| SN        | Subnetwork   |
| SNDPCP    | Subnetwork Dependent Convergence Protocol (OSI Network Layer)  |
| SNICP     | Subnetwork Independent Convergence Protocol (OSI Network Layer)  |
| SNPA      | Subnetwork Point of Attachment   |
| SOGITS    | Senior Official Group for Information Technology Standardization (CEC)   |
| SOGT      | Senior Official Group on Telecommunications (CEC)  |
| SP        | Security Protocol (SDNS)   |
| SPAG      | Standards Promotion and Applications Group   |
| SPARC     | Standards and Planning Requirements Committee  |
| SQL       | Standard Query Language (ISO)  |
| SSI       | System Software Interface  |
| SSP       | Subnetwork Specific Protocol (Network Layer)   |
| STAMINA   | Standard Automated Message Processing Interface for NATO's ACCISs  |
| STANAG    | NATO Standardization Agreement   |
| STC       | SHAPE Technical Centre   |
| STE       | Signalling Terminal  |
| STL       | Standard Text Language   |
| STN       | Switched Telephone Network   |
| STRIDA    | Systeme de Traitement et de Representation des Informations de Defense Aeriene                                       |
| STUR      | Specification Technique d'Utilisation Raccordement   |
| SUCOC     | Succession of Command  |
| SVID      | System V Interface Definition  |
| SWG       | Special Working Group (ISO JTC1)   |
| T         | Transport (profile)  |
| TA        | Connection Mode Transport Profile Using CLNS (ISP)   |
| TACSATCOM | Tactical Satellite Communications  |

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|         |   |
|---------|---|
| TADIL   | Tactical Data Link  |
| TAIS    | Target Architecture and Implementation Strategy (US DoD, DMS)   |
| TAOM    | Tactical Air Operations Module (US DoD)   |
| TB      | Connection Mode Transport Profile Using CONS (ISP)  |
| TBD     | To Be Determined  |
| TC      | Transport Connections; Technical Committee (ISO); Connection Mode Transport Profile Using TP0/TP2 Over CONS (ISP) |
| TCIS    | Technical Common Interface Standards (TSGCEE SG9)   |
| TCOS    | Technical Committee on Operating Systems (IEEE)   |
| TCP     | Transmission Control Protocol (US DoD)  |
| TCS     | Trusted Communications Sublayer (SANISI)  |
| TCSEC   | Trusted Computer System Evaluation Criteria (Orange Book)   |
| TD      | Connection Mode Transport Profile Using TP0 Over CONS (ISP)   |
| TE      | Connection Mode Transport Profile Using TP2 Over CONS (ISP)   |
| TEK     | Traffic Encryption Key  |
| TF      | Transfer Facility (ATCCIS)  |
| TFA     | Transparent File Access (POSIX)   |
| TIDP    | Technical Interface Design Plan   |
| TLV     | Tag-Length-Value  |
| TM      | Technical Memorandum; Terminal Management   |
| TMD     | Terminal Management Domain  |
| TMN     | Telecommunication Management Network (CCITT M.30)   |
| TOP     | Technical and Office Protocol   |
| TOR     | Terms of Reference  |
| TP      | Transaction Processing (OSI); Transport Protocol (OSI); Transport Class (OSI)                                     |
| TPDU    | Transport Protocol Data Unit (OSI)  |
| TPSUI   | Transaction Processing Service User Invocation  |
| TR      | Technical Report (ISO)  |
| TRI-TAC | Joint Tactical Communications Program (US DoD)  |
| TS      | Transport Service (OSI)   |
| TSA     | Time Synchronization Agent  |
| TSG     | Technical Study Group (ISO/IEC JTC1)  |
| TSGCEE  | Tri-Service Group on Communications and Electronic Equipment (NATO)   |
| TTC     | Telecommunications Technology Committee (Japan)   |
| TTCN    | Tree and Tabular Combined Notation (ISO)  |
| UA      | User Agent (MHS); Connectionless Mode Transport Profile Using CONS (ISP)  |
| UB      | Connectionless Mode Transport Profile Using CLNS (ISP)  |
| UER     | Union Europeenne de Radiodiffusion  |
| UIMS    | User Interface Management System  |

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|        |   |
|--------|---|
| UIT    | Union Internationale des Telecommunications (CCITT) |
| UK     | United Kingdom                                      |
| ULA    | Upper Layer Architecture (OSI)                      |
| UN     | United Nations                                      |
| US     | United States                                       |
| USGS   | United States Geological Survey                     |
| UTACCS | USAREUR Tactical Command and Control System         |
| UTE    | Union Technique de l'Electricite (France)           |
|        |   |
| VDT    | Visual Display Terminal                             |
| VPS    | Vector Product Standard                             |
| VSAT   | Very Small Aperture Terminal                        |
| VT     | Virtual Terminal (OSI Layer 7)                      |
| VTE    | Virtual Terminal Environment                        |
| VTP    | Virtual Terminal Protocol                           |
|        |   |
| WAN    | Wide Area Network                                   |
| WD     | Working Draft                                       |
| WDAD   | Working Draft Addendum (ISO)                        |
| WDAM   | Working Draft Amendment (ISO)                       |
| WDISP  | Working Draft International Standardized Profile    |
| WDTR   | Working Draft Technical Report                      |
| WG     | Working Group                                       |
| WP     | Working Paper (ATCCIS)                              |
| WSF    | Workstation Functional (CCITT M.30)                 |
| WWMCCS | World Wide Military Command and Control System      |
|        |   |
| XALS   | Extended Application Layer Structure                |
| XID    | Exchange Identification                             |
| XPG3   | Third Edition of the X/Open Portability Guide       |
| XSI    | X/Open System Interfaces                            |
| XTP    | Xpress Transfer Protocol                            |
| XVS    | X/Open System V Specification                       |
|        |   |
| ZSI    | German Information Security Agency                  |

**UNCLASSIFIED**

**INDEX**

AAP-6, 6.6.1.5  
Access Control, 4.3.4.2 (Directory)  
Ada Programming Language, 9.2.7.1  
Ada Programming Support Environment, 9.2.7.2, 9.2.7.3  
ACCS, 11.3  
ACE ACCIS, 11.2  
ACP 127, 4.4  
ACP 167, 6.6.1.5  
ACSE (ISO 8649, 8650, 10035), 4.3.1, 6.2.3, App D (Section VIII.D)  
ADatP-2, 6.6.1.5  
ADatP-3 (STANAG 5500), 6.6.1.5  
ADSIA, 6.6.1.2, 11.3  
Ada (ISO 8652), 9.2.7, App D (IX.G)  
Ada Bindings, 5.2.1 (POSIX)  
AHWG-Functional Profiles, 10.3.2  
AHWG-ISDN, 10.3.6  
AHWG-MMHS, 10.3.8  
AHWG-OSI Management, 8.2.1, 8.2.3, 8.2.6, 10.3.5  
AHWG-Security, 8.1.3, 10.3.7  
AIX, 5.3, 9.2.1  
ALS (ISO 9545), 4.2.3  
ANSI, 6.3.3, 6.4, 9.4.4  
Application Environmental Profile (AEP), 5.2.1  
Application Layer Structure (ISO 9545), 4.2.3  
Application Layer Standards, 10.4.7, App D (Section VIII)  
Application Layer Studies by JTC1, 4.2.3.1  
Application Options, 3.2.2, 4.3.1, 9.2.5, 9.3, 9.4.6, 10.3.3, 10.4.6, 11.6, 11.7,  
App D (Section VII), Table 2  
Application Portability, 5.2.1, 9.2.1, 9.2.5, 9.4  
Application Service Elements, 4.2.3.3, 4.3.5  
Application Service Objects, 4.2.3.3  
Applications Portability Profile (NIST), 5.3, 9.4.4  
Applications Programming Interface, 9.4.4  
Approach to OSI, 10.3.2  
Asia-Oceania Workshop, 9.2.5.2, 9.3.6  
ASN.1 (ISO 8824, 8825), 4.3.1, 4.3.6, 4.4, 6.2.3, App D (Section VII.C)



## UNCLASSIFIED

Association Control Service Element (ISO 8649, 8650, 10035), 4.3.5.1  
ATCCIS Architecture, 2.1.1, 2.1.3  
ATCCIS Background, 2.1  
ATCCIS Phase I and Phase II, v  
ATCCIS Permanent Working Group (PWG), iii  
ATCCIS Steering Group (ASG), iii  
ATCCIS Work Plan, iv

Base Standards, 2.2  
Basic Encoding Rules for ASN.1 (ISO 8825), 4.3.6.2  
Basic Ensemble, 2.1, 3.1, 4.1  
Basic Facilities, 2.1.1, 3.1, 3.2ff, 4.1  
Basic Interoperability, 2.1.2, 3.1  
Basic Mode Service Standards, App D (III.B)  
BASIC Programming Language, 9.2.7.9  
BICES, 11.4

C Programming Language, 9.2.7.5, App D (IX.G)  
CAE, 5.3, 9.2.1, 9.4.3, 9.4.5  
CAIS, 9.2.7.3  
CALs, 9.2.5.1, 9.2.5.3  
CCITT X.25, 3.2.2, 9.4.6, 10.4.2, 11.3, 11.6, 11.7, App A (Section 1.3.3),  
App C (Section 3.1)  
CCITT X.400, 3.2.1, 4.3.1ff, 4.3.1, 4.4, 10.3.8, 11.6, 11.7  
CCITT/CCIR, 3.2.1, 6.3.5, App D, App E, App F (Section 3.2)  
CCR (ISO 9804, 9805), 4.3.5.2, 6.2.3.1, 6.2.3.3, App D (Section VIII.E)  
CEN/CENELEC, 4.3.3.1, App F (Section 3.3)  
CEPT, App F (Section 3.11)  
CGI (DIS 9636), 9.2.3, 9.2.8.1, App D (Section VIII.W)  
CGM (ISO 8632), 9.2.3, 9.4.4, App D (Section VIII.Y)  
Classification Guide (NATO Network Security), 10.3.6  
CMIS/CMIP (ISO 9595, 9596), 8.2, App D (Section I.E)  
CO-Mode and CL-Mode Interworking, 3.2.3, 4.2.2, 9.4.6  
COBOL Programming Language, 9.2.7.6  
CODASYL, 6.3  
Coded Character Set Standards, App D (Section IX.E)  
Coded Representation Standards, App D (Section IX.D)  
Command Language and Panel Interface, 6.2.4  
Common Applications Environment (X/Open), 5.3, 9.2.1, 9.4.3, 9.4.5  
Computer Graphics Interface (CGI, DIS 9636), 9.2.3.4  
Computer Graphics Metafile (CGM, ISO 8632), 9.2.3  
Computer Graphics Reference Model, 9.2.3

## UNCLASSIFIED

Conceptual Data Modelling Facility, 6.2.5  
Conceptual Schema, 6.1.2  
Conclusions, 12.1, 12.2  
Configuration Management, 8.2.2  
Conformance Testing, 5.2.1, 8.4, 10.3.3, App D (Section I.G)  
Connection-Oriented (CO) Services, 3.2.3, 4.3.1, 9.3.2  
Connectionless-Oriented (CL) Services, 3.2.3, 4.3.1, 9.3.2  
COS/COSINE, 8.4, 9.5, App F (Section 3.12)  
CSNI (WG/3), 10.3.4  
CTS-WAN, 8.4

Data Compression, 9.2.4.4  
Data Definition Language (DDL), 6.1  
Data Element Standardization, 6.5  
Data Dictionary, 6.1, 6.2.4  
Data Link Layer Standards, App D (Section III)  
Data Management, 6.1ff, 6.6, App D (Section VIII.Q)  
Data Management Facility (DMF), 2.1, 3.1, 4.1, 6.1ff  
Data Management Issues, 6.6.1, 6.6.2, 6.6.3  
Data Management Policy, 6.6.1 (NATO)  
Data Management Reference Model (DP 10032), 6.2.1, App D (Section VIII.Q)  
Data Management Requirements, 6.6.1, 6.6.3  
Data Model, 6.1  
Data Representations, 6.5ff  
Data Stream Interface, 9.2.2.5  
Database, 6.1ff, 6.2.3, 10.3.3  
Database Language Standards (ISO 8907, 9075), App D (Section VIII.R)  
Datagram (CL) Service, 3.2.3, App C (Section 3.2)  
DDN and DMS, App C (Section 2.7)  
DFR (DP 10166), 9.2.9.2, App D (Section VIII.X)  
DIGEST, 9.2.4.1  
Digital Terrain Data, 9.2.4  
Directory Information Base (DIB), 4.3.4.1  
Directory Services (ISO 9594), 4.3.1, 4.3.4, 10.3.3, 10.3.8, App D  
(Section VIII.B)  
Distributed Applications, 4.2.4, 6.6.3  
Distributed Databases, 6.3.1  
Distributed Office Applications, 9.2.5.4 (DPA), 9.2.9.2 (DFR)  
Distributed Office Application Model (DOAM, DIS 10031), 9.2.5.4  
Distributed Transaction Processing Standards (DIS 10026), 6.2.6, App D  
(Section VIII.S)  
DML, 6.7

## UNCLASSIFIED

DOAM (DIS 10031), 9.2.5.4, App D (Section VIII.X)  
Document Filing and Retrieval (DFR, DIS 10166), 9.2.5.4, 9.2.9  
Document Interchange Formats, 9.2.5  
Document Printing Application (DPA), 9.2.5.4  
Domain, 6.1.3  
Domain Name System (US DoD), 4.3.7.5  
Drivability, 9.2.2.5, 9.4.4  
DTAM (CCITT T.400 Series), 9.2.2.4, 9.2.9.1  
DVI, 9.2.4.5

ECMA, 4.3.7, 6.2.3.1, 6.3, 8.1.2, App F (Section 3.4)  
EDIFACT, 9.2.5.1  
Electronic Data Interchange (EDI) and EDIFACT (ISO 9735), 6.6.2, 9.2.5.1,  
App D (Section IX.B)  
EMUG, App F (Section 3.7)  
Encoding for CGM, 9.2.3.2  
Enhanced Search, 4.3.4.2 (Directory)  
Enhanced Interoperability, 9.1, 9.2  
EPHOS, 9.3.4  
Ergonomics, 9.2.2.1  
Error Correction, 4.4  
Error Detection, 4.4  
ESPRIT, 9.2.7.3, 9.2.7.10  
Estelle Formal Description Technique (ISO 9074), 8.5.1  
ETSI, App F (Section 3.11)  
EWOS, 4.3.3.1, 9.2.2.3, 9.2.5.2, 9.3.2, 9.3.6, 9.5, App F (Section 3.8)  
Extended Application Layer Structure (ISO 9545/WDAD2), 4.2.3.3  
Export/Import, 6.2.4  
Extended Facility Set, 9.2.2.3

Fault Management, 8.2.2  
File Transfer Protocol (US DoD), 4.3.7.5  
FIPS 146 (US GOSIP), 9.3.3  
FIPS 151 (POSIX, ISO 9945), 9.2.1  
Formal Description Techniques (FDTs), 8.5, 10.3.3, App D (Section I.C)  
FORMETS, 6.6.1.5, 11.3  
Forms Interface Management System, 9.2.2.4  
FORTRAN Programming Language, 9.2.7.7  
FTAM (ISO 8571), 3.2.1, 3.2.2, 4.3.3, 9.2.9.1, 9.2.9.2, 9.2.9.3, 9.4.6, 10.3.3,  
11.3, App D (Section VIII.J)  
Functional Profile (TR 10000), 2.3, 9.3.2, 10.3.1, 10.3.2, App B  
Functional Profile (NATO), 9.3.1, App B

## UNCLASSIFIED

G-LOTOS (ISO 8807 PDAD1), 8.5.4  
Goal (NATO C3) Architecture, 11.1  
GOSIP (UK, US), 9.3.3, 9.3.4, 9.3.5  
Graphic Information Exchange, 9.2.4  
Graphical User Interface, 9.2.2.5  
Graphics, 9.2.3, 9.4ff  
Graphics Kernel System (ISO 7942, 8805, 8806, 8651), 9.2.2.5, 9.2.3.3,  
9.2.8.1, 9.4.4, 9.4.5, App D (Section VIII.U)

HDLC Layer 2 Standards, App D (Section III.C)  
Human-Computer Interface (HCI), 9.2.2

IDSS, iv  
IEEE P1003 (POSIX, DIS 9945), 5.2.1  
IEEE P1201 (UIMS), 9.2.2, 9.4.4  
IFIP, App F (Section 3.15)  
IGES, 9.2.3.6, 9.4.4, 9.4.6  
Implementor's Workshops (NIST), 4.3.3.2, 9.3.6  
Information Processing Equipment Standards, App D (Section IX.H)  
International Standardized Profile (ISP), 4.3.3.2, 9.3.2  
Internet (US DoD), 4.3.7.4  
Interoperability Parameters, 1.4, 2.3, 3.1, App A, App C  
Interfaces for Applications Portability (IAP), 9.2  
Interoperability, 3ff  
Interoperability Parameters for RS-232D and RS-423A, App A (Section 1.3.1)  
Interworking for MHS, 4.3.2.3  
Interoperability Parameters for STANAG 4202, App A (Section 1.3.3)  
Interoperability Parameters for CCITT X.25 LAP B, App A (Section 1.3.4)  
Interoperability Parameters for Combat Net Radio, App A (Section 1.3.3), App C  
(Section 3.1)  
Interoperability Parameters for Switched Networks, App A (Section 1.3.4), App C  
(Section 3.1)  
Interworking of Layers and Relay (DP 10028, TR 10029, DP 10038,  
DTR 10172), 4.2.2  
IRDS (DP 8800, ISO 10027), 5.2.1, 6.2.4, 9.4.4, App D (Section VIII.O)  
ISAM, 5.3, 9.4.3  
ISDN, 4.3.1, 10.3, 10.3.6, 11.3, App D, App E  
ISO/IEC, 3.2.1, App D, App E, App F (Section 3.1), App G  
ITI, 8.4  
ITSTC, App F (Section 3.10)

**UNCLASSIFIED**

Job Transfer and Manipulation (JTM, ISO 8831, 8832), 3.2.1, 4.3.1, 4.3.7.2,  
9.2.10, App D (Section VIII.M)  
JPEG, 9.2.4.5

Language Bindings, 5.2.1, 6.2.1, 9.2.3, 9.2.7  
LANs 4.2.1, 8.1.4, 9.4.6, 10.3.2, App D (II.F)  
Layers (see Reference Model for OSI)  
Link 1 Replacement (BICES), 11.4  
LISP Programming Language, 9.2.7.8  
Local Area Network Standards, App D (II.F)  
Long-Term Defense Plan, v  
LOTOS Formal Description Technique (ISO 8807), 8.5.1, 8.5.4  
Lower Layer STANAGs, 10.3.2, 10.4ff  
LTR, App C (Section 10)

Man-Machine Interface (See Human-Computer Interface)  
Man-Machine Language Standards (CCITT 300 Series), App D (Section IX.F)  
Management (Data), 6.5, 6.6  
Management (DMF), 6.1.3  
Management Guide, 10.3.5  
Management (OSI), 4.3.1, 4.3.2, 8.2ff, 10.3.5  
Manufacturing Message Specification (DIS 9506), 4.3.2.2, App D (Section VIII.I)  
MAP, 4.3.2.2  
Media Access Control (MAC), 4.2.2, App B, App D (Section II.F)  
Media-Independent Data Link Architecture (MIDLA), 10.3.4  
Message Handling Service (MHS, CCITT X.400, ISO 10021), 3.2.1, 4.3.2, 4.4,  
10.3.8, 11.6, 11.7  
Metadata, 6.2.5  
Methodology, 2.1ff  
MHS (CCITT X.400, ISO 10021), 3.2.1, 4.3.2, 4.4, 9.4.6, 10.3.8, 11.6, 11.7,  
App D (Section VIII.G)  
Military Message Handling System (MMHS), 10.3.3, 10.3.8, 11.6, 11.7  
Military Requirements (Features), 8.1ff, 10.2, 10.3 ff  
Models, 4.2.1 (OSI), 4.3.4.2 (Directory), 4.3.7.4 (ECMA Management), 4.3.5.3  
(RTSE), 4.3.5.4 (ROSE), 6.2.1 (Data Management), 6.2.3.1 (RDA),  
6.2.4 (IRDS), 6.2.5 (Data Models), 6.2.6 (TP), 6.2.7 (ODP), 9.2.2.4  
(TM), 9.2.2.5 (X-Windows), 9.2.3 (Computer Graphics), 9.4.1 (Open  
Systems), 10.4 (NATO OSI)  
MOTIS (ISO 10021), 3.2.1, 4.3.2, App D (Section VIII.H)  
MTS, App C (Sections 2.7, 3.1, 3.2)  
Multipeer Data Transmission (ISO 7498-1/PDAD2), 4.2.1, 10.3.2  
  
NACISA, 6.6.1.1, 11.2, 11.7

**UNCLASSIFIED**

Naming and Addressing (ISO 7498-3), 4.2.1  
NATO C3 Architecture, 11.1  
NATO C3 Master Plan, 11.1  
NATO Functional Profile, 9.3.1, App B  
NATO Interoperability Management Plan, 10.2  
NATO Organizations, App F  
NATO OSI STANAGs, 10.2ff, App H (Section I)  
NATO Reference Model (STANAG 4250), 10.2, App D (Section I.A)  
NCC, 8.4  
NDL (Database Language, ISO 8907), 6.2.1  
Network Independent Interface (NIIF), 10.5  
Network Layer Standards, App D (Section IV)  
Network Layer Substructure, 3.2.2  
Network Management (OSI), 4.3.1, 4.3.2, 8.2ff, 10.3.5  
NFR90, 10.5  
NFS, 9.4.4  
NIAG, 10.3, 10.5  
NIMP, 10.2  
NIST, 9.4.4  
NIST OSI Implementor's Workshop (NOIW), 4.3.3.2, 9.2.5.2, 9.3.3, 9.3.6,  
9.4.4  
NMOS, 11.5  
NOSA, 8.1.1ff, 10.3.6  
NTIS Transition Strategy, 4.3.1, 4.3.2.3, 8.2.3, 9.3.2, 10.3.1ff, 10.4ff, 11.2ff,  
App B  
Nunn Initiative, 10.3.4  
  
ODA (ISO 8613), 9.2.5.2, 9.2.9.1, 9.4.4, App D (Section VIII.X)  
ODIF (ISO 8613), 9.2.5.2, 9.4.4, App D (Section VIII.X)  
Office Document Language, 9.2.5.2  
Office Document Architecture (ODA, ISO 8613), 9.2.5.2, 9.2.9.1, 9.4.4, App D  
(Section VIII.X)  
OPEN 88, 5.3  
Open Distributed Processing (ODP), 3.2.1, 4.3.7.1, 6.2.7, 6.3.1, 9.2.6  
Open Distributed Processing Standards, 6.2.7, App D (Section VIII.T)  
Open Software Foundation (OSF), 5.3, 9.2.1  
  
Open Systems Interconnection, 3.1, 4.1ff  
Operating System Interfaces, 5.2, 5.2.1, 9.2.1, App D (Section VIII.C)  
Organizations, App F, App G  
OSCRL, 9.2.1  
OSI Conformance Testing (DIS 9646), 8.2, App D (Section I.G)

## UNCLASSIFIED

OSI Management (ISO 9595, 9596, 10040, 10165, 10166), 8.2, App D  
(Section I.E)  
OSI Registration Authorities (DIS 9834), 8.3, App D (Section I.F)  
OSI Seven-Layer Reference Model, 3.2  
OSF, 5.3, 9.4.5, App F (Section 3.14)  
OSITOP, 9.4.6, App F (Section 3.6)  
OSI STANAGs, 10.1, 10.2, 10.3ff, 10.4ff  
Overlapped Access ((ISO 8571/PDAD2), 4.3.3.1

Packet Switched Layer 3 Standards, App D (Section IV.B)  
PAGODA, 9.2.5.2  
Partially Replicated Database, 6.1.1  
Partitioned Database, 6.1.1  
Pascal Programming Language (ISO 7185), 9.2.7.4, App D (IX.G)  
PCTE, 9.2.7.3, 9.2.7.10  
PDES, 9.4.4  
PEDI, 9.2.5.1  
PG6 (TSGCEE), 10.3  
PHIGS (ISO 9592, 9593), 9.2.2.5, 9.2.3.5, 9.2.8.1, 9.4.5, App D (Section  
VIII.V)  
Photographic Data, 9.2.4.5  
Physical Layer Standards, App D (Section II)  
PICS Proforma, 4.3.3.1 (FTAM), 4.3.4.2 (Directory), 6.2.6 (TP), 8.4  
(Conformance Testing), 9.2.2.3 (VT)  
Portable Common Tool Environment (PCTE), 9.2.7.3, 9.2.7.10  
Portability, 9.1, 9.2, 9.4  
POSI, 9.3.6, 9.5, App F (Section 3.16)  
POSIX (ISO 9945), 5.2.1, 5.3, 5.4, 9.2.1, 9.2.2.1, 9.2.8.1, 9.4.2ff, App D  
(Section VIII.B)  
Presentation Layer Standards, App D (Section VII)  
Programmer's Hierarchical Interactive Graphics System (PHIGS), 9.2.3  
Programming Language Bindings, 9.2.8.1  
Programming Language Standards, 9.2.7, App D (Section IX.G)  
PWG, iii

Quadrilateral Interoperability Programme, 11.6, 11.7  
Quality of Service (QOS), 8.2.6, 10.2, 10.3.3, 10.3.5

Raster, 9.2.3.4, 9.2.5.2  
RDA (DP 9579), 3.2.1, 4.3.1, 6.2.3  
RDT (DIS 10031-2), 9.2.9.3  
Recommendations, 12.3  
Reference Model for Computer Graphics, 9.2.3

**UNCLASSIFIED**

Reference Model for Data Management, 6.2.1  
Reference Model for ODP, 6.2.7  
Reference Model for OSI (ISO 7498), 3.2, 4.2.1, 4.4, App D (Section I.A)  
Referenced Data Transfer (RDT, DIS 10031-2), 9.2.9.3  
Registration, 5.1, 10.3.3, 10.3.8, 8.3, App D (Section I.F)  
Relational Database, 6.1.3  
Relaying and Interworking of Layers (DP 10028, TR 10029, DP 10038, DTR 10172), 4.2.2  
Relay Options, 3.2.1, 3.2.2, 4.2.2, 4.3.1, App B, Table 4  
Reliable Transfer (RT, ISO 9066), 4.3.5.3, 6.2.3.2, App D (Section VIII.F)  
Remote Actions (RA) Service, 4.3.3.1  
Remote Procedure Call (RPC, DIS 10148-Withdrawn), 4.3.3.1, 4.3.5.5, 9.4.4  
Remote Data Access (RDA, DP 9579), 3.2.1, 4.3.1, 6.2.3.1, App D (Section VIII.P)  
Remote Open Document Editing (RODE), 9.2.9.1  
Remote Operations Service Elements (ROSE, ISO 9072), 4.3.1, 4.3.5.4, 4.3.5.5, 6.2.3.1, 6.2.3.2, App D (Section VIII.F)  
Replication and Knowledge Management, 4.3.4.2 (Directory)  
Representation Standards, App D (Section IX.D)  
Representations (Data), 6.5  
ROSE (ISO 9072), 4.3.5.4, 6.2.3.2, App D (Section VIII.F)  
RTSE (ISO 9066), 4.3.5.3, App D (Section VIII.F)  
Routing and Relay Layer 3 Standards, App D (Section IV.E)  
Routing Framework (TR 9575), App D (Section I.A)

SANISI, 8.1.1ff, 10.3.6  
Schema, 4.3.4.2 (Directory), 6.2.5 (Data Models)  
SDIF (ISO 8879), 9.2.5  
SDL (Formal Description Technique), 8.5.1  
SDNS, 8.1.1ff, 10.3.6  
SDTS, 9.2.4.2  
Security, 4.4, 6.1, 6.7, 8.1, 9.2ff, 10.3.6, App D (Section I.D)  
Security Architecture (ISO 7498-2), 4.2.1  
Security Architecture (NATO), 8.1.1, 8.1.3  
Security Framework (DP 10181), 8.1.1, 8.1.2.1  
Service Control Facility (SCF), 2.1, 3.1, 4.1, 5.1ff  
Session Layer Standards, App D (Section VI)  
Seven Layers (see Reference Model for OSI)  
SGML (ISO 8879, 9069; DIS 9070; TR 9573; DTR 10037), 9.2.5.3, 9.4.4, App D (Section VIII.Z)  
SG9 (TSGCEE), 10.3  
SG11 (TSGCEE), 10.3  
Simple Mail Transfer Protocol (US DoD), 4.3.7.5



**UNCLASSIFIED**

SINGARS, App C (Section 2.7)  
Software Development and Documentation Standards, 9.2.7, 9.2.8, App D  
(Section IX.G)  
Software Engineering Environments, 9.2.8.2  
Software Environment, 9.2.8  
SP3, SP4, 8.1.1ff, 10.3.6  
SPAG, 4.3.3.2, 9.4ff, 9.5, App F (Section 3.5)  
SQL (Database Language, ISO 9075), 5.2.1, 5.3, 6.2.2.2, 6.4, 6.7, 9.4.3, 9.4.4  
SQL Specialization, 6.2.3.1 (RDA)  
STAMINA, 11.2, 11.7  
STANAG 4202, App A (Section 1.3.3)  
STANAG 4250, 10.2, 10.4, App H (Section I)  
STANAGs (non-OSI), 10.5, App A  
STANAGs (OSI), 10.1, 10.2, 10.3ff, 10.4ff  
STANAGs 4250-4266, 10.4ff, App H (Section I)  
Standard Generalized Markup Language (SGML), 9.2.5  
Standards Applicable to Enhanced Interoperability, 9.1ff  
Standards Applicable to NATO OSI, 10.4  
Standards Applicable to the DMF, 6.2, 6.3, 6.4, 8.1ff  
Standards Applicable to the SCF, 5.2, 8.1ff  
Standards Applicable to the SMF, 7.2, 8.1ff  
Standards Applicable to the TF, 4.3, 8.1ff  
Standards Organizations, App F  
Status of ISO Standards, 4.3.1, 5.2.1, 6.2, 6.3, 6.4, 8.1.2, 8.2, 8.3, 8.4, 8.5,  
App D, App E, App G  
Status of NATO OSI Standards, 10.3, 10.4  
Structure of Management Information (DIS 10165), 8.2, App D (Section I.E)  
Sub-Transaction, 6.2.6  
System Management Facility (SMF), 2.1, 3.1, 4.1, 7.1ff  
Systems Management (DIS 10040, DIS 10164), 8.2.1, App D (Section I.E)  
  
Taxonomy (TR 10000), 9.3.2, 10.3.1, 10.3.2, App D (Section I.H)  
TCIS (now NTIS) Transition Strategy, 4.3.1, 4.3.2.3, 8.2.3, 9.3.2, 10.3.1ff,  
10.4ff, 11.2ff, App B  
TCP/IP (US DoD), 4.3.7.5  
Telematic Services, 3.2.1, 4.3.1, App D (Section VIII.N)  
TELNET (US DoD), 4.3.7.5  
Terminal Management (TM), 9.2.2.4  
Test Suite, 4.3.3.1 (FTAM), 4.3.4.2 (Directory), 4.3.5.1 (ACSE), 9.2.2.3 (VT)  
Time Synchronization, 4.3.7.2  
Toolkit, 9.2.2.5  
TOP, 8.4, 9.4.6  
Transaction Processing (TP), 3.2.1, 4.3.1, 4.3.7.1, 6.2.6

**UNCLASSIFIED**

Transaction Processing Standards (DIS 10026), 6.2.6, App D (Section VIII.S)  
Transfer Facility (TF), 2.1, 3.1, 4.1ff  
Transport Classes, 3.2.3  
Transport Layer Standards, App D (Section V)  
Transport Options, 3.2.1, 3.2.2, 4.3.1, Table 3  
Trusted Communications Sublayer (TCS), 8.1.3.2, 10.3.6  
TSGCEE SG9, 10.2, 10.3ff, App F (Sections 2.1, 2.2)  
TSGCEE SG9 MMHS AHWG Work Plan, 10.3.5  
TSGCEE SG9 OSI Management AHWG Work Plan, 10.3.8  
TSGCEE SG9 Nunn Initiatives, 10.3.4  
TSGCEE SG9 Security AHWG Work Plan, 10.3.7  
TSGCEE SG9 WG1 Work Plan (Lower Layers), 10.3.2  
TSGCEE SG9 WG2 Work Plan (Upper Layers), 10.3.3  
TSGCEE SG9 WG3 Work Plan (CSNI), 10.3.4  
TTCN, 8.5

UER, App F (Section 3.11)  
UIMS (IEEE P1201.3), 9.2.2.4, 9.4.4  
UK GOSIP, 9.3.3  
UNIX, 5.2.1, 5.3, 9.2.1, 9.4ff  
Upper Layer Architecture (ULA) (ISO 7498-1/PDAD3), 4.2.1, App D  
(Section VIII)  
US GOSIP, 9.3.3  
User Descriptor Object, 9.2.2.4  
User Interfaces, 9.2.2

Virtual Circuit (CO) Service, 3.2.2  
Virtual Terminal (VT, ISO 9040, 9041), 3.2.1, 4.3.1, 4.3.7.2, 9.2.2.3, 9.4.6,  
App D (Section VIII.K)  
Visual Display Terminal (VDT, DIS 9241), 9.2.2.2, App D (Section VIII.L)  
Vocabulary and Representation Standards, App D (Section IX.D)  
VPS, 9.2.4.2

WG1 (TSGCEE), 10.3.2  
WG2 (TSGCEE), 10.3.3  
WG3 (TSGCEE), 10.3.4  
Windows, 9.2.2.4, 9.2.2.5, 9.4.3, 9.4.4, 9.4.5  
Workshops, 9.3.6  
WP 7L, 6.5, 12.2  
WP 22, 1.1  
WP 23, 1.1  
WP 24, 1.1, 4.1, 6.1, 7.1

**UNCLASSIFIED**

XALS (ISO 9545/WDAD2), 4.2.3.3  
X/OPEN, 5.3, 9.4.2, App F (Section 3.13)  
X/Windows, 9.2.2, 9.4.3, 9.4.4, 9.4.5

Index-12

**UNCLASSIFIED**