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PROPOSED MODIFICATIONS TO DCAC-370-175-13

13 JANUARY 1989

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION / AVAILABILITY OF REPORT Unlimited A
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE OADR	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Computer Sciences Corporation 6b OFFICE SYMBOL (If applicable) M/C 266	7a. NAME OF MONITORING ORGANIZATION DCA/ Defense Communications Engineering Center
6c. ADDRESS (City, State, and ZIP Code) 3160 Fairview Park Drive Falls Church, VA 22042	7b ADDRESS (City, State, and ZIP Code) 1860 Wiehle Avenue Reston, VA 22090
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Defense Communications Agency 8b OFFICE SYMBOL (If applicable) R600	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER DCA100-87-C-0013
8c. ADDRESS (City, State, and ZIP Code) 8th & South Courthouse Road Arlington, VA 22204	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. 87-9 / WORK UNIT ACCESSION NO

11. TITLE (Include Security Classification)
Proposed Modifications to DCAC 370-175-13 (U)

12. PERSONAL AUTHOR(S)
Roix, Robert; Christensen, John; Namdar, Nina

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Final Technical	FROM 6/88 TO 1/89	89, 1, 13	57

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Changes, modifications, Primary Rate Interface (PRI), video, data, interface, ISDN

19. ABSTRACT (Continue on reverse if necessary and identify by block number) The primary purpose of this document is to update and expand the current "DSN System Interface Criteria" circular. This document establishes the physical and electrical interface criteria necessary to provide engineering guidance to interconnect the various elements of the worldwide DSN with its supporting transmission facilities, other telecommunications systems, and commercial networks. This document identifies the standard interface points within the DSN and defines the functional and electrical characteristics of these interface points and the network as a whole.

This document develops specific draft input for revisions to DCA Circular 370-175-13. The format for this task report focuses on the basic circular revision in terms of deletions, modifications, and additions. DCEC specifically requested that information be developed addressing some interfaces found primarily in the future DSN: (1) ISDN Primary Rate Interface - Modification to Chap. 12, ISDN Interfaces, (2) Interfaces for optical cable terminals - Modifications to chaps. 6, 8, & 14, as appropriate, and (3) Video and switched/non-switched data interfaces - New chapter X, entitled "DSN Special Service Interfaces."

20 DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a NAME OF RESPONSIBLE INDIVIDUAL James Johnson	22b TELEPHONE (Include Area Code) 703/876-1057 22c OFFICE SYMBOL DCEC R610

PROPOSED MODIFICATIONS TO DCAC 370-175-13

TASK 87-9

FINAL

13 JANUARY 1989

Prepared for:

DEFENSE COMMUNICATIONS AGENCY
DEFENSE COMMUNICATIONS ENGINEERING CENTER
1860 WIEHLE AVENUE
RESTON, VIRGINIA 22090

Prepared By:

COMPUTER SCIENCES CORPORATION
3160 FAIRVIEW PARK DRIVE
FALLS CHURCH, VIRGINIA 22042

CONTRACT DCA100-87-C-0013

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Defense Switched Network (DSN) System Interface Criteria, DCAC 370-175-13

DCAC-370-175-13, "Defense Switched Network (DSN) System Interface Criteria", dated April 1988, specifies technical interface criteria and associated information necessary to interconnect the end users with their associated supporting DSN switch, and to interconnect the wide variety of DSN switches with the appropriate interexchange carrier facilities in order to create a fully compatible Defense Switched Network.

1.1 Purpose

This document develops required and recommended changes, additions and modifications to DCAC 370-175-13, Defense Switched Network (DSN) System Interface Criteria, dated April 1988. The basic DCA circular was sent to the field in August 1988, no MILDEP comments have been received regarding that previously published document. This document provides recommended changes for the next revision of DCA Circular DCAC-370-175-13. It contains recommendations to modify and update the aforementioned circular. While this report does not intend to be the next edition of said circular, it is intended to provide the foundation for change in terms of modifications, additions, and deletions.

1.2 Scope

The scope of this document is to develop specific draft input for revisions to DCA Circular 370-175-13. After reviewing the current version of DCAC-370-175-13, and several meetings at DCEC, it was agreed that the format for this document would focus on the basic DCA circular revision in terms of deletions, modifications, and additions. Deletions include the elimination of incorrect or inapproriate information. Modifications include revising the text where necessary; including up-to-date analog and digital interface information based on the T1 and CCITT specifications. In the area of Additions, DCEC requested that information be developed addressing specific types of interfaces found primarily in the future DSN. Initially, six new areas to be addressed were identified as:

* ISDN Primary Rate Interface

* ISDN interface specifications to interconnect equipment using MF signaling to equipment using CCS No. 7 Signaling

* Interfaces with high speed digital switched or non-switched services

* Video Interfaces

* Switched/non-switched Data Interfaces

* Interfaces for optical cable terminals.

After some discussion and definition of these six areas, two were placed in a held in abeyance catagory by the Task Officer and will not be addressed in this product. It was agreed that the new areas of additional information would be covered in the following manner:

* ISDN Primary Rate Interface - Modification to Chapter 12, ISDN Interfaces

* Interfaces for optical cable terminals - Modification to Chapters 6, 8, and 14 as appropriate. It should be noted that while this area is referred to as "fiber optic interface", the physical interface takes place in the electrical domain and not in the optical domain. No special interface characteristics or criteria is required, the digital interface information already contained in the DCAC is appropriate and media independent.

* Video and Switched/non-switched Data Interfaces would be combined into a new chapter X entitled "DSN Special Service Interfaces".

1.3 Deletions

The current version of the DCA circular contains 15 Chapters of information. Much of this information was included in previous editions because no related documents had been published. At this time, the information is contained in other published DSN related documents and should be considered for elimination from this publication. Specifically, much of the information contained in Chapters 3 through 7 does not belong in this document, since the information does not specifically address DSN interface criteria. This information is more than adequately covered in the current version of the DSN System Description and DSN System Specification.

1.4 Modifications

Modifications include text revisions and rewritten chapters. Text revisions include narrative changes and errata sheet changes to the existing DCA circular, wherever changes were too extensive, the entire chapter was rewritten. It is recommended that this material be included in the next edition of the basic circular.

1.4.1 Pen and Ink Corrections

The following pages represent pen and ink changes that need to be made to the basic DCAC. They are documented in -ERRATA Sheet change format and primarily consist of editorial type changes. These changes could either be sent to the field as change 1 to the April 88 publication or held and incorporated in the next version of the document.

The following are changes to Defense Switched Network (DSN) System Interface Criteria - DCAC 370-175-13, dated April 1988.

pg vi	Table 6-1. Change DSN Nodal Switch Performance Requirements to read "DSN Switch Transmission Performance Requirements."
pg vi	Table 6-2. Same as above.
pg xii	Under CCS - 4th line - delete "(2) Common Channel Signaling."
pg 5-1	Paragraph 2a. Last sentence - change 65 milliseconds to read "60 milliseconds."
pg 6-1	Paragraph 1, next to last sentence. Change to read "includes the European, Pacific, and CONUS areas."
pg 6-1	Paragraph 1a. Change Overseas Reference Segment 640 km to read "Overseas Terrestrial Reference Segment 640 km."
pg 6-11	First paragraph, first word. Change "DMATS" to read "Defense Metropolitan Area Telephone System (DMATS)."

pg 6-30 Same as pg vi.

pg 6-31 Same as pg vi.

pg 6-32 Same as pg vi.

pg 6-33 Same as pg vi.

pg 8-1 Paragraph 1, second sentence. After DSN switching system add "and subsystems. These digital interface specifications are transmission media independent. The interface takes place electrically and can include all types of media."

pg 8-2 Add footnote to Figure 8-1 - Transmission Facility Equipment*.

*Transmission terminal equipment may be any type of media including coaxial cable, fiber optic cable, radio, microwave, tropo, or satellite.

The electrical specifications of this interface are identical and are independent of transmission media.

pg. 8-3 Table 8-1. Delete the word "subject."

After line rate change "1.544 megabits per second ±32 ppm" to read 1.544 mb/s ±50 ppm.

Insert solid line to divide electrical characteristics from framing characteristics.

pg 8-3 Paragraph (2), first sentence. Change minimum number to read "minimum 12.5 percent."

pg 8-3 Table 8-1. After line rate change "1.544 megabits per second ±32 ppm to read 1.544 Mb/s ±50 ppm."

pg 8-4 Table 8-1. Under Framing Strategy and Out of Frame Detection after the word "generated" add "and notify the DSN surveillance center."

pg 8-6 Table 8-2. Delete the word "subject".

pg 8-7 f. Hardware Requirements. "Interface compatibility is contained in paragraph 2 of this chapter".

Change "paragraph 2 of this chapter" to read "Tables 8-1 and 8-3 of this chapter".

pg 8-8 Table 8-3. Delete the word "subject". Insert a solid line to divide electrical characteristics from framing characteristics.

pg 8-9 Paragraph (e). Change lower-rate to read "subrate."

Paragraph (f). Change 500-bits/s to read "500 b/s."

pg 8-11	Paragraph 4b. Change title to read "End-to-End Bit Count Integrity Consideration."
pg 8-22	Table 8-9. Delete the word "subject".
pg 8-27	Table 8-10. Delete the word "subject".
pg 8-33	Table 8-11. Delete the word "subject".
pg 8-36	Table 8-12. Delete the word "subject".
pg 9-1	Paragraph 1a(1)2. Change "Secure-voice" to read Secure voice."
pg 9-10	Figure 9-7. Change (FCC-99) to read (FCC-98).
pg 9-14/9-24	Change sentence. "All calls from the DSN toward the PBX are completed by the PBX attendant" to read "All calls from a DSN switch through the PBX are completed by the PBX attendant."
pg 9-15	Figure 9-8. Change drawing as follows:

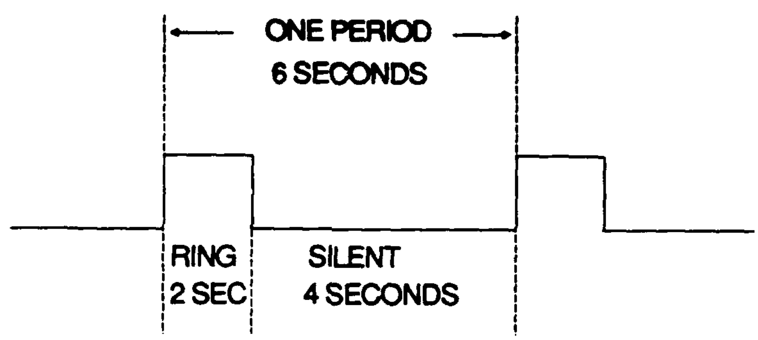

FIGURE 9-8 RINGING SIGNAL TELSET (10 IPM)

pg 9-16.	Figure 9-9. Change caption to read "Precedence Alerting Signal to Telset (30 IPM)". Delete "offhook" on both entries.
pg 9-22	Paragraph commencing "The cadence . . . Delete all after "OFF" and add "for routing calls; for precedence calls, ringing toward the station equipment is 1.65 seconds ON followed by 3.5 seconds OFF. Repeated until called party answers or calling party goes on hook."
pg 9-24	Change sentence. "Precedence calls about routine" to read "Precedence calls above routine".
pg 9-25	Item g. Delete "Continue from page 9-29".
pg 10-3	Paragraph 5b. Delete second sentence. In third sentence after "European" add "and Pacific."

1.4.2 Replacement Chapters

It is recommended that the description of the DSN system and associated environment as contained in Chapters 1 and 2 be replaced with the revised text that is attached as Appendix A & B. The definitions and system environment have changed since the original text was written under the GTE contract. It is very important that readers have a good grasp of the environment in order to understand the interface requirements and criteria.

Additionally, attached as enclosures C & D are new manuscript versions for chapters 12 and 14. The existing versions of these chapters should be replaced by these rewritten versions. Chapter 12 was rewritten to include the requested information on ISDN Primary Rate Interface (PRI). The new or changed material is marked with a bar symbol in the right hand margin to indicate the amount of change. Chapter 14 had extensive editorial and some technical changes, during the review process it was determined that a complete restructuring of this chapter was required. Therefore, no bar symbols were used.

1.4.3 Additions

The primary additions included in this document consist of a recommendation to add a new chapter addressing special service interfaces. These special interfaces define end user services that are provided over other than standard voice or voice grade lines. The intent of including this information is to provide a clearer description of the evolving environment and associated defined interface requirements or specifications for new end user services. Attached as enclosure C is the draft manuscript of this new proposed chapter. This manuscript includes information requested on Video and Data (switched and nonswitched) service interfaces.

1.5 Summary and Conclusions

There are a total of fourteen chapters in the April 88 version of the DSN System Interface Criteria. The information contained in this analysis includes replacement text for four of the fourteen, recommends the deletion of five of the fourteen, and includes the recommended text for a new chapter entitled "DSN Special Service Interfaces". If the recommendation to eliminate chapters 3 through 7 is not accepted, the pen and ink corrections should be considered as the minimum changes required. Due to resource constraints only pen and ink recommendations are included for chapters 8 through 11 and 13, additional review is required.

It is recommended that the information contained in this report be staffed for coordination and comment in preparation for updating the April 88 version of the basic DCA circular, DCAC 370-175-13. After the comments are received and coordinated within the respective DCA/DCEC staffs, these coordinated changes can either be incorporated within the basic April 88 version of the circular as change sheets or be included in a complete manuscript update depending on the complexity and extent of the approved changes.

Appendix A. Chapter 1, System Interface Criteria Introduction - Replacement text

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CHAPTER 1. INTRODUCTION

1. Scope. The purpose of this document is to identify and define the physical and electrical interface characteristics for the various types of interconnect requirements found in the current, transitioning, and future DSN environments. The contents of this document are in a format that emphasizes Defense Switched Network (DSN) system element requirements to interface the switched hardware elements with each other and with the End User/Customer Premises Equipment required to support the service needs of the customer/subscriber population. This document defines the Point of Termination (POT) where the physical interface is implemented and describes the electrical characteristics required for the desired service. This document addresses only the physical interfaces and does not include any discussion regarding the higher level software-related interfaces that might be introduced by individual network elements after the physical interface has been successfully employed.

2. System Environment Description.

a. Switched Networks - DCS Transmission Interfaces. Each individual voice or data packet switch has an associated Network Interface (NI) and/or Inter-Network Interface (INI) identified for purposes of defining jurisdictional boundaries. This designated POT is the point of demarcation between the supporting carrier facilities and the supported voice or data switched service facility. Figure 1-1 generically illustrates this concept. The concept of POT is also applied between different types of carrier support (i.e., carrier-to-carrier). With the division of technical/operational responsibility clearly identified by a defined POT, requirements for systems interface and the associated definition of physical interface criteria can be made.

b. DSN Interfaces. The stated purpose of the DSN System Interface Criteria, dated April 1988, is to provide the MILDEP and end user community with an identification and understanding of detailed design and engineering information required to provide the physical interface criteria for the evolving DSN. New DSN switches must electrically interface with existing and planned switched network facilities via existing and planned interexchange carrier facilities. Specific interfaces will normally be two-wire subscriber loops on an analog basis, four-wire trunk and access lines on an individual analog basis (4 kHz) or digital basis (64 kb/s), or on a digital group (digroup) basis in T-1 (1.544 or 2.048 Mb/s) format. Figure 1-2 shows a variety of possible digital switch/transmission interfaces. These physical and electrical interfaces are specifically identified in subsequent chapters of the this DCAC. Since both analog and digital modes of operation will exist within the overall DCS network for the foreseeable future (switches and carrier facilities), the interfaces identified include all potential types. Simplified functional diagrams of analog and digital switching systems are shown in figures 1-2 and 1-3. These diagrams identify the POT and interfaces where requirements and objectives apply and show the relationship between the supporting interexchange carrier facilities, the switching equipment, and the local end users via the cable distribution plant. The interfaces shown are located on a distribution frame. Switch offices have many such distributing

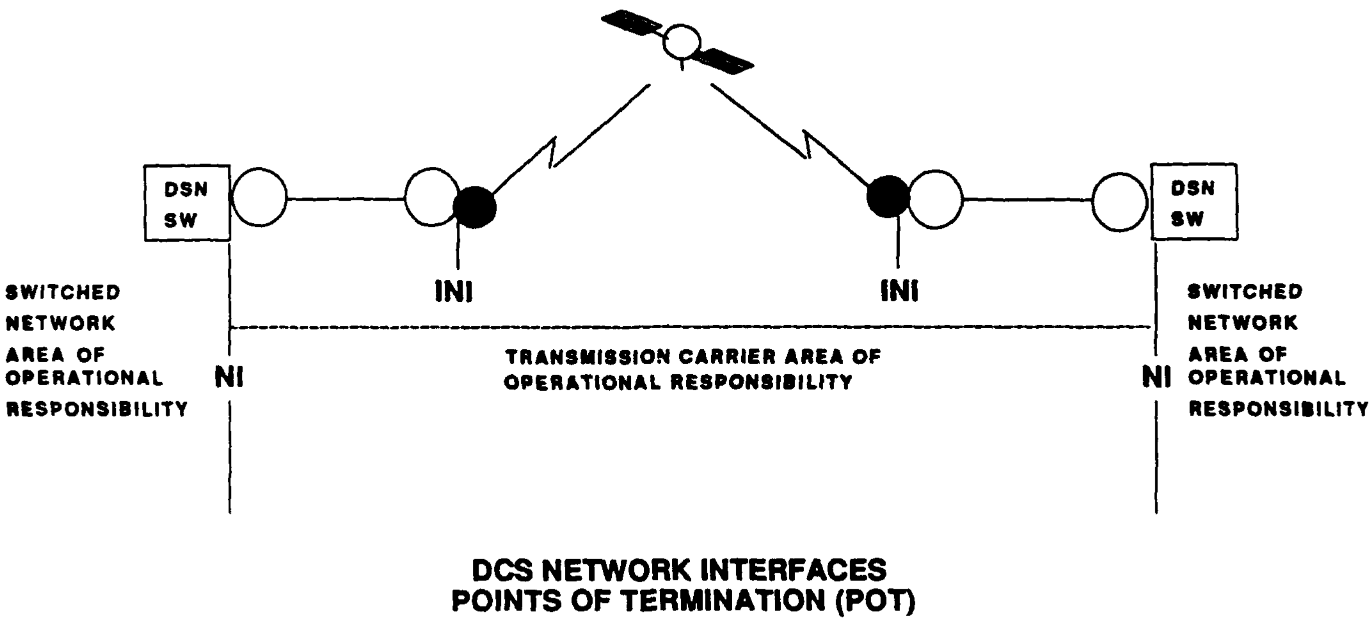

FIGURE 1-1. NETWORK INTERFACE-POINT OF TERMINATION

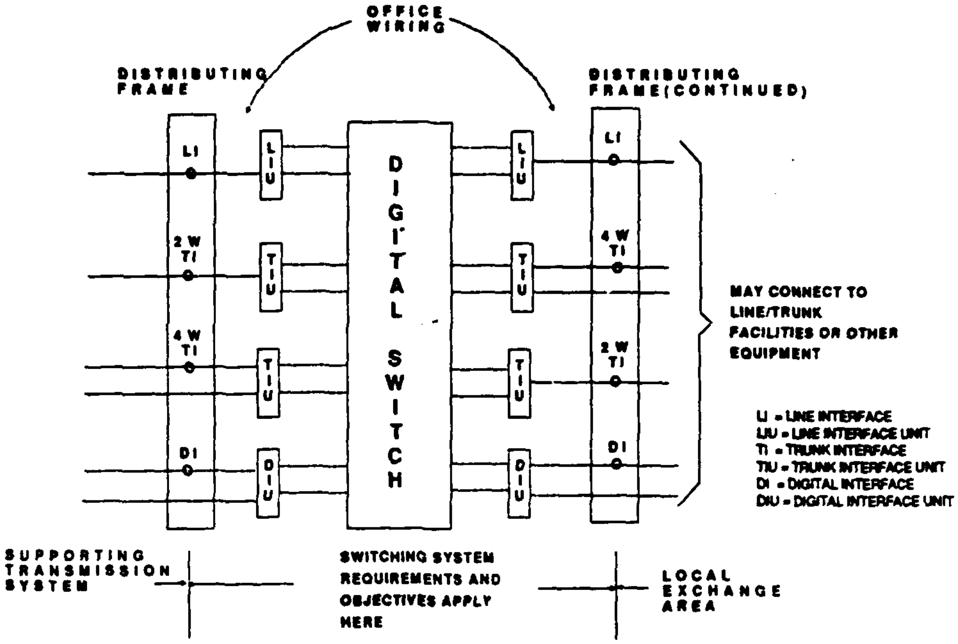

FIGURE 1-2. DIGITAL SWITCHING SYSTEM/CARRIER INTERFACE REQUIREMENTS

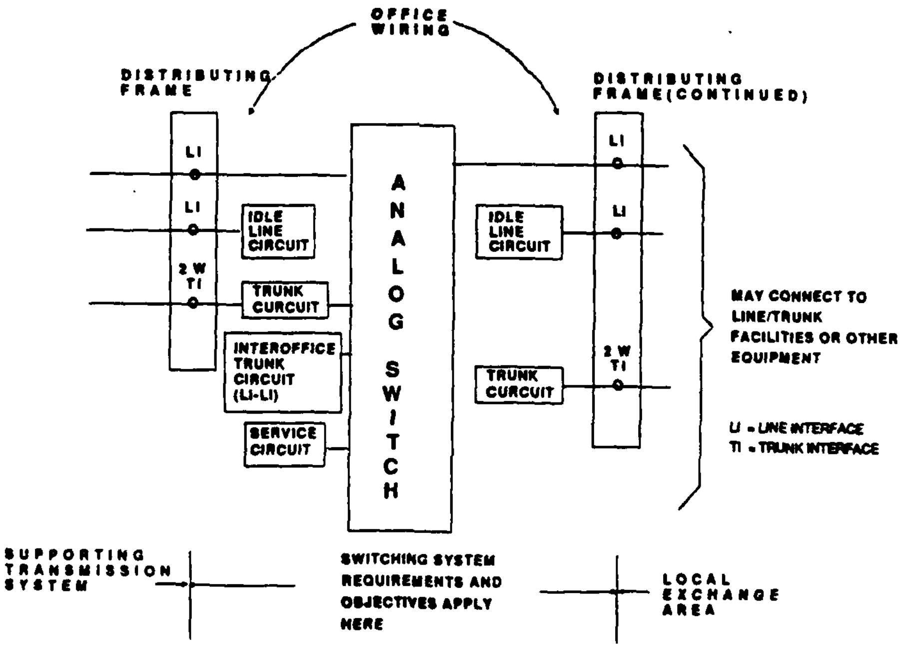

FIGURE 1-3. ANALOG SWITCHING SYSTEM/CARRIER INTERFACE REQUIREMENTS

frames, but the switching system interfaces are considered to be on the main distribution frame where the first connection between the switching equipment and the supporting trunk interface unit (TIU), line interface unit (LIU), or the digital interface (DI) is made.

(1) Analog Two-Wire Line Interface (LI). End user access lines (loops) connect to the switching system at this voice frequency interface. Switched special services lines and some local area trunks may also connect to this interface.

(2) Analog Two-Wire Trunk Interface (2WTI). Analog two-wire message network, operator services, and switched special services for Automatic Call Distributor (ACD) and local switched services network trunks connect to the switching system at this voice frequency interface.

(3) Analog Four-Wire Trunk Interface (4WTI). This voice frequency interface (usually applicable to a DSN MFS only) is the point at which the digital switching system connects with the four-wire analog message network, operator services, and special services trunks. This interface consists of two two-wire appearances, one for each direction of transmission.

(4) Digital Facility Interface (DI). The digital interface is applicable only to digital switches. The interface consists of two two-wire appearances: a transmit (T) side and a receive (R) side. The DI terminates switched network transmission trunks/lines, operator services, message network, and special services trunks carried over digital transmission facilities.

(5) Remote Terminal Line Interface (Remote LI). This interface is essentially equivalent to that of the line interface described above. However, it is intended to support a remote switching unit (RSU) application. The RSU functions as an extended switching point and serves the same general loop population as the primary switching facility. This requires the interconnecting Remote-Host (RH) link to be operated at 0-db loss. A digital switch will accept and transmit digroups (1.544 Mb/s trunks) of 24 individual, 64 kb/s channels. Wherever appropriate, digroups (T1s) will terminate directly on the DSN digital switch. The switch internally disassembles the 1.544 Mb/s streams, assigns individual channels to the correct time slots, and performs the necessary internal assembly of the channels for onward transmission to the end user destination. This will eliminate the requirement within the Government-owned carrier facilities for extensive numbers of first level multiplexers (AN/FCC-98's) and for numerous jackfields and wiring necessary to terminate the individual circuits at the TCF. All terminations supporting DSN can be at the T-1 digital interface (DI) level. In order to minimize costs and ensure required performance, coordination of transmission upgrade programs and digital switching programs is mandatory.

c. DSN Supported Service Requirements. The DSN services for which the commercial and Government-owned carrier systems are designed and engineered to provide interconnect support include: (1) unencrypted voice, (2) voiceband encrypted voice 64 kb/s digital data. These services are described as follows:

(1) Unencrypted Voice Service. DSN's predominant service is to provide for common user, unencrypted voice telephone services. Since the common voice telephones used within DSN are designed to operate over unconditioned VF circuits, these services will be supported by a common grade of DSN trunking.

(2) Voiceband Encrypted Voice/Digital Data Services. These services include standard voiceband secure voice (i.e., STU II -2400 b/s, STU III) and voiceband digital data (i.e., DDN 2400 b/s dial-ups) at rates equal to or less than 4800 b/s, where the user's modem/terminal equipment provides the appropriate level of signal processing. Since these items of equipment are designed to operate over unconditioned VF circuits, these services can also be supported by common grade DSN trunks. Higher speed voiceband data services like DDN host access (9600 b/s), STU IIIs operating at 9600 b/s and Vinson 16 kb/s service must be supported by either dedicated conditioned circuits or by a special subnetwork.

(3) Digital Data Services (56 kb/s). These services include common channel signaling (DSN CCS No. 7) and 64 kb/s switched digital data services for selected user communities. These services will be provided by special dedicated 64 kb/s digital data trunks. The switching system criteria within the DSN network should be designed to provide special routing access to these trunks.

d. Other DCS Transmission Services. In addition to supporting the switched services provided by DSN, DCS transmission services can provide long haul circuits for a wide variety of other end users. Within the capacity limits of the transmission/multiplex terminal equipment, Government-owned carrier facilities can provide the following services:

(1) DS1 (1.544 Mb/s) Point-to-Point digital services (i.e., Near full motion video, Direct computer-to-computer connections, etc.).

(2) Point-to-Point VF circuits used for nonswitched offhook voice services.

(3) Point-to-Point teletype/data circuits.

(4) Command center C^2 interconnect facilities.

(4) Circuit support to non-common user systems.

(5) High speed computer-to-computer connectivity.

(6) System/network control circuits.

(7) Terrestrial extensions for distribution of DSCS circuits/services.

(8) Spare capacity reserved to support expansion, reconstitution, or reconfiguration needs of the primary transmission users, including the needs of DSN.

3. DCS DSN Current Environment. Figure 1-4 depicts the DSN relationships found in the current DCS environment. The location of the physical and electrical interfaces that are found in this environment are also identified. The remainder of this Systems Interface Criteria document focuses on expanding the information surrounding these interfaces.

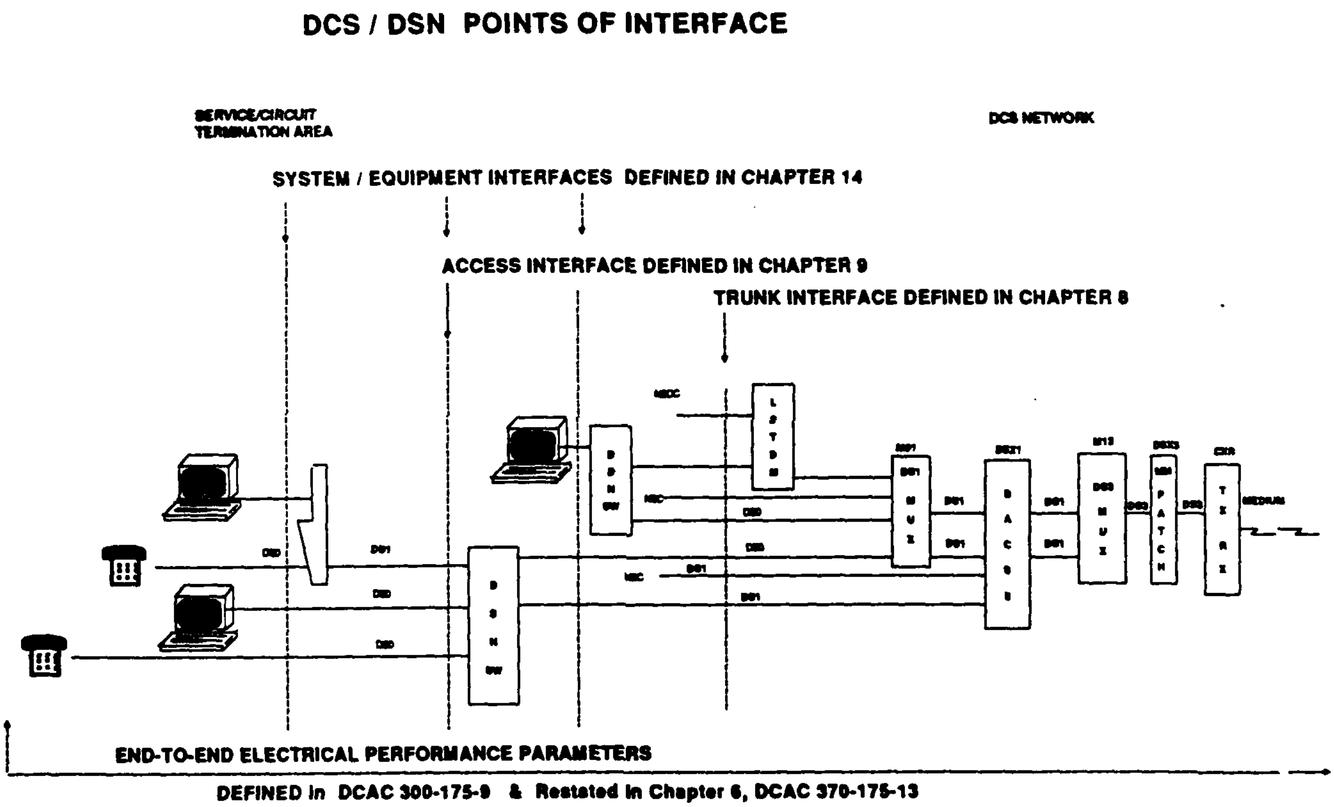

FIGURE 1-4. DSN CURRENT NETWORK INTERFACE ENVIRONMENT

4. DCS DSN Future Environment. Figure 1-5 depicts the future switching systems and the interactive relationship with ISDN and the DCS. The wide variety of differing interfaces is expected to be reduced in an all-digital environment. However, the time table for the migration to ISDN, coupled with an all digital DCS, is not clear at this time. The interfaces needed for the future DSN network are only just beginning to be addressed. Chapter 12 contains some of the emerging information concerning ISDN interface requirements.

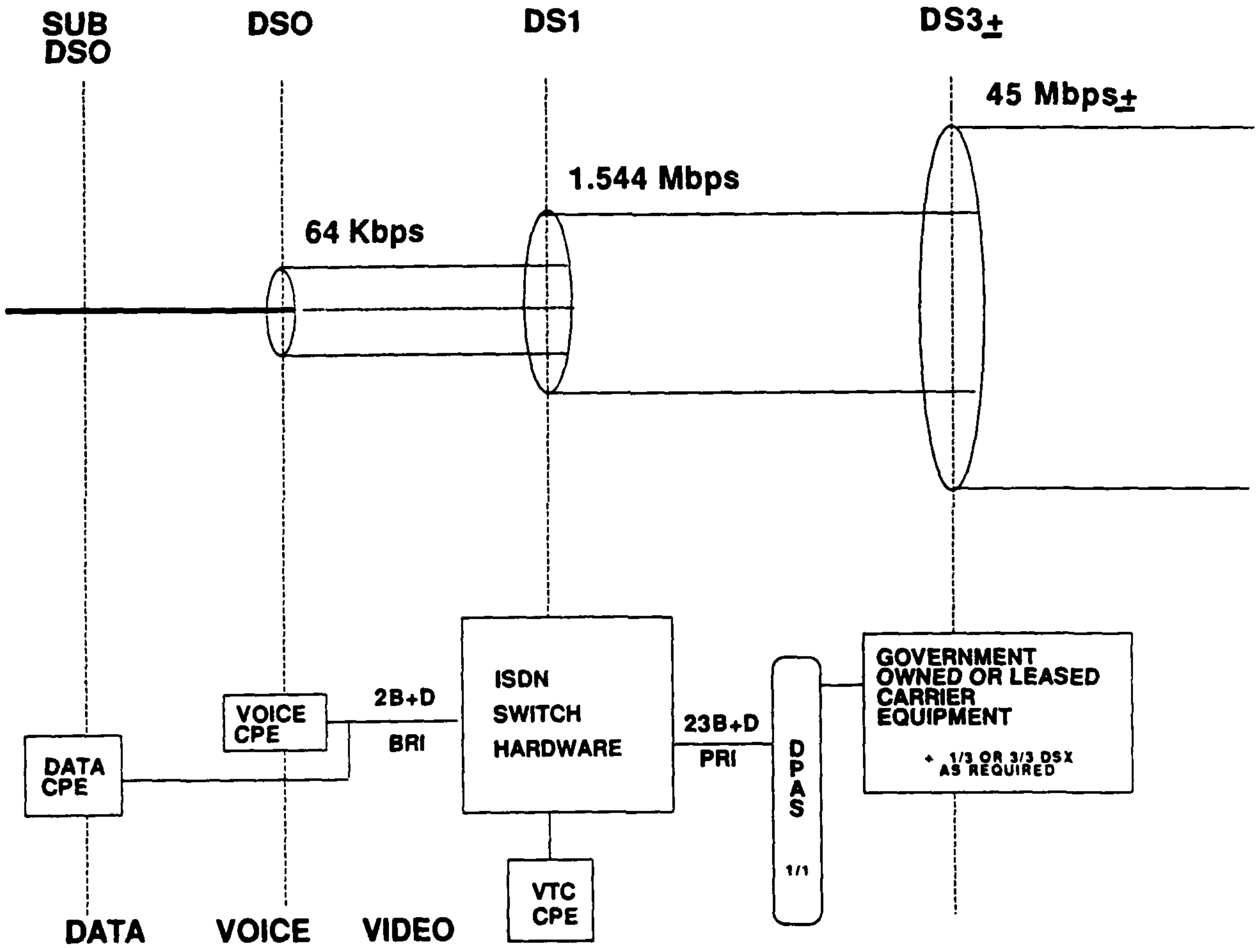

FIGURE 1-5. DSN FUTURE NETWORK INTERFACE ENVIRONMENT

Note: Care must be taken to identify the proper timeframe for applying the associated interface information contained in this DCA circular. Some is applicable only to the present and transitional DSN, and some addresses only future applications (i.e., ISDN). It is necessary that the reader fully understand the differing environmental configurations.

Appendix B. Chapter 2, DSN Network Elements - Replacement text

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CHAPTER 2. DSN MAJOR NETWORK ELEMENTS

1. System Functions and Element Descriptions.

a. Switching Systems. A telecommunications switch either opens and closes circuits or selects paths or circuits. The function of the DSN switching subsystem is to translate customer dialing instructions (or off-hook for specially classmarked stations) into one or a succession of path selections and provide distant end user proper notification and connection. The subsystem also determines the specific treatment a call will receive. To execute these functions, the DSN has defined seven individual switching element components; five of these elements are integral components of the DSN. The sixth and seventh are the voice Private Branch Exchange (PBX), which may be connected to an EO or MFS, and the DCTN PBX Switching Interface. This element is unique and applies only to selected locations within the WESTHEM environment. It is not discussed further in this circular. The five primary DSN elements are the End Office Switch (EO), the Multifunction Switch (MFS), the Standalone Switch (SAS), the Small End Office switch (SMEO), and the Remote Switching Unit (RSU). The physical and electrical interfaces required to interconnect these individual elements into a composite Defense Switched Network are the subject of this circular.

(1) End Office Switch. An end office switch is an integral part of the DSN that provides all local switched call connections and DSN-service features/call treatment. This switch will perform the functions of a military dial central office or primary private branch exchange (PBX), and function as a terminating office in the DSN. EO's will not serve as lateral tandem switches for traffic destined for EO's in other geographic areas of the Worldwide DSN. That is, an EO may tandem traffic up or down the hierarchy on behalf of any subtending Remote Switching Units or PBX's, but normally traffic originated at an EO will be forwarded to a multifunction switch (MFS) or standalone switch (SAS) to be routed to another end office. However, EO's may be allowed to connect to other DSN switches and PBX's including EO's [via Community of Interest (COI) trunks], where direct traffic volumes or economic and crisis factors dictate. The EO's will provide:

(a) Official long distance services via DSN by interconnections with MFS's or SAS's.

(b) Local and long distance services via the local public switched networks in accordance with agreements with the Host Nation, as applicable.

(c) Official services by direct interconnection with other systems or networks.

(2) Small End Office (SMEO) Switch. Like the end office, the small end office switch is an integral part of the DSN that provides switched call connections and all local and DSN service features, including multilevel precedence and preemption (MLPP), to its users. The SMEO switch must comply with the DSN Worldwide Numbering and Dialing Plan and will provide user dialed precedence and inter-area service without attendant assistance. A SMEO will

not serve as a lateral tandem switch for traffic destined for switches in other geographic areas of the Worldwide DSN. Unlike an EO, the SMEO derives the precedence and inter-area capability from classmarked access lines that tie SMEO's to SAS's, MFS's, or EO's, as applicable. The SMEO will not contain the precedence access threshold feature and will not terminate multifrequency 2 of 6 signaling interswitch trunks. The SMEO provides increased capabilities over the private branch exchange without incurring the procurement costs of a full end office capability. For a more complete description, refer to the current GSCR, Appendix C-2. Discussions in this text will refer to both the EO and SMEO as term end office, unless it is important to note a distinction, in which case the specific switching element will be specified.

(3) Standalone Switch (SAS). The SAS functions primarily as a tandem switch and is most frequently found in the DSN-WESTHEM. The SAS will also function as a traffic concentrator for subordinate EO's and PBX's. As specified in paragraph 2.2.2 of the GSCR, it will perform no EO functions except for the termination of two-wire and four-wire direct subscribers. Subscribers are two-wire instruments or four-wire instruments/four-wire terminal sets homed by access lines on a MFS or SAS, or an EO switch with a Precedence Access Threshold (PAT) capability. These terminations have direct access to the DSN and are not subject to the restrictions of either classmarked EO Access Lines or the PAT capability. Subscriber Access Lines will be provided the same classmarking capability as User Access Lines. The term "subscriber" will be used whenever the type of connection is significant. When the type of connection is not significant, the terms "customer" or "station" will be used. Economic considerations are determining that most requirements for direct customer access to precedence or inter-area service are to be met by classmarked two-wire service provided through MFS's, EO's, or RSU's; however, specific mission requirements may continue the use of four-wire terminal sets/subscriber instruments indefinitely. Refer to GSCR, Appendix A, for a description of the specific equipment used to perform the SAS function.

(4) Multifunction Switch (MFS). The MFS incorporates the combined functions of a SAS and an EO into one hardware/software configuration. Detailed descriptions of the specific equipment used to perform the MFS function are beyond the scope of this Interface Criteria document.

(5) Remote Switching Unit (RSU). The RSU provides DSN two-wire service for large concentrations of remote users and is dependent on the call processor of an end office (parent switch) or on the EO function of a MFS to process network calls. Certain switch types may also provide Remote Line Modules (RLM's), which provide service to additional users remotely located from the RSU. As specified in paragraph 2.2.4 of the GSCR, subscribers will not be terminated on an RSU or RLM. DSN policy allows command and control user support behind an RSU, but the RSU is limited to being homed off of a single DSN switch. RSU's are used as concentrators for large remote users to reduce the amount of local interconnect plant required to provide EO type services.

(6) Private Branch Exchanges (PBX's). The PBX's interconnected to the DSN are defined as a customer/user-premise equipment and are not

considered an integral part of the DSN switching subsystems. The PBX is a telephone exchange serving a single organization or local area. To obtain DSN service, the PBX must be interconnected with a DSN switch. For DSN inter-area or precedence (any DSN service above ROUTINE) service, the intervention of an attendant is normally required. While many aspects of PBX architecture are not specified by the Defense Communications System, the standards laid down in this DCS interface document must be met before PBX's are permitted to interconnect with elements of the DSN.

2. Types of Switch/Transmission Interface Links.

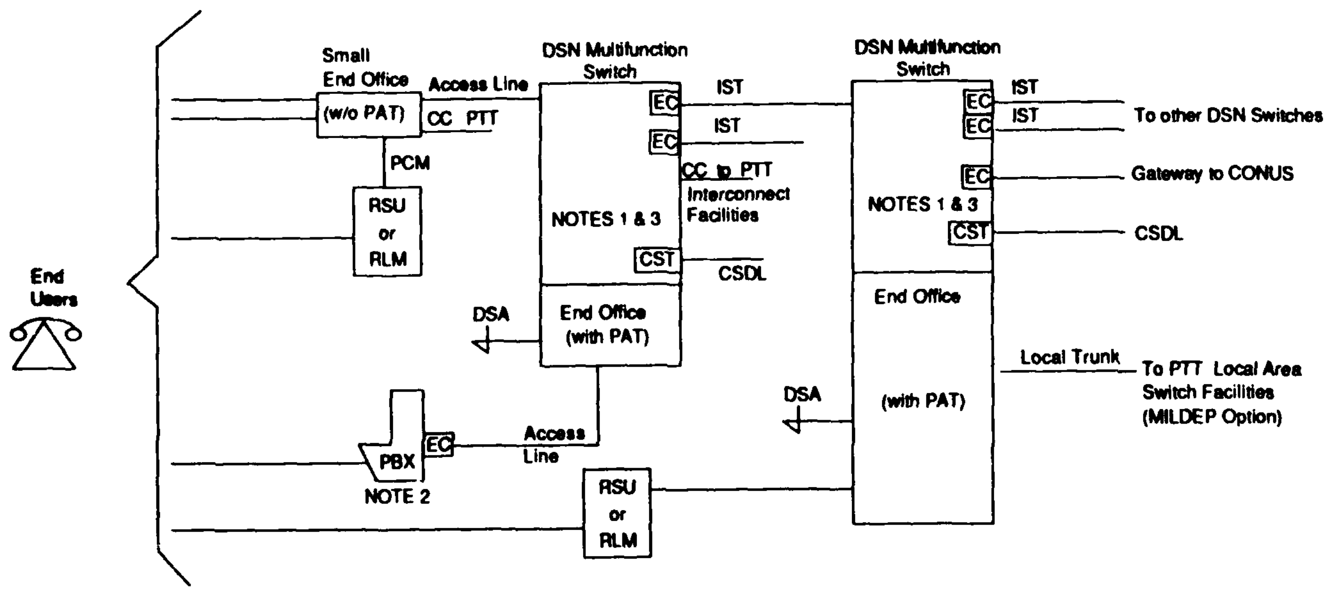
a. Access Lines. Access lines are defined as single or multichannel circuits that allow end-user equipment to gain access to the network. Access lines are used in the DSN, for example, between telephone instruments and the EO/MFS, between PBX and EO switches, or between data set terminals and the EO. In the DDN, access lines interconnect the end user/host terminal facilities with the Packet Switch nodes and provide entry into the DDN network. Essentially, voice access lines normally are provided via the local base, camp, post, or station outside plant cable distribution system. Data access lines begin at the user location in the cable distribution system, and usually extend to the supporting packet switch, which may nor may not be located on the same DoD base, camp, post, or station.

b. Interswitch Trunk (IST's). Interswitch voice trunks are the long-haul trunks (circuits) interconnecting two DSN switches (i.e., between two MFS's, between two EO's, and between an MFS and EO). IST's are normally provided by either Government-owned transmission systems, commercially leased carrier systems or services, or from a mixture of interexchange carrier facilities. DSN interswitch digital trunks can also be provided by the transmission facility at the 64 kb/s (DS0) level. DDN interswitch trunks are called "backbone trunks" and are provided at speeds from 9.6 to 56 kb/s circuits. DDN trunks are not currently provided by any of the DSN switch network elements.

c. Community of Interest (COI) Trunks. Community of Interest (COI) trunks are those trunks found between equal level switches (i.e., EO-to-EO), where the level of interswitch traffic demands direct circuit connections. These trunks are engineered using the same criteria as interswitch trunks. The electrical specifications and interface criteria are identical.

d. User Loops. These are included in the total definition of access lines and are usually limited to that portion of the access line from the end users equipment to the first DSN switch network element.

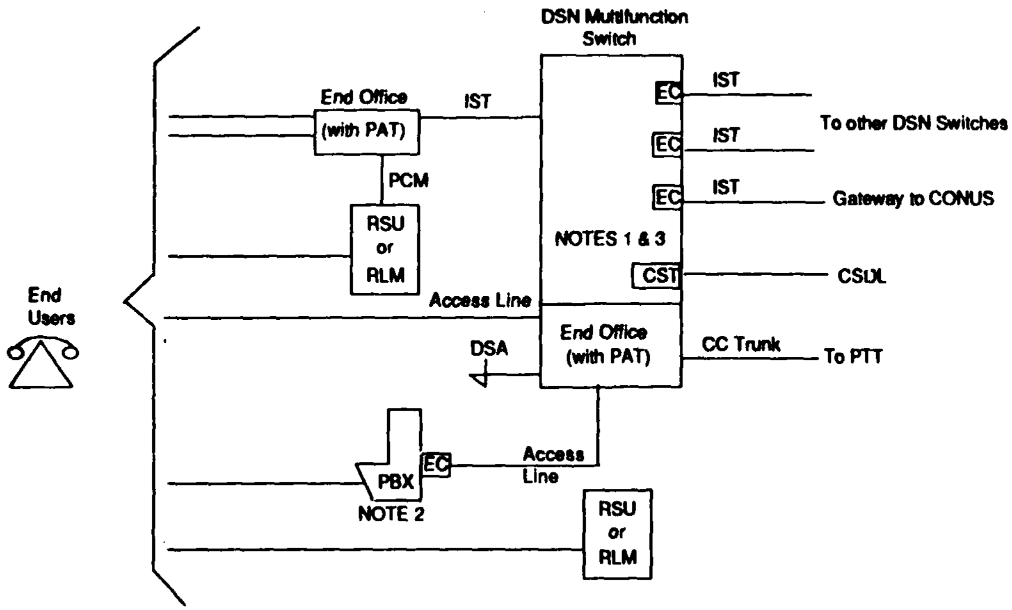
3. Relationship of DSN Switches and Associated Interconnect Facilities. The actual relationship of the various DSN switching system elements and the associated interconnect elements are shown in figures 2-1, 2-2, and 2-3. There are slight variations in differing parts of the worldwide system. It is these relationships that help focus and define the requirements for the evolving interface criteria needed to mold the independent elements into a true worldwide network.



CSDL = CCS DATA LINK
CST = COMMON CHANNEL SIGNALING TERMINAL
DSA = DIAL SERVICE ASSISTANCE
PTT = POST TELEPHONE & TELEGRAPH
IST = INTERSWITCH TRUNK
EC = ECHO CANCELLER
CC = COMMERCIAL CARRIER
RSU = REMOTE SWITCH UNIT
RLM = REMOTE LINE MODULE

NOTE:
1. TYPICAL MULTIFUNCTION DSN SWITCH
2.. PBX'S ARE NOT ELEMENTS OF THE DSN
3. DETAILED APPLICATION OF ECHO CANCELLERS ARE COVERED IN CHAPTER 5 AND 6.

FIGURE 2-1. DSN NETWORK ELEMENTS - EUROPE



CSDL = CCS DATA LINK
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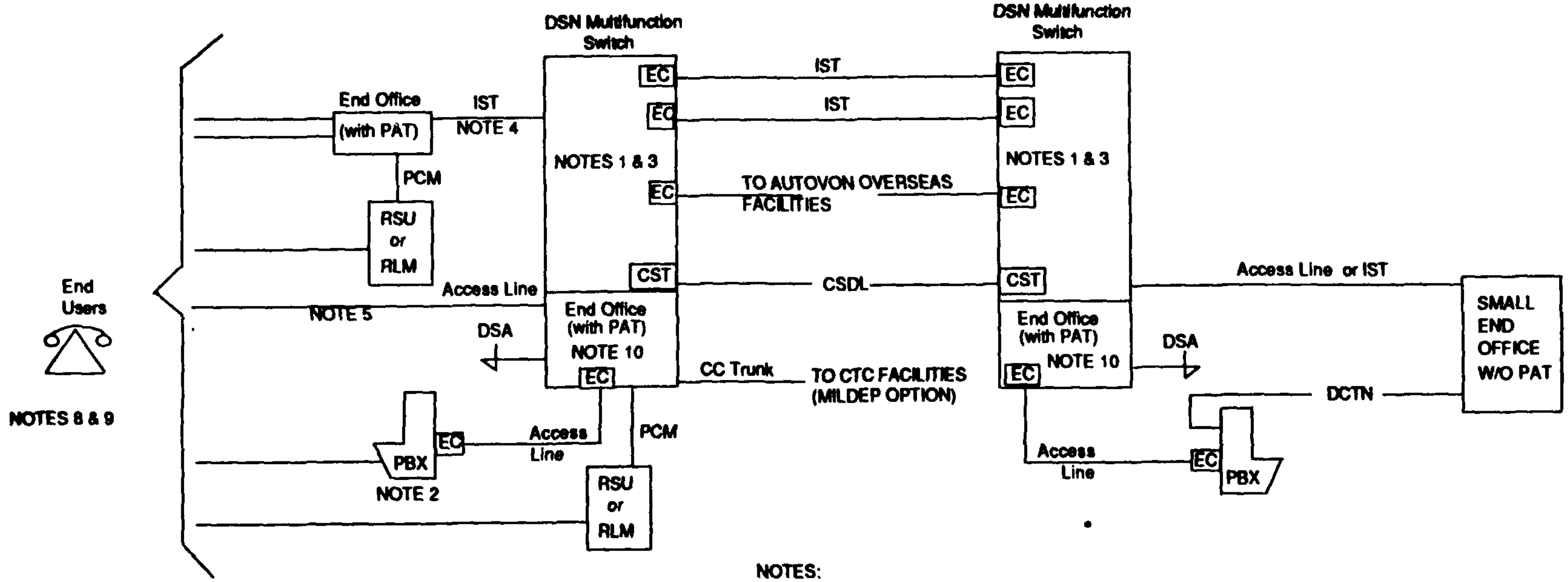
NOTE:
1. TYPICAL MULTIFUNCTION DSN SWITCH
2.. PBX'S ARE NOT ELEMENTS OF THE DSN
3. DETAILED APPLICATION OF ECHO CANCELLERS ARE COVERED IN CHAPTER 5 AND 6.

FIGURE 2-2. DSN NETWORK ELEMENTS - PACIFIC



IST = INTERSWITCH TRUNK
CTC = COMMERCIAL TELEPHONE COMPANY
DSA = DIAL SERVICE ASSISTANCE
CST = COMMON CHANNEL SIGNALING TERMINAL
CSDL = CCS DATA LINK
EC = ECHO CANCELLER
CC = COMMERCIAL CARIRIER
SDN = SOFTWARE DEFINED NETWORK
DCTN = DEFENSE COMMERCIAL TELECOMMUNICATIONS NETWORK
RSU = REMOTE SWITCH UNIT
RLM = REMOTE LINE MODULE

NOTES:

1. TYPICAL MULTIFUNCTION DSN SWITCH
2. PBX'S ARE NOT ELEMENTS OF THE DSN
3. DETAILED APPLICATION OF ECHO CANCELLERS ARE COVERED IN CHAPTER 5 AND 6.
4. IST DIGITAL AND ANALOG INTERFACE IS DETAILED IN CHAPTER 9
5. ACCESS TRUNKS, LOCAL LOOP, RSU, AND RLU INTERFACE CHAPTER 9
6. SIGNALING AND SUPERVISORY CRITERIA DETAILED IN CHAPTER 5
7. COMMERCIAL TELEPHONE COMPANY
8. USER ACCESS TO THE DSN IS LIMITED TO A PAT OR CLASS MARKED ACCESS LINES
9. DSN SUBSCRIBER S HAVE DIRECT (UNRESTRICTED) ACCESS TO THE DSN
10. PAT = PRECEDENCE ACCESS THRESHOLD

Figure 2-3. DSN NETWORK ELEMENTS - WESTERN HEMISPHERE

Appendix C. Chapter 12, ISDN Interfaces - Replacement text

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CHAPTER 12. ISDN INTERFACES

1. General. This chapter will discuss Integrated Services Digital Network (ISDN) interfaces for the DSN. The DSN switches shall provide for or be capable of being upgraded to support several ISDN interfaces utilizing appropriate DSN ISDN, American National Standards Institute (ANSI), or International Telephone and Telegraph Consultative Committee (CCITT) standards, in that order. After a description of the general ISDN configuration, the following interfaces are discussed:

a. User (non-ISDN) terminal to the MFS/EO switch interface.

b. ISDN terminal to the switch interface [Basic Rate Interface(BRI)].

c. PBX/PABX to the MFS/EO switch interface [Primary Rate Interface (PRI)].

d. Interface to other networks, including PSN's and the DDN.

e. Specific signaling requirements for individual user services will be discussed in future revisions. As part of a relatively new technology, ISDN standards are still under development. Therefore, these criteria are not to be considered final and are subject to change and revision.

2. Introduction to ISDN Interfaces. The main objectives of ISDN technology are to eliminate further growth of separate voice and data networks and to provide the user with a universal plug that carries all services to a network. ISDN will provide the user with simple connections to the network regardless of terminal type. ISDN proposes to use the same digital switches and routes to establish connections to a wide range of different telecommunication services. DCS is migrating towards an all digital network; making ISDN a reality. Figure 12-1 shows this DCS transitional phase. The services covered include packet switched data (DDN), PCM voice (DSN) as well as non-switched services and video. This drawing indicates the transmission and switching requirements based on the digital technology. Clearly, the present DCS consists of two separate switched networks, namely DSN and DDN. Figure 12-2 shows the ISDN DCS configuration. Several observations can be made from this drawing. First, the number of interfaces have been reduced to the ISDN interfaces: Basic Rate Interface and Primary Rate Interface. Second, the network uses the same digital switches and transmission facilities. Third, the customer requirements including voice, data, and images are satisfied by customer premises equipment that interfaces the network at a single point either at the basic or primary rate. An ISDN customer premises equipment should satisfy all the communication needs of the end-user. A non-ISDN customer premises equipment can interface the network via a Terminal Adapter. These issues are explained in detail in the rest of this chapter. It will take a number of years for a full ISDN network to be put in place. The current effort is intended to define a small, standard set of interfaces between the user and the network that will last a significant time into the future. The ISDN is an evolutionary concept designed to allow the user and network to move into the new technology in a graceful and cost-effective manner. From the user's point of view, the ISDN concept is a single network access link that puts the user in contact with all carrier services. Instead

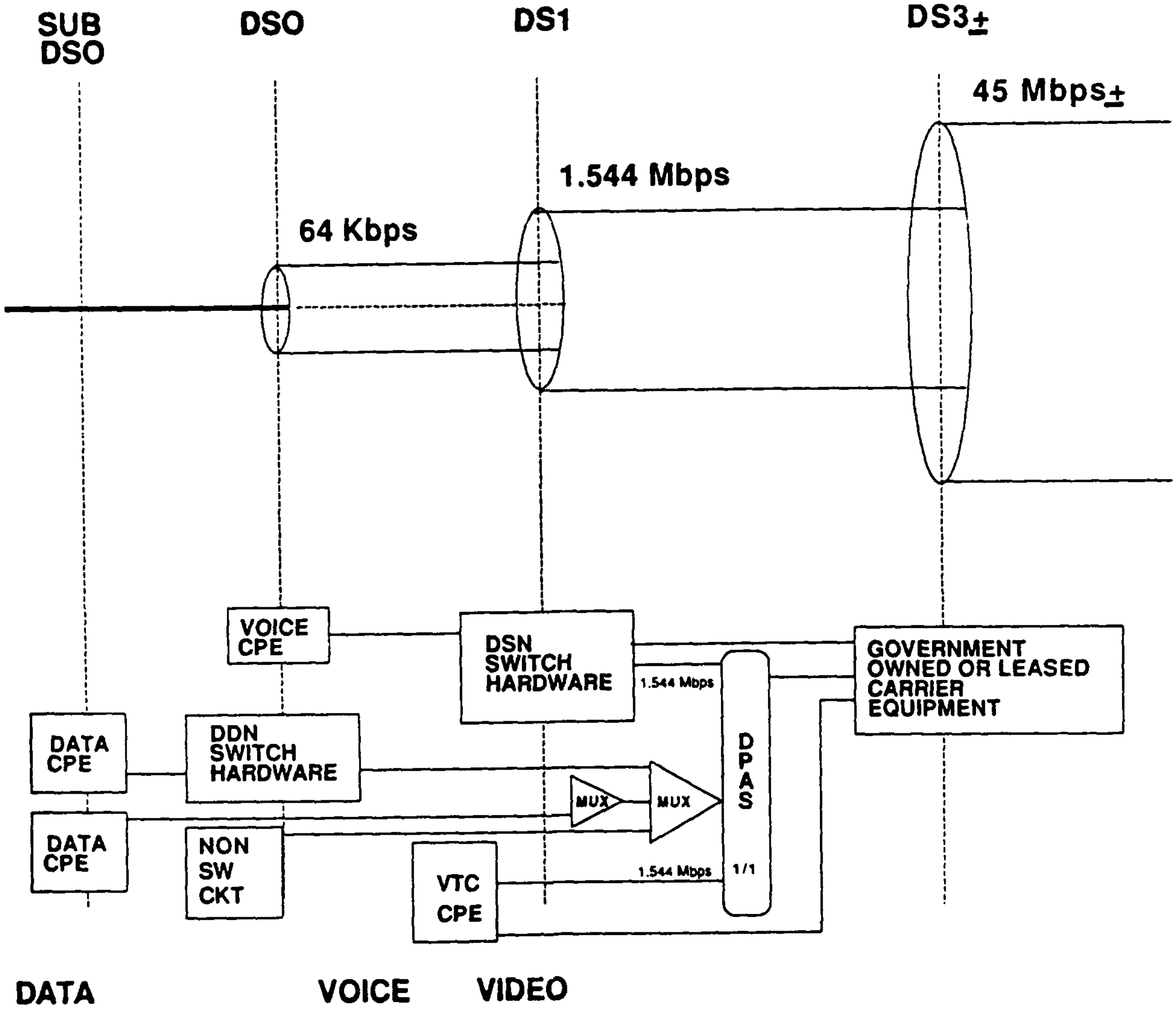


FIGURE 12-1. 1990's DCS CONFIGURATION

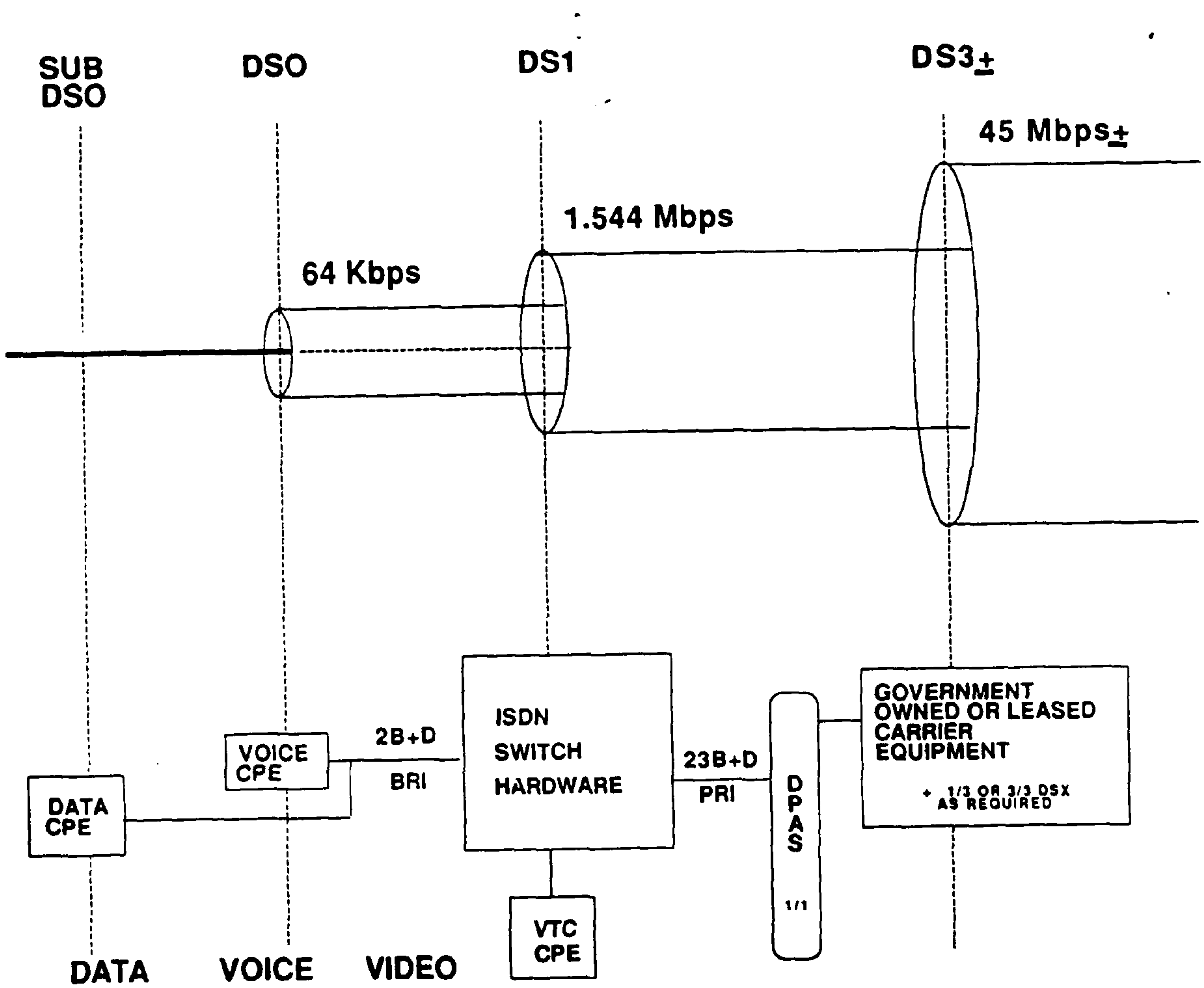


FIGURE 12-2. 1995+ ISDN DCS CONFIGURATION

of having a separate circuit for each type of service, ISDN will provide the user with a single network interface over which all services can be accessed.

a. ISDN Channel Definitions. The information capacity of the ISDN user-network interfaces is characterized in terms of channels that carry a fixed bit rate across the interface. To carry encoded voice and voice-equivalent information, telephony networks are evolving to a 64 kb/s clear channel rate for circuit-switching and to common channel signaling for control. In its earliest form, ISDN was to extend this 64 kb/s channel and common channel signaling to the user. As planning for ISDN continued, other capabilities such as packet-switching were added. ISDN channel definitions follow:

(1) "B" channels are the 64 kb/s clear channels used for a variety of user information streams either at or adapted up to 64 kb/s. Each information stream can be from one user or from multiple users multiplexed together. "B" channels carry circuit-mode or packet-mode user information such as voice, data, facsimile, and user-multiplexed information streams.

(2) "D" channels are primarily intended for signaling information to control ISDN services and may carry rates of 16 or 64 kb/s, depending on the interface. Furthermore, the idle time of this channel may be used for packet-mode user data and telemetry.

(3) "H" channels provide the user with a higher bit rate information capacity. H0 channels carry 384 kb/s, H11 channels carry 1536 kb/s, and H12 channels carry 1920 kb/s information capacity. H channels may be used for high-speed applications such as fast facsimile, video, high-speed data, high-quality audio, and multiple information streams of a lower bit rate.

b. Standard ISDN Interface Configuration. Figure 12-3 represents the standard ISDN interface. Variations of this configuration are possible; however, all variations will incorporate the same functions and specifications as the standard interface. This figure illustrates the interconnection of the functional groups and reference points adopted by the CCITT. The only interface not part of the CCITT recommendation is the U interface.

(1) The Network Termination 1 (NT1) encompasses the functions of the OSI physical layer and represents the electrical and physical termination of the network on the customer's premises. Functions of the NT1 device include electrical termination of the subscriber line, line maintenance functions and performance monitoring, timing, power transfer, multiplexing, conveying line activation/deactivation requests to the central office, and contention resolution. The NT1 is a network termination point and forms an interface between the customer and the ISDN carrier. This interface provides the common physical and electrical connection for all user-provided equipment which could be either NT2 or TE equipment.

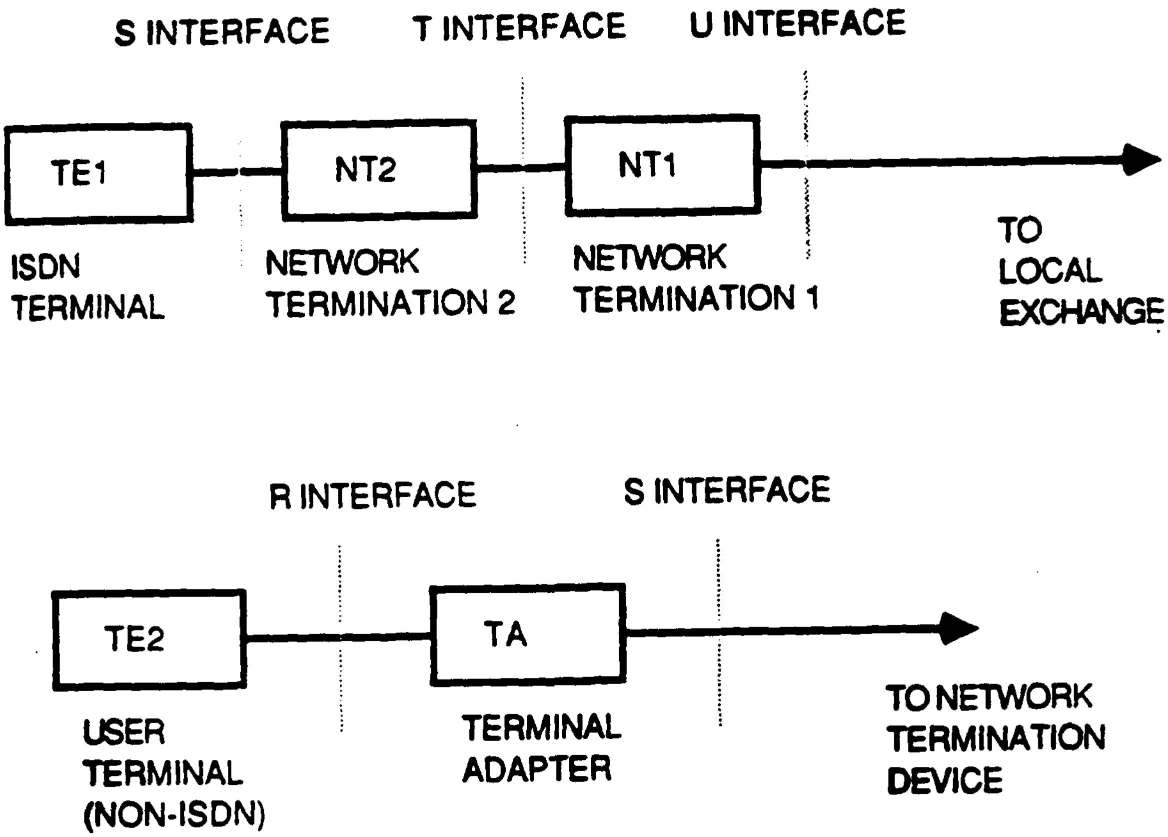


FIGURE 12-3. STANDARD ISDN INTERFACE

(2) The Network Termination 2 (NT2) functions are related to the lower three layers of the OSI Reference Model (e.g., physical, data link, and network). These functions include protocol handling,multiplexing/ demultiplexing, synchronization, error control/error detection, localized switching and routing for multiple terminals, and concentration. Local Area Networks (LANs) and Private Automatic Branch Exchanges (PABXs) such as the Northern Telecom SL-1 switch are examples of NT2 functions.

(3) The Terminal Equipment 1 (TE1) is completely compatible with ISDN interface specification requirements and can be connected directly to an NT1 or NT2. TE1 examples include digital telephones, Data Terminal Equipment (DTE), integrated voice/data terminals that are designed according to the ISDN user-network interface.

(4) Terminal Equipment 2 (TE2) consists of existing terminals that do not meet ISDN interface criteria but are compatible with current interfaces such as RS-232C, RS-449, the X-series public data networks, and the V-series for modems. The TE2 is connected to the ISDN via the Terminal Adapter (TA).

(5) The TA converts existing signaling into ISDN signaling, allows existing interfaces to be compatible with the ISDN network, and converts different circuit and packet-switched rates into the standard ISDN data rates.

(6) The CCITT uses a set of reference points to define the specific ISDN interface points. The interfaces already defined by the CCITT occur at the R, S, and T reference points (see figure 12-3). The U interface, between the NT1 and the network, has not been standardized by the CCITT; however, it is being standardized by ANSI. The U standard will be included in DCS ISDN section as an interface requirement to cover the post-divestiture CONUS environment. The interface points specified can be applied to the DCS.

(7) The key objective of the ISDN user-network interface is its ability to function compatibly under different arrangements. The reference points define the divisions between the functional groups at which interfaces could appear.

(8) Situated between the NT1 functional grouping and the NT2 functional grouping is the T reference point. It corresponds to the minimal ISDN network termination at the customers' premises.

(9) The interface between the NT2 functional grouping and the terminal devices is referenced by the S reference point. The S reference point will support point-to-point, star, and multipoint configurations of terminals.

(10) The R reference point corresponds to the interface between the terminal adapter and terminal equipment. This interface only exists when non-ISDN terminal equipment is used in the configuration.

(11) The U interface is intended to connect the NT1 terminal to the existing copper wire pair and exists only for the basic rate (2B+D). CCITT has not yet recommended U interface standards for several reasons. First, the physical form of the interface may change as the technology evolves. Second, in most countries outside the U.S., the network owns the network termination equipment on the user's premises, which includes the U interface. In these countries, this interface specification is left to network administrators. In the U.S., due to divestiture , the network is not allowed to provide certain types of network termination equipment. The customer must ,therefore, purchase such equipment from a separate source and connect it to the network. As a result, there is more pressure on the United States to standardize the U interface.

(a) The ANSI T1D1 committee is currently establishing the standards for the U reference point. This interface is discussed in section 3a.

(b) Many variations on the standard physical user-network interface in figure 12-3 exist. However, most of these configurations can be broken down into two groups. These groups include NT1, NT2, and TA function configurations and multiple terminal equipment configurations.

(c) Where applicable, terminal equipment configurations other than the standard one in figure 12-3 may be used with variations of the NT1, NT2, and TA configurations. For simplicity, the NT1, NT2, and TA configuration variations are shown with a standard terminal equipment connection.

(12) Figure 12-4 illustrates some possible alternate terminal equipment configurations for user premises. These include:

(a) A multiple terminal passive bus arrangement to NT1.

(b) Multiple terminals supported by a star arrangement to an NT1.

(c) Multiple terminals supported by a star arrangement to NT2.

(d) A multiple terminal passive bus connected to NT2.

(e) A multiple terminal connection to multiple NT2's and NT1's.

(f) A multiple terminal connection to multiple NT2s and a single NT1.

(g) A multiple terminal connection to a single combined NT1-NT2 functional grouping.

(h) A multiple non-ISDN terminal connection to a single NT1 through a single combined NT2 and TA functional grouping.

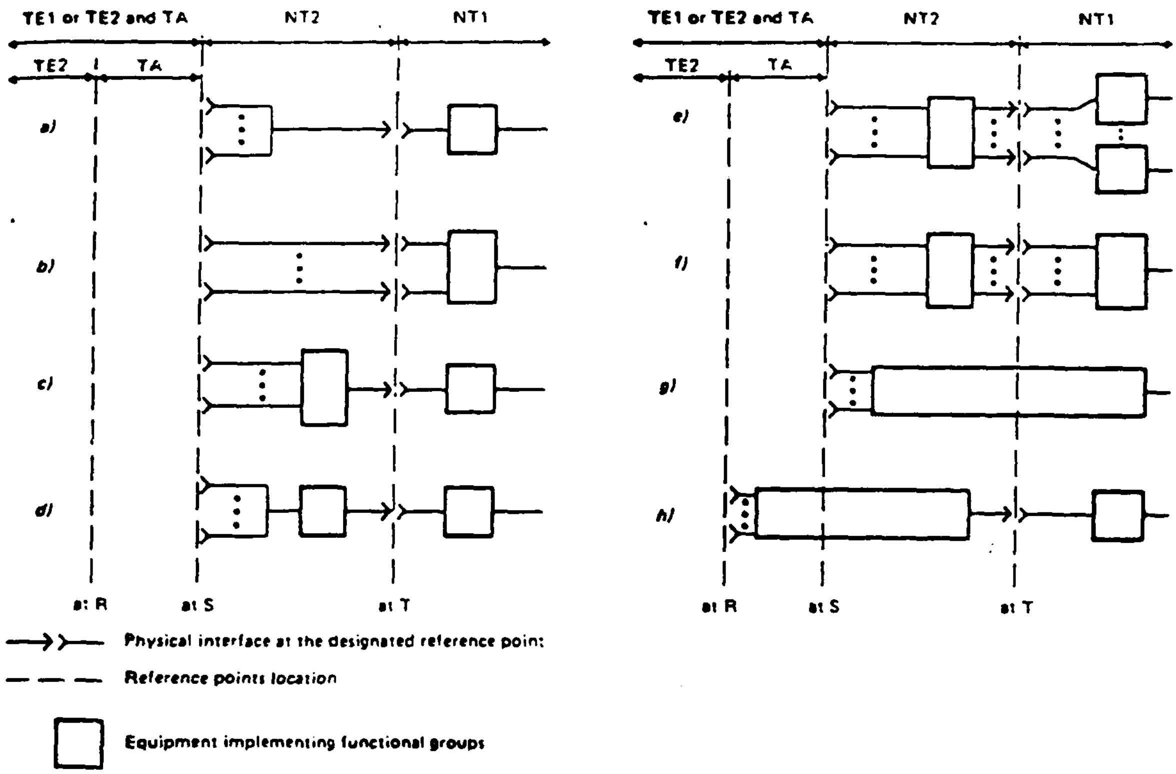


FIGURE 12-4. MULTIPLE TERMINAL EQUIPMENT CONFIGURATIONS

1. Another alternate terminal arrangement is the hybrid arrangement in which an analog channel is connected directly into a special NT1 device. This arrangement is discussed in section 3c.

2. Figures 12-4a and 12-4b illustrate cases where NT2 functions are only physical connections. In these cases, all the characteristics of the physical interfaces applied at reference points S and T are identical. These cases represent the typical user terminal and ISDN terminal to switch interface expected to be found in the DCS environment.

3. Figures 12-4c and 12-4d illustrate how individual terminals can interface an NT2 device at individual S reference points, basic rate (2B+D) interfaces and then be fed through to the NT1 device via a T reference point, primary rate (23B+D or 30B+D) interface. These configurations are typical of PBX/PABX connections.

4. Figures 12-4e and 12-4f illustrate multiple connections between NT2 equipment and NT1 equipment. Figure 12-4e illustrates multiple NT1 equipment while figure 12-4f illustrates the NT1 providing upward multiplexing of the multiple connections.

5. Figure 12-4g shows the merging of NT1 and NT2 functions into one device. The merging of both network termination devices for other configurations in figure 12-4 may also occur.

6. Figure 12-4h illustrates the merging of NT2 and TA functions into the same equipment. As above, the merging of TA and NT2 functions may occur for other configurations with non-ISDN terminals in figure 12-4. Note that TE1 and TE2 + TA can be used interchangeably in figure 12-4. In addition to the above examples, there exists a possible combination of NT1, NT2, and TA into one physical entity in which both reference points S and T exist but are not fully realized as physical interfaces. Such an implementation is to be considered an interim connection of a non-ISDN terminal to an ISDN and is to be used only in the early stages of ISDN. All of the above-mentioned connections are variations of either the standard single connection, the passive bus connection, or the star arrangement. The standard single connection has already been discussed.

7. The passive bus arrangement can be broken down into two possible configurations: a short passive bus or an extended passive bus.

8. The star wiring arrangement provides a point-to-multipoint arrangement, as with the passive bus; however, physical point-to-point wiring between the network termination device and the terminal equipment is used. One or more of the connections to the network termination device may be a passive bus instead of a standard point-to-point connection.

9. Figure 12-5 illustrates some possible combinations of the functional groupings and reference points R, S, and T. Figures 12-5a and 12-5b show separate interfaces at S and T ; Figures 12-5c and 12-5d show an

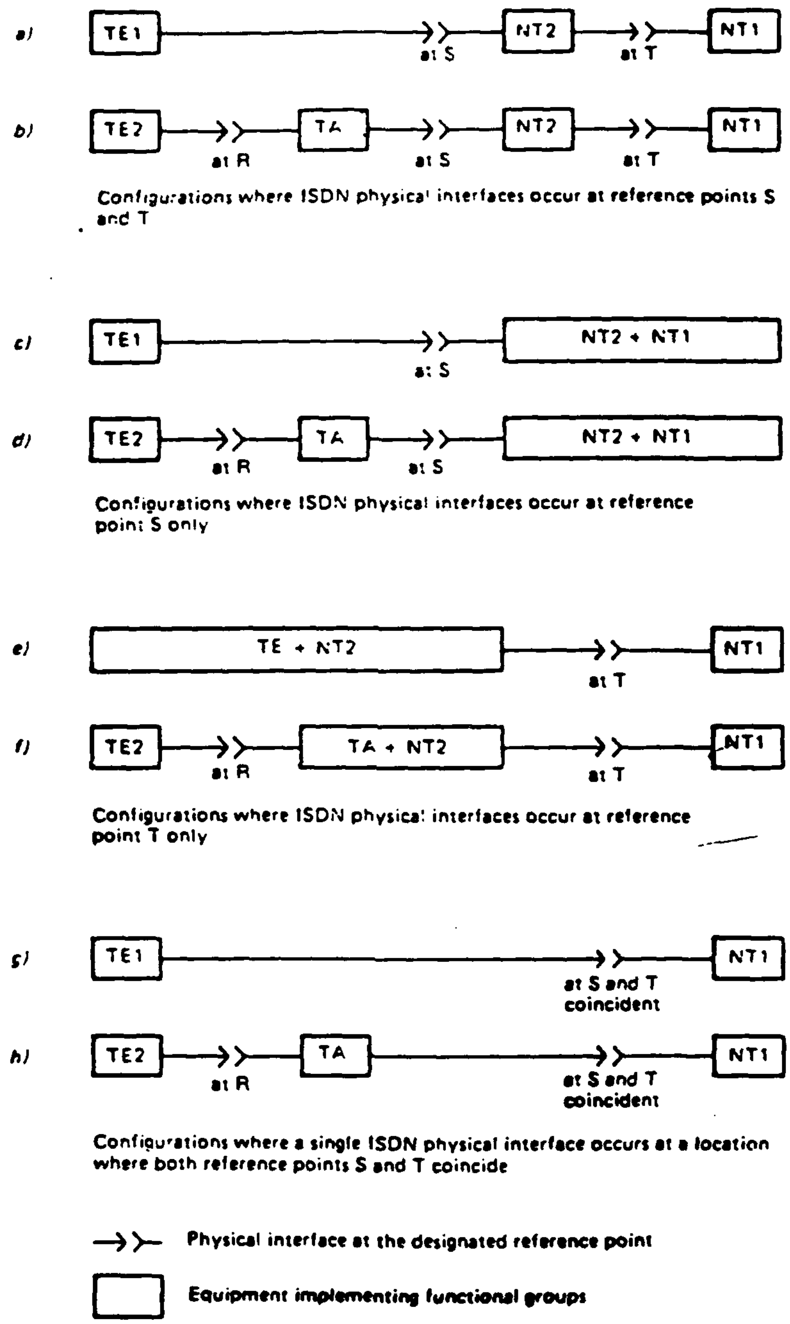


FIGURE 12-5. COMBINATIONS OF FUNCTIONAL GROUPINGS AND REFERENCE POINTS

interface at S but not T; Figures 12-5e and 12-5f show an interface at T but not S; Figure 12-5g and 12-5h show an interface at S and T where they coincide.

a. An important set of these cases is those in which no NT2 function is present. This represents a case where reference points S and T coincide and the terminal connects directly to the network. This illustrates the fact that an ISDN compatible terminal or a non-ISDN terminal and a TA can connect directly to a network through the NT1 or to an NT2 device using the same interface specifications. This insures the increase flexibility of the terminals.

b. Another important feature is the fact that an ISDN terminal is interchangeable with either the grouping of a non-ISDN terminal and a TA or another ISDN terminal.

c. As shown, there are several combinations of functional groupings possible. The configuration that is appropriate for each specific user will vary as a function of the local regulations and user needs. Based on the current industry trend , figures 12-5c and 12-5d are recommended as typical DCS configurations.

c. ISDN and DSN Network Architecture. Figure 12-6 illustrates the typical ISDN switch configuration. With this architecture, the Network Termination (NT) is connected to the Line Termination (LT) at the Multifunction switch end office. The LT is also referred to as the ISDN node. The function of the LT is to channel the information from the user along the proper service network (i.e., packet-switched, circuit-switched).

(1) The positioning of the LT in the DSN is a major issue and will require further study. During the early stages of ISDN, certain DSN services, such as host computers or dedicated services, will not be connected to the LT. They will instead be connected directly to their respective network switch.

(2) Any impact a different LT position for the DSN will have on the user-network or network-network interface cannot be fully realized. Therefore, the interface criteria provided in this chapter are based on the commercial ISDN standards related to the DSN. Any interface requirements that are a result of the emerging DSN ISDN architecture will be included in future revisions.

3. Basic Rate Interface. For the basic rate interface, the NT1 is basically a relay device. A 192 Kb/s time division multiplexed stream provides two 64 Kb/s B channels, one 16 Kb/s D channel, and 48 Kb/s of overhead on the user side (at the S/T interface). The overhead bits are used for contention resolution, DC balancing, and frame recognition. On the network side of the NT1, no CCITT standards exist; however, ANSI has developed a draft standard for layer 1 of the ISDN basic access interfaces at the network side of the network termination. Two basic access interfaces are of concern to the DSN:

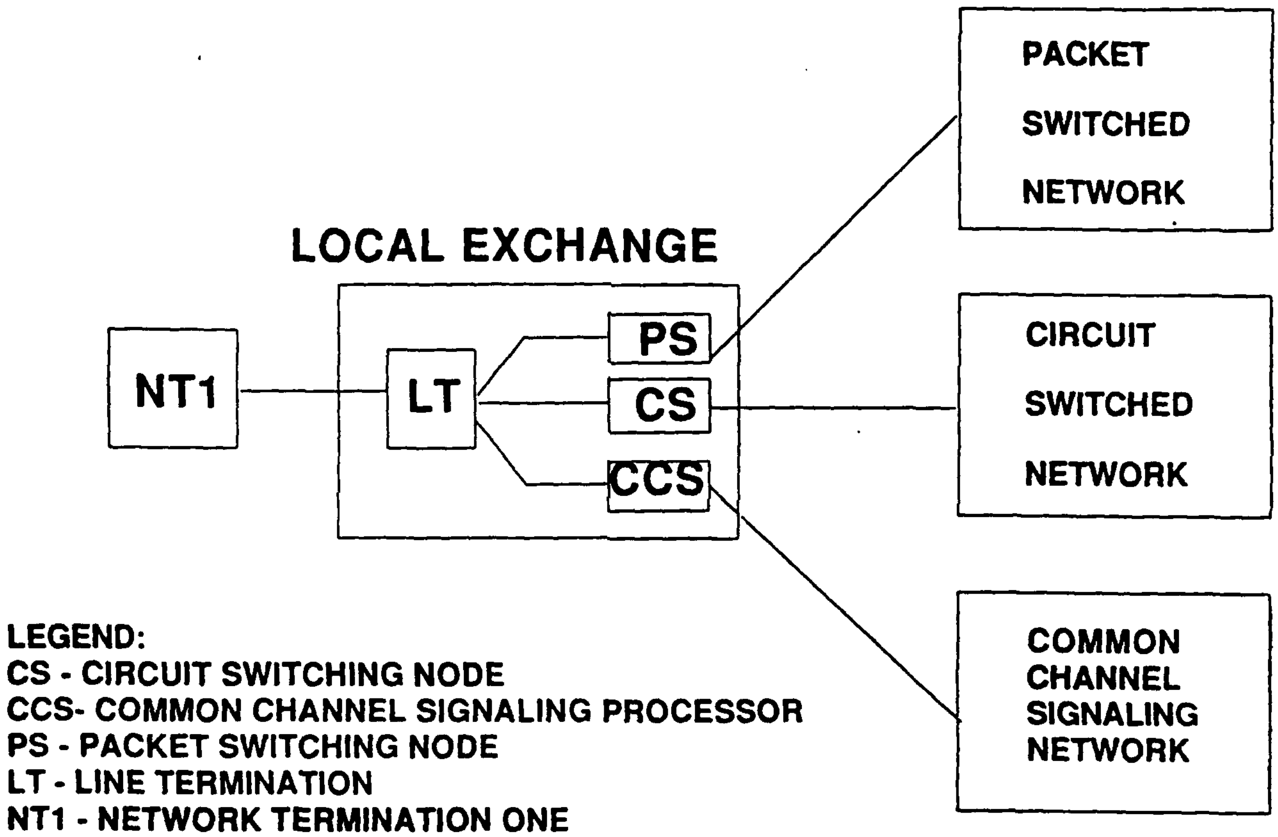


FIGURE 12-6. ISDN NETWORK ARCHITECTURE

ISDN terminal to the switch interface and user (non-ISDN) terminal to the switch interface.

a. ISDN Terminal to Switch Interface. As shown in figure 12-7, the ISDN terminal to switch configuration consists of an ISDN terminal (TE1) connected via a 2B+D line across the S/T interface to the network termination. The network termination is then connected to the LT at the central office by a 2-wire local loop across the U interface.

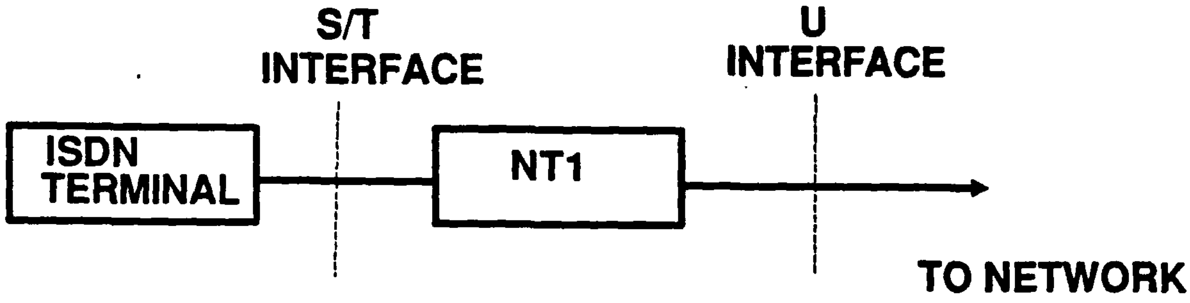


FIGURE 12-7. THE ISDN TERMINAL TO SWITCH INTERFACE

(1) ISDN Terminals. ISDN terminals will be discussed in future revisions.

(2) The S/T Interface. The Physical Layer of the ISDN for the Basic Rate Interface is specified in CCITT Recommendation I.430. Bit and octet timing, frame alignment, activation, deactivation, power feeding, and maintenance functions are provided by the interface. The S/T interface can support a single terminal on a point-to-point arrangement or multiple terminals through a synchronous bus by contention resolution or through multiple point-to-point arrangements.

(3) The U Interface. Although no standards have been developed for this interface by the CCITT, ANSI has been developing standards and some basic requirements exist for the U interface. This section presents the electrical characteristics of the ISDN Basic Access signal appearing at the network side of the NT1 device. It also presents the physical interface between the network and the network termination (the U interface).

b. User Terminal to Switch Interface. The user terminal to switch interface is similar to the ISDN terminal to switch interface, with one exception: the interface between the TA and the user terminal (the R interface). The user terminal to switch interface requires the same NT1 to the network interface (U interface) as the ISDN terminal to switch interface. Also, the interface between the TA and the NT1 (the S/T interface) for the user terminal to switch interface has the same specification as the TE1 to NT1 interface for the ISDN terminal to switch interface. Therefore, the S/T and the U interfaces for the user terminal to switch connection will follow the criteria established in paragraph 3a.

c. Hybrid Interfaces. The access used during the transition to ISDN may be of the hybrid type. The hybrid interface consists of a digital interface (a B and D channel combination) operating above the analog voice channel A (A + 2B + D, A + B + D, or A + D). These interfaces connect the analog channel directly to the NT1 device witn the standard ISDN interface structure for the digital connections. Both the analog and digital channels are combined at the NT1 functional grouping and sent over the same transmission medium. STUIII's fall into the catagory of analog phones. In the future, when digital loops exist in the DCS environment, the STUIII's should be modified to transmit digital signals. In another words, the final digital to analog conversion within the STUIII can be eliminated.

(1) DSN/DCS has an extensive inventory of analog telephones many of which will remain in use for some time to come, therefore, the hybrid interfaces will ease the implementation of ISDN during this transitional period. However, there has been no explanation or specification in the I-series CCITT Recommendations of a device to handle such a connection.

(2) An NT1 device that could handle both the analog channels and ISDN digital channels should be able to convert analog to digital, convert tone/pulse signaling to common channel signaling, and support all the existing analog telephone functions. This arrangement needs for further study and clarification.

4. Primary Rate Interface (PRI).

a. Application. PRI is designed to serve: (1) a large number of terminals such as those behind a PBX, LAN, or controller, and (2) higher bit rate applications.

(1) Physical Interfaces. Two different physical interfaces exist:

(a) based on the "North American Standard," 1.544 Mb/s

(b) based on the "European Standard," 2.048 Mb/s.

b. Channel Structure. Table 12-1 summarizes the different rate structure:

TABLE 12-1. PRIMARY RATE INTERFACE CHANNEL STRUCTURE

PRI Structure	North American	European
B	23B+D	30B+D
H0	3H0+D	5H0+D
	4H0	
B&H0	3H0+5B+D	
H1	H11	H12+D

TABLE 12-1. PRIMARY RATE INTERFACE CHANNEL STRUCTURE (CON.)

B = 64 Kb/s

D = 16 OR 64 Kb/s

H0 = 384 Kb/s

H11 = 1536 Kb/s

H12 = 1920 Kb/s

c. Anticipated Typical Access Architecture

(1) This paragraph provides information on the North American perspective of network equipment located between the customer network interface (NI) and an internal interface within the Network Element (NE) that processes the D channel. This NE might be an ISDN switch, an ISDN Remote Switch Unit (RSU), or a standalone Exchange Termination (ET) used in conjunction with an analog switch or non-ISDN digital switch.

(2) Although ISDN is not fully implemented, several configurations anticipated for the Primary Rate Interface involve equipment such as T1 lines, Multiplexers, and DS1 connector. The most common architecture is the "T Carrier" (see figure 12-8). In this case, the transport facility is a T1 carrier line, the DS1 connector, Network Terminating one and two (NT1/NT2), and an ISDN switch (an ISDN switch is by definition a Network Element (NE) that processes Primary Rate D channel. This includes ISDN switches, ISDN Remote Switch Units (RSUs), or standalone Exchange Terminations (ETs) used in conjunction with as analog switch or non-ISDN digital switch.)

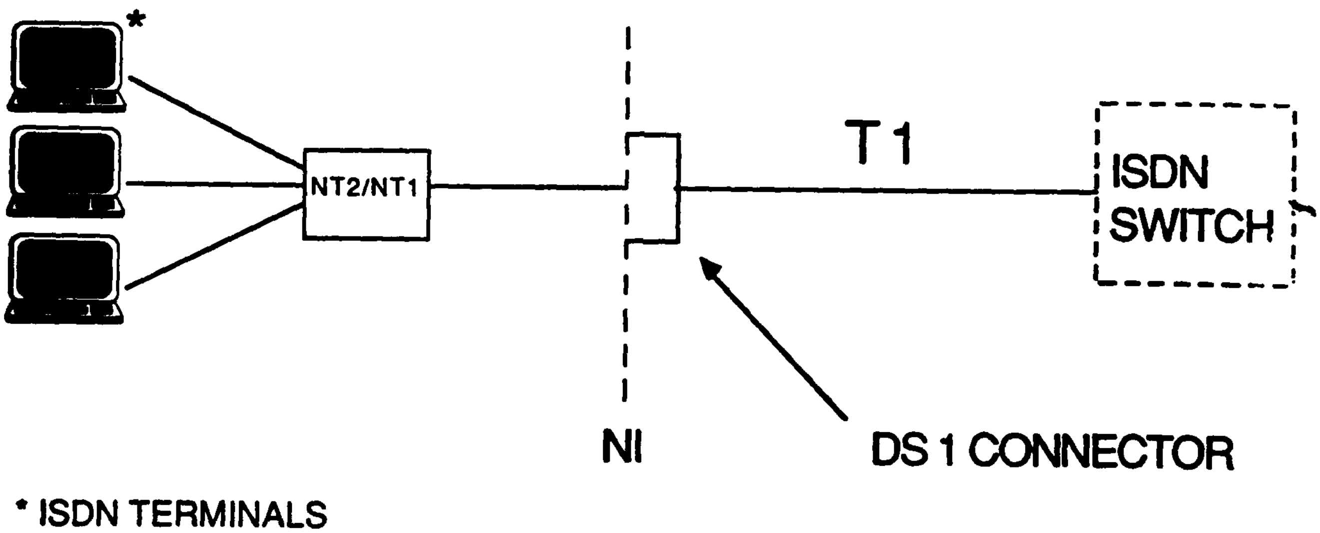


FIGURE 12-8. T CARRIER ARCHITECTURE

d. Interface Requirement

This paragraph discusses the interface requirements of the primary rate interface. Therefore, the emphasis will be on physical characteristics as opposed to signaling and information transfer. The section is divided into three main sections: electrical, format, and signaling requirements. Primary sources of information are CCITT and T1E1. CCITT defines the electrical characteristics for both 1.544 Mpbs and 2.048 Mb/s interfaces at interface points 1 and 2 as defined in figure 12-9. These interface points are located at the input/output port of the TE/NT.

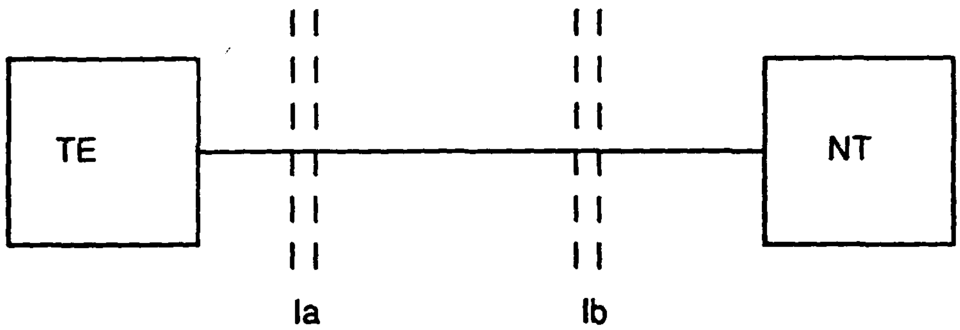


FIGURE 12-9. PRIMARY RATE INTERFACE POINTS

(1) Electrical Requirements

(a) The electrical characteristics are defined for the two primary rate interfaces: 1.544 Mb/s and 2.048 Mb/s. First, the requirements for 1.544 Mb/s are discussed. The basic signal characteristics as defined by CCITT and T1E1 and listed in table 12-2 provide the general requirement of the signal at the interface point.

TABLE 12-2. CCITT DIGITAL INTERFACE AT 1.544 MB/S

CHARACTERISTIC	REQUIREMENT
Bit Rate	1.544 Mb/s ±50 Parts Per Million (PPM)
Pair(s) in Each Direction of TX	One Symmetric Pair
Code	B8ZS

(b) CCITT recommendation I.431 defines the input and output port requirements for the primary rate interface. Specifications at the output ports (see figure 12-9) are shown in table 12-3.

TABLE 12-3. CCITT OUTPUT PORT SPECIFICATION AT 1.544 MB/S

CHARACTERISTIC	REQUIREMENT
Test Load Impedance	100 Ohms Resistive
Nominal Pulse Shape	See Pulse Mask (figure 12-10)
Signal Level at 722 Khz	$\pm$12 dBm to +19 dBm
Signal Level at 1544 Khz	At Least 25 dB Below the Power at 772 Khz
Voltage at Zero	< The Value Produced in That Time Slot by Other Marks of figure 12-10, or $\pm$5% of the Peak Pulse (Mark) Amplitude Whichever is Greater

(c) Input port specification is the same as the output port characteristics with two modifications. The attenuation for the interconnecting pair should be proportional to the square root of the frequency and the loss at 772 KHZ frequency shall be in the range of 0 to 6 dB.

(d) CCITT specifies the jitter and wander requirements for this interface. Specifically, it specifies the tolerable jitter at TE input, the TE output jitter. Figure 12-11 is the amplitude-frequency characteristic of tolerable sinusoidal input jitter without producing bit errors or losing frame alignment. The TE output jitter requirement follows:

a Band 1 (10 HZ- 40 KHZ): 0.5 UI Peak-to-Peak

b Band 2 (8 KHZ - 40 KHZ): 0.07 UI Peak-to-Peak

(e) Wander requirements--specified for frequencies below 10 HZ--are the same for the network side and the user side. The requirement is that wander shall not exceed 5 UI Peak-to-Peak in any 15 minute interval and shall not exceed 28 UI Peak-to-Peak within a 24 hour period.

(f) The T1E1 subcommittee provides the 1.544 Mb/s interface requirements shown in table 12-4.

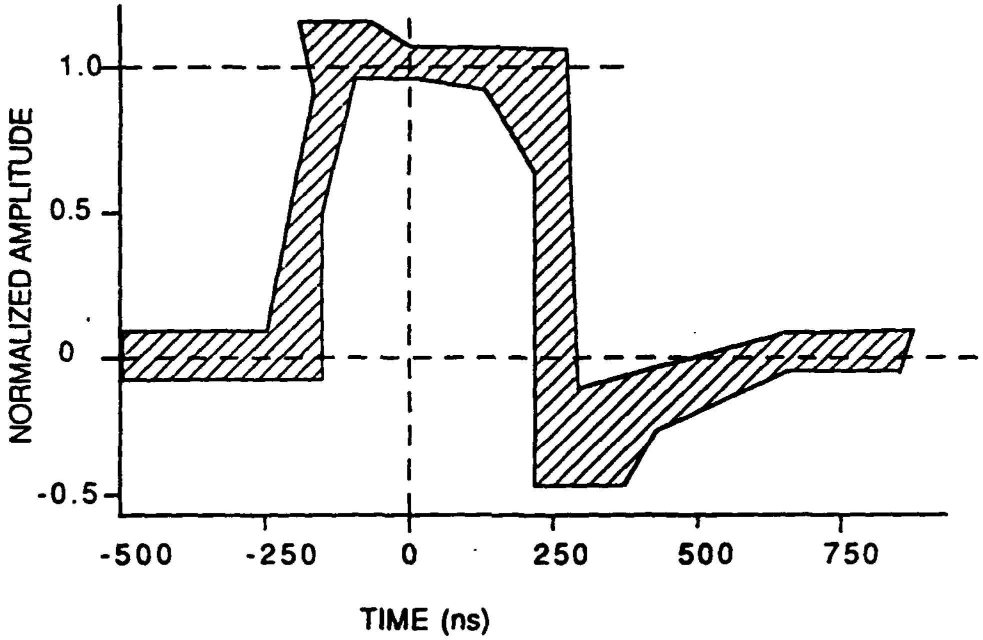
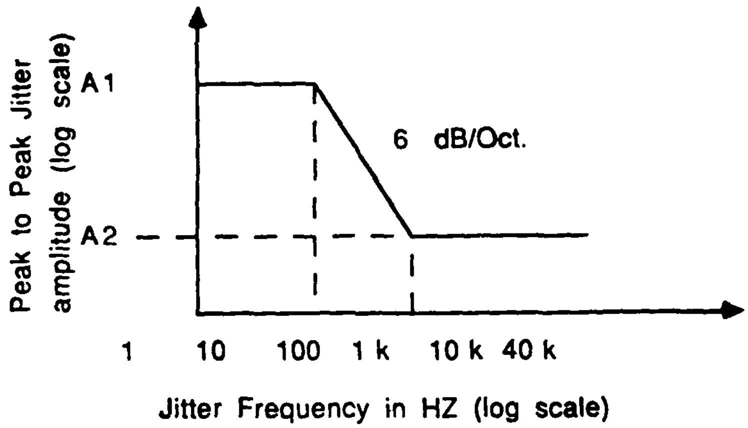


FIGURE 12-10. PULSE MASK AT 1.5444 MB/S



A1 5.0 UI
A2 0.1 UI
f1 120 Hz
f2 6 kHz
UI = Unit Interval (648 ns)

FIGURE 12-11. CCITT TOLERABLE TE INPUT JITTER CHARACTERISTICS

TABLE 12-4. T1E1 CUSTOMER-NETWORK INTERFACE REQUIREMENTS (PRIMARY RATE ACCESS)

CHARACTERISTIC	REQUIREMENT
Test Load	100 Ohms ±5%
Standard Pulse Characteristic	Amplitude Between 2.4 and 3.6 Volts Measured at the Center of the Pulse. The Isolated Pulse should fit the normalized template of Figure 12-10.
Power Level	12 to 19 dBm at 772 kHz 25 less at 1544 kHz in a 2 to 3 kHz band
Pulse Amplitude Imbalance	<200 mv in any window of 17 consecutive bits
Pulse Width Imbalance	<20 nsec in any window of 17 consecutive bits
60 Hz Variation in Pulse	The envelope of the pulse amplitude shall be limited as shown in Figure 12-10.
Pulse Density	Except for the quasi-random signal, a DS1 signal should not have more than 15 consecutive "zeros"; at least N "ones" in each and every time window of 8(N+1) digit time slot where N is between 1 through 23

(g) The previous paragraph stated the CCITT jitter requirement. T1E1 committee has also specified jitter requirement for the DS1 interface. T1E1 considers the same frequency band as CCITT. The standards committee considers two types of signals at the Network Interface point: Carrier Signal and Customer Interface (CI) Signal. It states that the carrier signal shall not exceed the following limits in both bands simultaneously:

1 Band 1 (10 HZ- 40 KHZ): 5.0 UI Peak-to-Peak

2 Band 2 (8 KHZ - 40 KHZ): 0.1 UI Peak-to-Peak.

(h) There are two types of CI signal jitter at the NI:

1 Where the equipment on the CI side of the interface is the source, i.e., Terminal Equipment (type 1)

2 Where the CI source is part of a user network and is transported over a user's facility to the interface (Type 2).

(i) The CI signal type 1 jitter is then limited to:

1 Band 1 (10 HZ- 40 KHZ): 0.5 UI Peak-to-Peak

2 Band 2 (8 KHZ - 40 KHZ): 0.07 UI Peak-to-Peak.

(j) The CI signal type 2 jitter is then limited to:

1 Band 1 (10 HZ- 40 KHZ): 5.0 UI Peak-to-Peak

2 Band 2 (8 KHZ - 40 KHZ): 0.1 UI Peak-to-Peak.

(k) The T1 standard wander requirement for both the carrier and the CI signal is the same as the CCITT.

(l) The remainder of this section is designated to the 2.048 Mb/s rate. The requirement for this interface is based on the section six of the CCITT Red Book Recommendation G.703 (This section should be reexamined when the CCITT blue book is published.) T1 standards do not include the 2.048 rate. The electrical characteristics at the 2.048 Mb/s rate are shown in table 12-5.

TABLE 12-5. CCITT DIGITAL INTERFACE AT 2.048 MB/S

CHARACTERISTIC	REQUIREMENT
Bit Rate	2.048 Mb/s ±50 Parts Per Million (PPM)
Pair(s) in Each Direction of TX	One symmetric pair
Code	HDB3

(m) CCITT provides the output port specifications as shown in table 12-6.

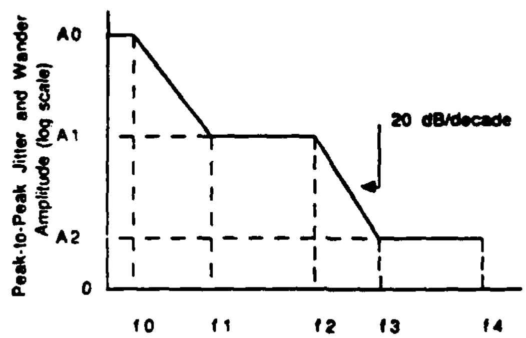
Table 12-6 CCITT OUTPUT PORT SPECIFICATION AT 2.048 MB/S

CHARACTERISTIC	REQUIREMENT
Test Load Impedance	120 Ohms Resistive
Nominal Peak Voltage of a Mark	3V
Peak Voltage of a Space	0 ±0.3V
Nominal Pulse Width	244 nsec

Table 12-6 CCITT OUTPUT PORT SPECIFICATION AT 2.048 MB/S (CON.)

CHARACTERISTIC	REQUIREMENT
Ratio of Amplitude of Positive	0.95 to 1.05 and negative pulses at the center of the pulse interval
Ratio of the Widths of Positive	0.95 to 1.05 and negative pulses at the nominal half amplitude
Nominal Pulse Shape	See pulse mask

(n) The CCITT recommendation on jitter for 2.048 primary rate interface is found in Blue Book recommendation I.431. This recommendation takes two different subscriber configurations into account: one access and multiple accesses. An example of a one access configuration is a network with transmission systems of either high Q or low Q clock recovery circuits. Multiple accesses include transmission systems of the same kind (either high Q or low Q recovery circuit) or of different kinds (some with high Q and some with low Q recovery circuits). The minimum tolerable input sinusoidal jitter/wander to a TE for the 2.048 Mb/s is given in figure 12-12.



A0	A1	A2	f0	f1	f2	f3	f4
20.5 UI	1.0 UI	0.2 UI	12×10^{-6} Hz	20 Hz	3.6 Hz	18 Hz	100 kHz

FIGURE 12-12. CCITT MINIMUM TOLERABLE INPUT JITTER FOR 2.048 MB/S RATE

(o) Two cases of output jitter are considered: (1) TE and NT2 with only one user-network interface, and (2) TE with more than one user-network interface to the same network. For the first case, the TE output jitter in the absence of input jitter should be as shown in table 12-7.

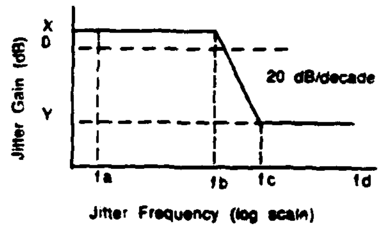
TABLE 12-7. TE AND NT2 OUTPUT JITTER

Measurement Filter Bandwidth		Output Jitter
Lower Cutoff	Upper Cutoff	UI Peak-to-Peak
20 Hz	100 Khz	<= 0.125 UI
700 Hz	100 Khz	<= 0.02 UI

(p) In the presence of input jitter the output jitter is given by:

Output Jitter = Intrinsic Jitter+(Input Jitter * Transfer Function)

The transfer function characteristics are shown in figure 12-13.



Y	X	fa	fb	fc	fd
-19.5 dB	0.5 dB	10 HZ	40 HZ	400 HZ	100 kHZ

FIGURE 12-13. JITTER TRANSFER CHARACTERISTIC FOR 2.048 MB/S PRIMARY RATE INTERFACE.

(q) For multiple user interfaces, the Output Jitter is the same as the one user-network interface case. In the presence of input jitter the Output Jitter depends on several factors:

1 The input jitter of each access

2 The transfer characteristics

3 The timing extraction and distribution concept

4 The future growth of the TE.

(r) The transfer characteristics between any receiver and transmitter should be tested against the transfer function of figure 12-13. However, the following parameters should be used:

y	x	fa	fb	fc	fd
-19.8 dB	0.2 dB	not defined	0.1 Hz	1 HZ	100 kHZ

Other parameters included in the CCITT blue book regarding the 2.048 Mb/s primary rate interface are: Tolerable Longitudinal Voltage, Output Signal Balance, and Impedance towards ground. These requirements are included in table 12-8.

TABLE 12-8. ELECTRICAL CHARACTERISTIC FOR 2.048 MB/S PRIMARY RATE INTERFACE

ELECTRICAL CHARACTERISTIC	OBJECTIVE
Tolerable Longitudinal Voltage	2 Vrms over frequency range 10 Hz to 30 Mhz
Output Signal Balance	>= 40 dB for frequency 1 MHz Minimum value decreasing from 40 dB at 20 dB/decade over frequency range 1 to 30 Mhz
Impedance Toward Ground	>1000 Ohm for 10 Hz < F< 1 Mhz

Test configuration for the above requirements are included in the CCITT Blue Book to be published in the near future.

(2) Format Requirement at the Interface Point

(a) This paragraph uses the same outline structure as the previous section. Therefore, the 1.544 Mb/s primary rate is discussed first followed by the 2.048 Mb/s primary rate interface discussion on signal format requirements at the interface point.

(b) CCITT requires the following framing format for the 1.544 Mb/s interface:

1 Each frame should be 193 bits long and consists of an F-bit followed by 24 consecutive time slots, numbered 1 to 24

2 Each time slot should consist of 8 consecutive bits, numbered 1 to 8

3 The frame repetition rate should be 8000 frames/s.

(c) CCITT uses the multi-frame structure format. Each multi-frame is 24 frames long and is defined by the multi-frame alignment signal (FAS) which is formed by every fourth F-bit and has a binary pattern (... 001011 ...). Multi-frame structure uses Cyclic Redundancy Check (CRC) for error correction purposes.

(d) Tl also requires a frame is 192 information digits time slot preceded by one digit time slot containing (F) bit, for a total of 193 digit time slot. Tl standard requires the 1.544 Mb/s carrier or customer signal at the network interface to be either in Superframe(SF) or the Extended Superframe (ESF) format. The superframe (SF) format consists of 12 consecutive frames. The F bits in SF format requires F bits to be used for signaling only. The extended superframe consists of 24 consecutive frames. The F bits in this format are used for the framing pattern sequence, data link, and CRC check.

(3) Signaling Requirements

The signaling requirements for the primary rate access are discussed in great detail in Appendix II of the "Generic Switch Requirement" document.

Appendix D. Chapter 14, Electrical and Physical Interface Criteria - Replacement text

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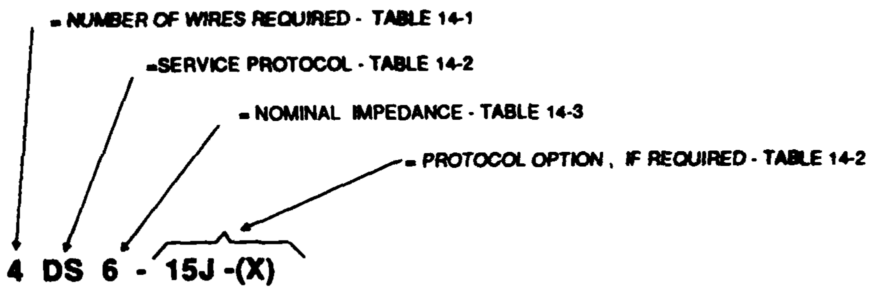
CHAPTER 14. DSN - PHYSICAL AND ELECTRICAL INTERFACE APPLICATIONS

1. General. This chapter provides engineering and application guidance for the electrical and/or physical interface when connecting telecommunications systems and equipment within the Defense Switched Network (DSN) worldwide.

2. Scope. This chapter emphasizes the requirements of the network terminating equipment at the user premises, the interface with the provider of facilities and the interface at DSN Central Office Terminating Equipment (PBX and EPBX, End Office or Multifunction Switch). The interface includes two- and four-wire user access lines, PBX and EPBX access lines, and interswitch trunks.

3. Interface Codes. Interface codes have four basic components: Number of wires, Protocol, Impedance, and Protocol option. A typical application interface code would consist of the following elements:



4. Determining the Interface Specification. The proper interface code can be determined in either one of two ways. The first way to determine the required application interface specification is to derive the information from the appropriate tables using the following sequence: table 14-1 (Total Wires Required), table 14-2 (Protocol Codes and Selected Options), and table 14-3 (Impedance). The second way to find the correct interface code is to use table 14-4. This table contains many of the most common interconnect codes found in the current, transitional, and future DCS/DSN. Start with the identification of proper type of end point equipments. Then determine the type of interconnect facilities that exist between the two identified end points. The right hand column is indexed to a figure that reflects the equipment, the interconnect and the proper technical characteristics relating to that interface. The overall objective is to reduce the various types of interfaces as the DCS/DSN transitions toward an all digital environment. Many of the analog and transitional interfaces will naturally migrate out of use as the network elements are upgraded to digital operation.

TABLE 14-1. TOTAL WIRES USED

For most interface codes, the following chart defines the total number of conductors used in that interface. Exceptions to this rule are noted on the individual application interface specification sheets in table 14-4.

Number of Wires	Code
2	2
4	4
6	6
7	7
8	8
9	9
10	10
12	12

TABLE 14-2. SERVICE PROTOCOL AND SELECTED OPTIONS

INTERCONNECT SERVICE DESCRIPTION	CODE	OPTIONS
End user -loop seizure DP and DTMF sending and 20 Hz receiving	US	
Terminated on DSN MFS, EO or MILDEP PBX		
Common channel signaling DSN multifunction switch to DSN multifunction switch	CC	
Digital Interface	DS	
2.048 Mb/s (PCM 30), per CCITT G.703 and G.732		15A
1.544 Mb/s D4 framing (PCM-24)		15E
1.544 Mb/s (DS1) format		15J
Type I E&M signaling and DX1	MA	
Type II E&M signaling and DX1	MB	

TABLE 14-2. PROTOCOL CODES AND SELECTED OPTIONS (CON.)

Type V E&M signaling - ETS only DSN MFS, and ETS to other DSN elements	MC	
Analog access line and/or trunk	SF	
DSN ETS MFS to DBP, PTT	HK	
DSN, ETC, and MFS, DSA operator to dedicated manual ringdown end user station DSN, ETC, and MFS to offices which employ 50 Hz signaling	HZ	(1) (2)
DSN, ETS, and MFS DID/DOD to DBP, PTT	IK	
600/750 Hz Signaling to ETS switches to be replaced and USAF exchanges (transitional) 2280 Hz signaling to ETS switches to be replaced and USAF exchanges (transitional)	IS	(1) (2)
DSN, ETS, MFS to ETS RP 40 switches	RP	

The following chart provides the nominal reference impedance at the specified interface when evaluating transmission performance.

TABLE 14-3. IMPEDANCE

Impedance:	Value (ohms)	Code	Value (Ohms)	Code
	75	0	150	5
	100	1	600	6
	120	2	1200	7
	124	3	Variable	8
	135	4	900	9

TABLE 14-4. APPLICATION INTERFACE SPECIFICATION INDEX

From	Interconnect	To	Interface Code	Page
End user	Two-wire voice grade line or off-hook service	End Office	2US9	14-6
DSN MFS or EO	Voice Grade Data Link	MFS, EO, PBX or EPABX	4CC6	14-7
DSN MFS	Interswitch or Off Network Trunks PCM-24	DSN MFS, EO or other Networks	4DS1-15E	14-8
RLU/RSU	PCM-24 PCM-30	MFS or EO MFS or EO	4DS1-15J 4DS2-15A	14-9 14-10
DSN MFS or EO	Interswitch or off Net Trunks (PCM-30)	MFS, EO, or PTT	4DS2-15A	14-10
DSN MFS or EO	Analog Trk E&M Type I and DX	PBX, EPBX, PTT, Interexchange Carrier, DCTN, or FTS	6MA6 4MA6	14-11 14-12
DSN MFS or EO	Analog Trk E&M Type II and DX	EO, PBX, PABX, PTT, Interexchange Carrier, DCTN, FTS, SDN or AUTOVON	6MB6 8MB6	14-13 14-14
DSN MFS	Analog Trunk E&M Type V	Transitional ETS Elements	6MC6	14-15
DSN MFS or EO	Analog Trk E/W SF	EO, PBX, EPABX, PTT, Interexchange Carrier, DCTN, or FTS	8SF6	14-16
DSN MFS or EO	Analog Trunk	MFS to PTT	2HK6	14-17
DSN MFS or EO	Analog Trunk	ETS MFS, DSA Operator to dedicated manual ringdown station	2HZ6-(1)	14-18
DSN MFS or EO	Analog Trunk	ETS MFS, to Central Offices that employ 50 Hz signaling	2HZ6-(2)	14-19

TABLE 14-4. APPLICATION INTERFACE SPECIFICATION INDEX (CON.)

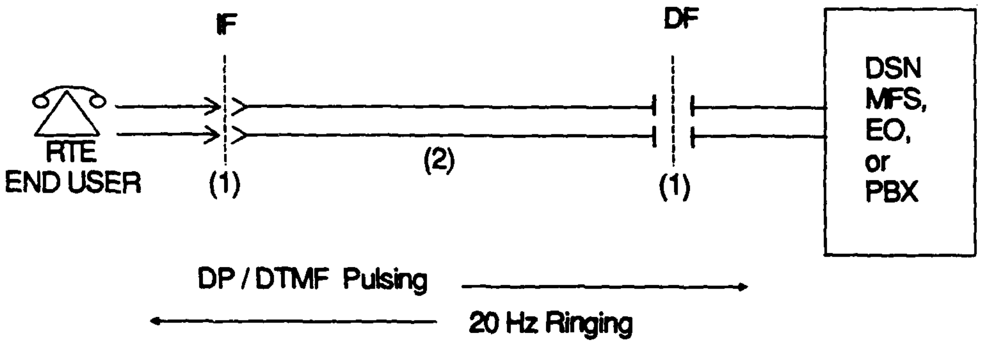
From	Interconnect	To	Interface Code	Page
DSN MFS	Analog Trunk DID/DOD	ETS to DBP, PTT	2IK6	14-20
DSN MFS	Analog Trunk	ETS switches not to be replaced and USAF exchanges	4IS6 (1)	14-21
DSN MFS	Analog Trunk 3-wire	ETS Switch Elements RP40	3RP6	14-22

Description - Connects End user premises equipment to voice grade interconnect facilities for transmitting voice and 20 Hz ringing, DP/DTMF pulsing or off-hook service operation.

- Two-wire (T and R).

- Facility Type: Voice Grade.

Illustration



2US9

Electrical Features
- Impedance: 900 ohms
- Bandwidth: Nominal 4 kHz
- Frequency Range: 300 - 3000 Hz
- Levels TLP: 0.0 Nominal Transmit, Receive -7 dB Maximum, reference test frequency 1004 Hz.

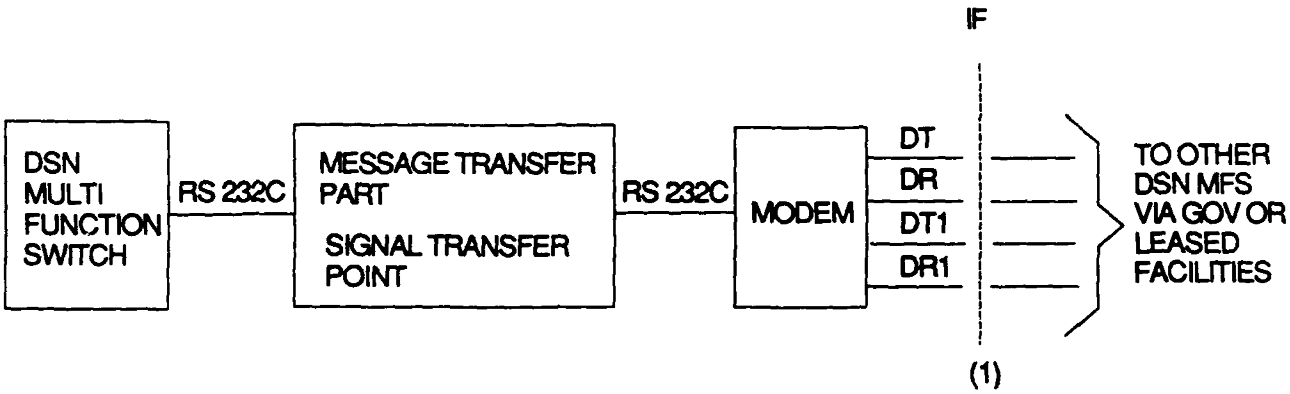
References Chapter 5, Paragraphs f and g; Chapter 9, Paragraph 1a.

Note
(1) Transmission Level Point (TLP) for measurement
(2) Loop resistance 0 to 1500 ohms typical, verify vendor specification
IF = Interface (Plug and Jack)
RTE = Registered Terminal Equipment
DF = Distributing Frame.

FIGURE 14-1. SPECIFICATION FOR INTERFACE TYPE 2US9

Description	-	Connects DSN multifunction switch to Common Channel Signaling (CCS) data link(s) via interconnect facility suitable for transmitting data signals.
	-	Operating mode full duplex (FDX).
	-	Physical description: four-wire (DT, DR, DT1, DR1).
	-	Facility type: Voice grade (May be DDS off net extension).

Illustration



4CC6

Electrical Features	- Impedance: 600 ohms - Levels TLP: +13 Transmit, -3 Receive, Reference Test Frequency 1004 Hz - Bandwidth: Nominal 4 kHz - Frequency Range: 300 - 3000 Hz - Speed: 9.6 Kb/s or less
Reference	Chapter 6, Paragraph 3.
Note	(1) Transmission Level Point (TLP) for testing IF = Interface

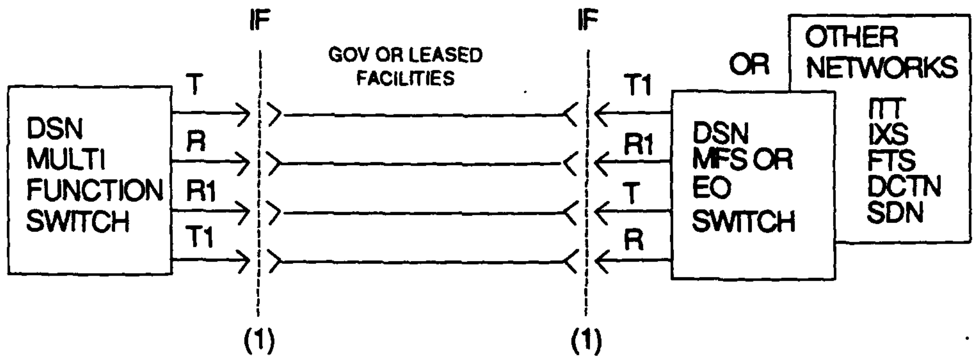
FIGURE 14-2. SPECIFICATION FOR INTERFACE TYPE 4CC6

Description - Connects digital inter switch trunks via 1.544 Mb/s high capacity service (PCM-24)

- Operating Mode: D4 Framing Format

- Physical Description: DSX-1.

Illustration



4DS1-15E

Electrical Features
- Impedance: 100 ohms
- Levels (TLP unless otherwise noted): 12.4 - 18.0 dBm (all 1's signal 2 kHz bandwidth centered at 772 kHz)
- Speed: 1.544 Mb/s ± 50 ppm (772 kHz).

Reference Chapter 6; Chapter 8, Section A, Paragraph 2.

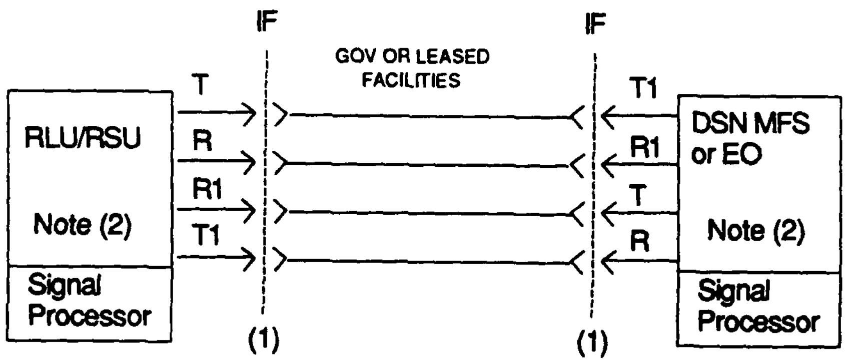
Note (1) Transmission Level Point (TLP) for measurement
IF = Interface (DSX-1 Cross Connect).

FIGURE 14-3. SPECIFICATION FOR INTERFACE TYPE 4DS1-15E

Description - Connects referenced equipment per T1 (1.544 Mb/·` high capacity line as a transmission medium

- Operating Mode: D4 Framing Format
- Physical Description: DSX-1.

Illustration



4DS1-15J

Electrical Features
- Impedance: 100 ohms
- Levels (TLP unless otherwise noted): 12.4 -18.0 dBm (All 1's signal 2 kHz bandwidth centered at 772 kHz)
- Speed: 1.544 Mb/s ± 50 PPM (772 kHz)
- Format: DS1 (T1).

Reference - Chapter 8, Section A, Paragraph 2.

Note
DSX = Digital Signal Crossconnect frame
(1) Transmission Level Point (TLP) for measurement
(2) May require one or more T1 lines due to particular application
(3) Typically the communications between the RLU signal processor and the host utilize one or more channels of the PCM span line facility.
IF = Interface (DSX-1 Cross Connect)

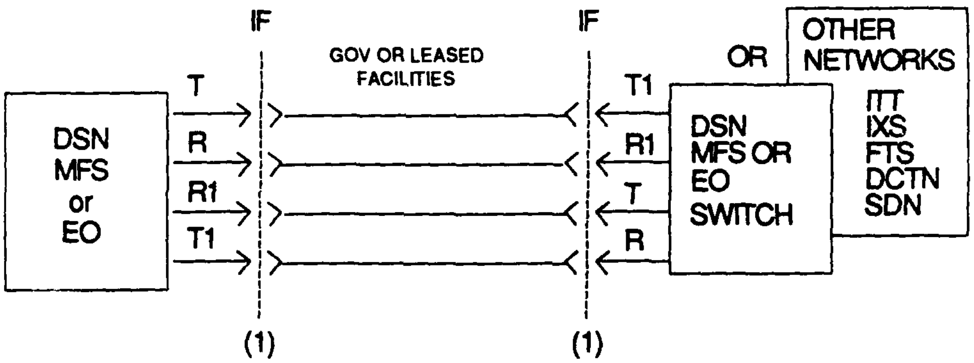
FIGURE 14-4. SPECIFICATION FOR INTERFACE TYPE 4DS1-15J

Description - Connects digital DSN Access Lines via 2.048 Mb/s high capacity service

- Operating Mode: PCM 30 Framing Format

- Physical Description: DSX-1.

Illustration



4DS2-15A

Electrical Features
- Impedance: 1200 ohms
- Levels (TLP unless otherwise noted): Pulse mask is under study
- Speed: 2.048 Mb/s.

References
- Chapter 8, Section A, Paragraph 3
- CCITT Recommendation G.703 and G.732.

Note (1) Transmission Level Point (TLP) for measurement
IF = Interface (DSX-1 Cross Connect).

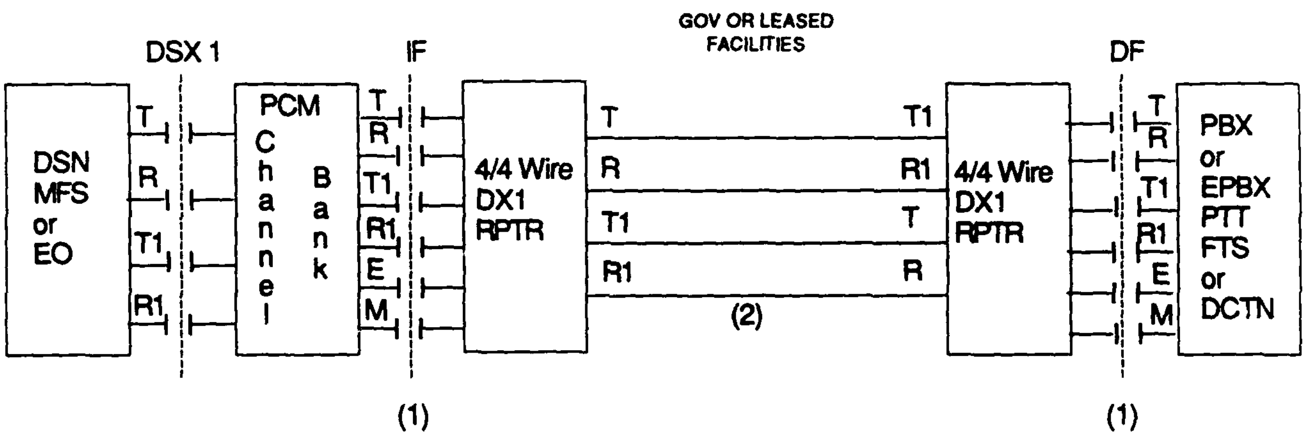
FIGURE 14-5. SPECIFICATION FOR INTERFACE TYPE 4DS2-15A

Description - Type I E&M Signaling. The DSN multifunction switch or end office originates on the M lead. Facility interface code TL31M (registered)

- Six-wire (T,R,T1,R1,E,M).

- Line facility type: Voice Grade.

Illustration



6MA6

Electrical Features
- Impedance: 600 ohms
- Levels TLP: 0.0 dB transmit, -6 receive, reference test frequency 1004 Hz
- Bandwidth: Nominal 4 kHz
- Frequency range: 300 - 3000 Hz.

Reference Chapter 8, Section A, Paragraph 5.

Note
(1) Transmission Level Point (TLP) for measurement
(2) Facility resistance range not to exceed 5000 ohms
DSX1 = Digital Crossconnect Frame
IF = Interface
DF = Distributing Frame.

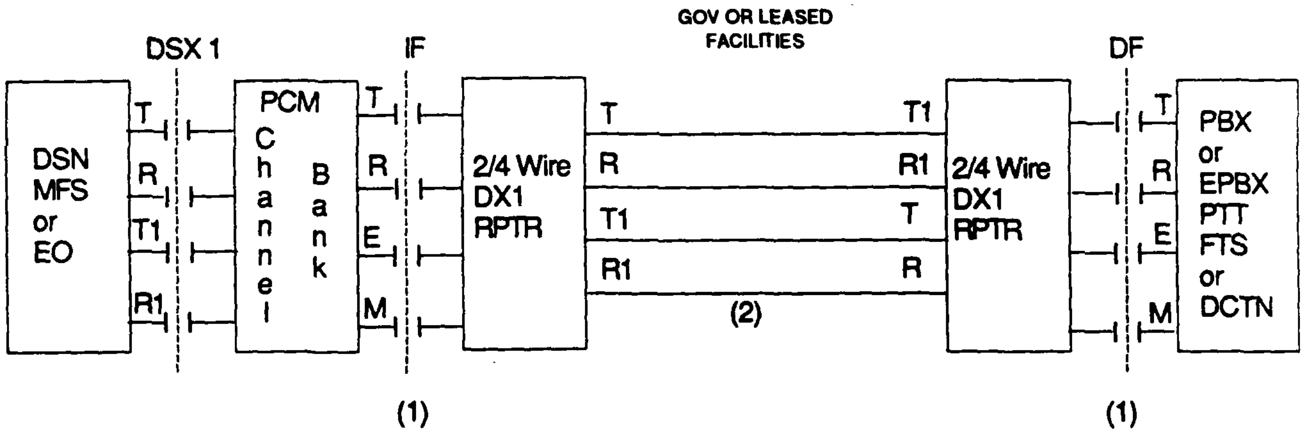
FIGURE 14-6. SPECIFICATION FOR INTERFACE TYPE 6MA6

Description - Type I E&M Signaling. The DSN multifunction switch or other network switch originates on the M lead. Facility interface code TL11M (registered)

- Four-wire (T, R, E, M).

- Off network trunk facility type: Voice Grade.

Illustration



4MA6

Electrical Features
- Impedance: 600 ohms
- Levels TLP: 0.0 dB transmit, -6 receive, reference test frequency 1004 Hz
- Bandwidth: Nominal 4 kHz
- Frequency range: 300 - 3000 Hz.

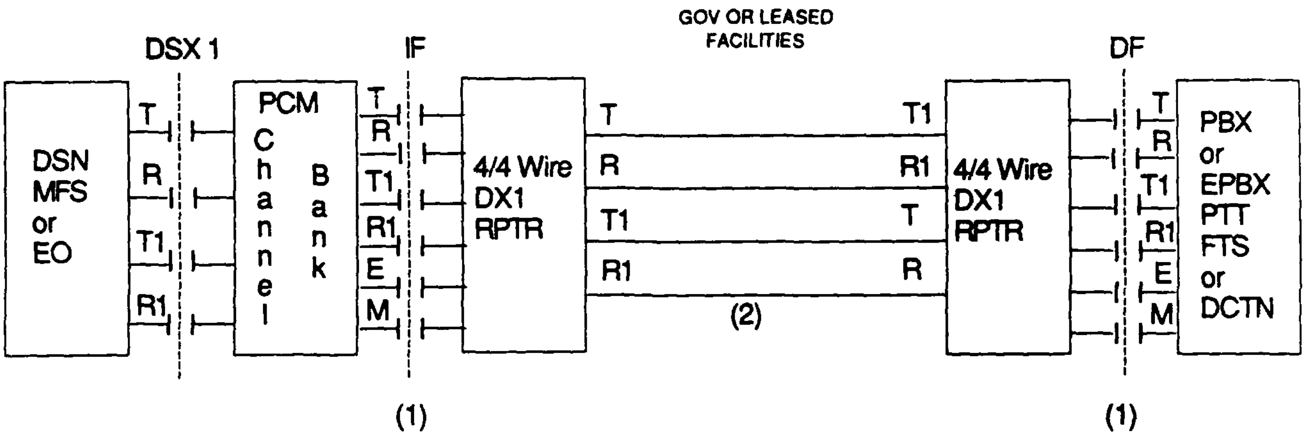
Reference Chapter 9, Paragraph 1d.

Note
(1) Transmission Level Point (TLP) for measurement
(2) Facility resistance range not to exceed 5000 ohms
(3) Transitional
DSX1 = Digital Crossconnect Frame
IF = Interface
DF = Distributing Frame.

FIGURE 14-7. SPECIFICATION FOR INTERFACE TYPE 4MA6

Description	- Type II E&M Signaling, the DSN MFS or end office originates on the M lead. DSN MFS or other network switch equipment originates on the M lead facility interface code TL12M (registered)
	- Six-wire (T, R, E, T1, M, R1).
	- Off Network Trunk Facility Type: Voice Grade.

Illustration



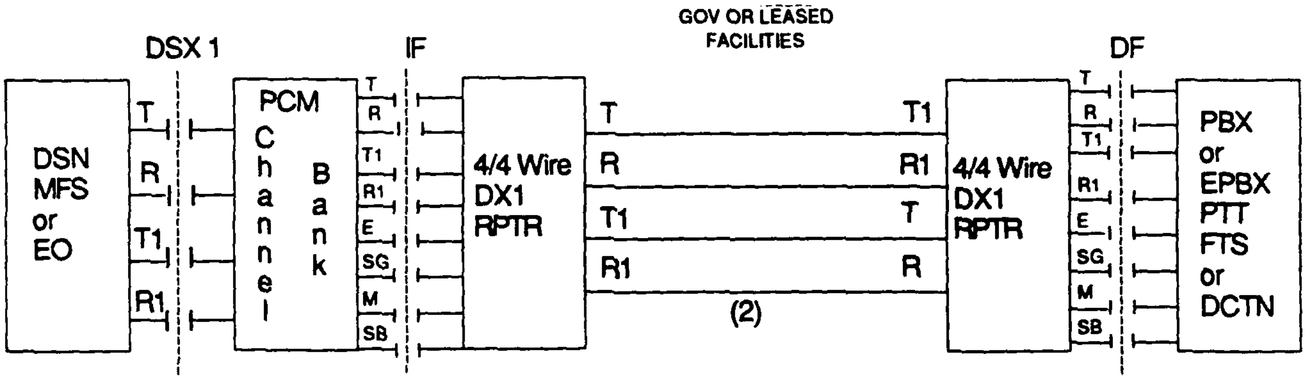
6MB6

Electrical Features	- Impedance: 600 ohms - Levels TLP: 0.0 transmit, -6 receive, reference test frequency 1004 Hz - Bandwidth: Nominal 4 kHz - Frequency range: 300 - 3000 Hz.
Reference	Chapter 8, Paragraph 5.
Note	(1) Transmission Level Point (TLP) for measurement (2) Facility resistance range not to exceed 5000 ohms DSX1 = Digital Crossconnect Frame IF = Interface DF = Distributing Frame.

FIGURE 14-8. SPECIFICATION FOR INTERFACE TYPE 6MB6

Description	- Type II E&M Signaling, the DSN MFS or end office originates on the M lead. DSN MFS or other network switch equipment originates on the M lead facility interface code TL12M (registered)
	- Eight-wire (T, R, T1, R1, E, SG, M, SB).
	- Off Network or Access Line Trunk Facility Type: Voice Grade.

Illustration



8MB6

Electrical Features	- Impedance: 600 ohms - Levels TLP: 0.0 transmit, -6 receive, reference test frequency 1004 Hz - Bandwidth: Nominal 4 kHz - Frequency range: 300 - 3000 Hz.
Reference	Chapter 8, Paragraph 5.
Note	(1) Transmission Level Point (TLP) for measurement (2) Facility resistance range not to exceed 5000 ohms DSX1 = Digital Crossconnect Frame IF = Interface DF = Distributing Frame.

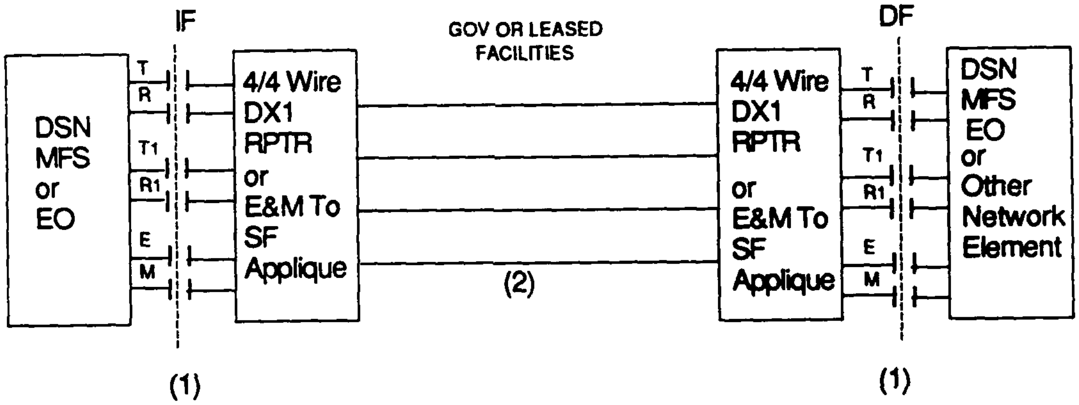
FIGURE 14-9. SPECIFICATION FOR INTERFACE TYPE 8MB6

Description - Type V E&M Signaling, the DSN Multifunctions switch or end office originates on the M lead.

- Six Wire (T, R, T1, R1, E, M).

- Access line facility type: Voice grade used primarily in the European Telephone System (ETS).

Illustration



6MC6

Electrical Features
- Impedance: 600 ohms
- Levels TLP: 0.0 Transmit, -6 Receive, Reference Test Frequency 1004 Hz
- Bandwidth: Nominal 4 kHz
- Frequency Range: 300 - 3000 Hz.

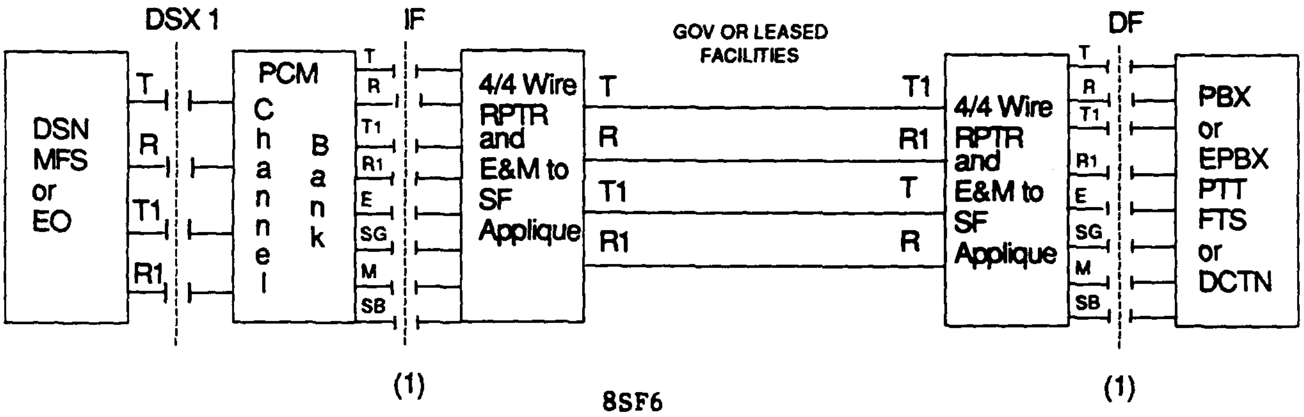
Reference Chapter 8, Paragraph 5.

Note
(1) Transmission Level Point (TLP) for measurement
(2) Facility Resistance Range not to Exceed 400 ohms per lead
IF = Interface.

FIGURE 14-10. SPECIFICATION FOR INTERFACE TYPE 6MC6

Description	-	Connects customer voice grade facilities suitable for transmitting voice and single frequency (in-band) signaling tones.
	-	Eight-wire (T, R, T1, R1, E, SG, M, SB).
	-	Off Network or Access Line Trunk facility type: Voice Grade.

Illustration



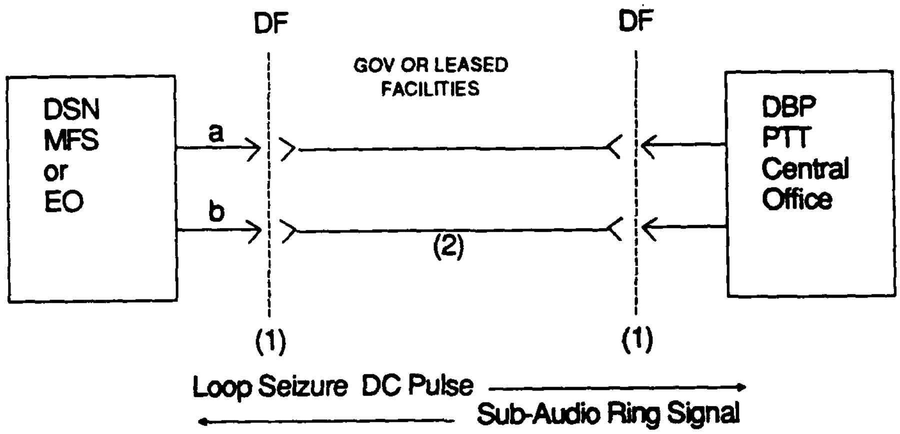
Electrical Features	- Impedance: 600 ohms - Levels (TLP unless otherwise noted): 0.0 dB transmit, -6 dB receive, reference test frequency 1004 Hz - Bandwidth: Nominal 4 kHz - Frequency Range: 300 - 3000 Hz.
Reference	Chapter 8, Paragraphs 5.
Note	(1) Transmission level point for testing DF = Distributing Frame IF = Interface.

FIGURE 14-11. SPECIFICATION FOR INTERFACE TYPE 8SF6

Description - The HKZ circuit is a ring in/dial out two way trunk designed to provide incoming and outgoing traffic between an ETS switch and the PTT, DBP. All incoming traffic will be terminated at the ETS attendant station.

- Two wire (a and b).

Illustration



2HK6

Electrical Features

- Impedance: 600 ohms
- Levels TLP: 0.0 Transmit, -6 receive, reference test frequency 1004 Hz
- Bandwidth: Nominal 4 kHz
- Frequency Range: 300 - 3000 Hz.

References Chapter 8, Section A, Paragraph 5, and ET1-TSEP/GP, VOL 3, Appendix 18-7.

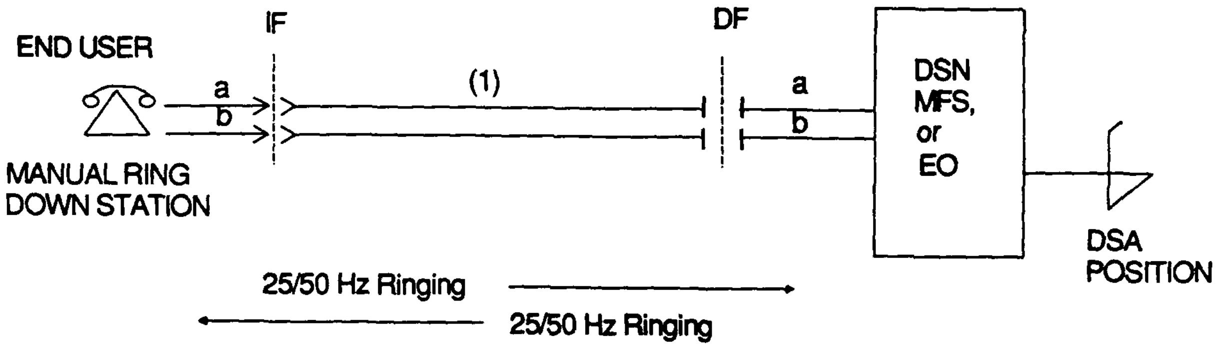
Note (1) Transmission Level Point (TLP) for measurement
(2) Facility resistance range not to exceed 500 ohms per load
DF = Distributing Frame and Interface Point.

FIGURE 14-12. SPECIFICATION FOR INTERFACE TYPE 2HK6

Description - This trunk is used to interface between DSA operators and dedicated manual ring down stations.

- Two wire (a and b).

Illustration



2HZ6-(1)

Electrical Features
- Impedance: 600 ohms
- Levels TLP: Transitional Service.

References Chapter 8, Section A, Paragraph 5, and ET1-TSEP/GP, VOL 3, Appendix 18-11.

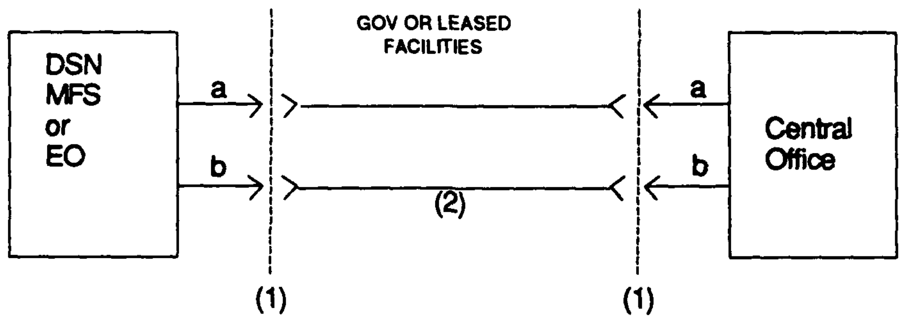
Note (1) Maximum VF Transmission/Signaling is limited to 70K meters (approximately 43.5 miles)
IF = Interface
DF = Distributing Frame.

FIGURE 14-13. SPECIFICATION FOR INTERFACE TYPE 2HZ6-(1)

Description - This trunk is used between DSN-ETS offices with 2-wire facilities that use the 50 Hz signaling or that interface to mixed 50 Hz/carrier tie trunks with an intermediate unit to convert the 2-wire 50 Hz trunk line to a 4-wire E and M trunk line.

- Two wire (a and b).

Illustration



2HZ6-(2)

Electrical Features
- Impedance: 600 ohms
- Levels TLP: 0.0 Transmit, -6 Receive, Reference Test Frequency 1004 HZ
- Bandwidth: Nominal 4 KHZ
- Frequency Range: 300 - 3000 Hz.

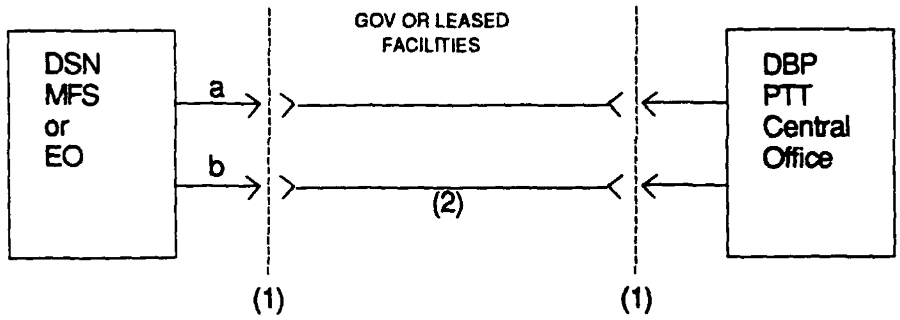
References Chapter 8, Section D, and ET1-TSEP/GP, VOL 3, Appendix 18-10.

Note
(1) Transmission Level Point (TLP) for measurement
(2) Facility Resistance not to exceed 400 ohms per lead
DF = Distributing Frame and Interface Point.

FIGURE 14-14. SPECIFICATION FOR INTERFACE TYPE 2HZ6-(2)

Description	-	The IKZ is a 2-wire trunk circuit designed to provide DID/DOD service between a DSN-ETS office and the DBP central office.
	-	Two wire (a and b).

Illustration



2IK6

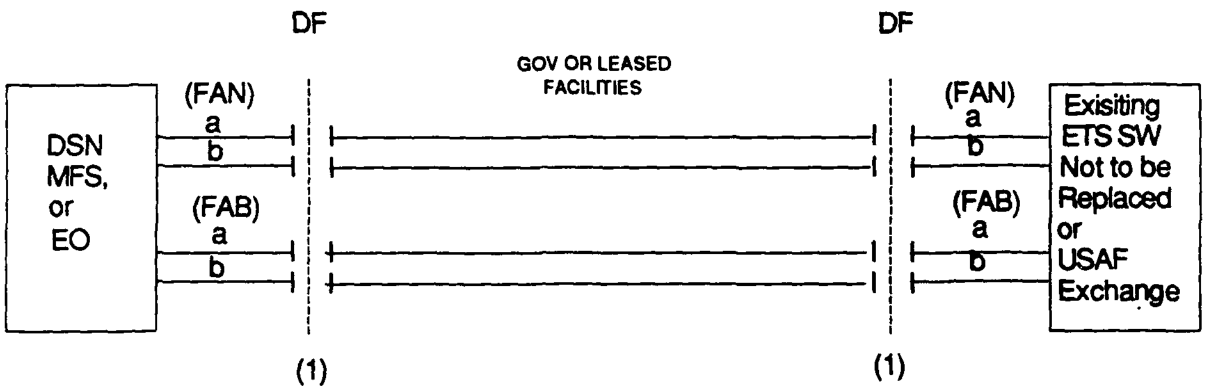
Electrical Features	-	Impedance: 600 ohms
	-	Levels TLP: 0.0 Transmit, -6 receive, reference test frequency 1004 Hz
	-	Bandwidth: Nominal 4 kHz
	-	Frequency Range: 300 - 3000 Hz.
References		Chapter 8, Section D, and ET1-TSEP/GP, VOL 3, Appendix 18-6.
Note		(1) Transmission Level Point (TLP) for measurement (2) Facility resistance range not to exceed 500 ohms per load DF = Distributing Frame and Interface Point.

FIGURE 14-15. SPECIFICATION FOR INTERFACE TYPE 2IK6

Description - The signaling and supervision requirements of the in band 4-wire 600/750 Hz trunk and 4-wire 2280 Hz interface used to connect the KN switch to existing or not to be replaced ETS or USAF-exchanges via the VF 600/750 Hz signaling mode.

- Four wire (a and b FAB send and a and b FAN receive).

Illustration



4IS6

Electrical Features
- Impedance: 600 ohms
- Levels TLP: 0.0 Transmit, -6 Receive, Reference Test Frequency 1004 HZ
- Bandwidth: Nominal 4 KHZ
- Frequency Range: 300 - 3000 Hz.

References Chapter 8, Section D, and ET1-TSEP/GP, VOL 3, Appendix 18-13.

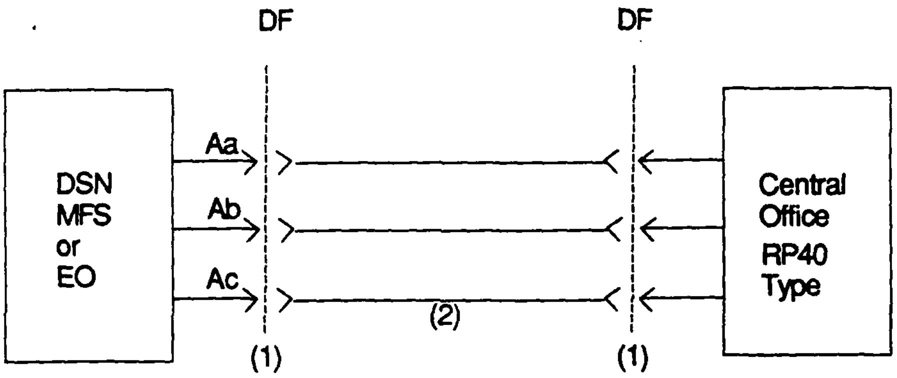
Note (1) Transmission Level Point (TLP) for measurement
DF = Distributing Frame and Interface Point.

FIGURE 14-16. SPECIFICATION FOR INTERFACE TYPE 4IS6

Description - The signaling and supervision requirements of the ETS RP40 2-wire interface used to connect the KN switch to existing RP40 trunk relay repeaters during the intermediate phase of conversion.

- Three wire (Aa, Ab, and Ac).

Illustration



3RP6

Electrical Features
- Impedance: 600 ohms
- Levels TLP: 0.0 Transmit, -6 receive, reference test frequency 1004 Hz
- Bandwidth: Nominal 4 kHz
- Frequency Range: 300 - 3000 Hz.

References Chapter 8, Section D, and ET1-TSEP/GP, VOL 3, Appendix 18-8.

Note
(1) Transmission Level Point (TLP) for measurement
(2) Facility resistance range not to exceed 400 ohms per load.
DF = Distributing Frame and Interface Point.

FIGURE 14-17. SPECIFICATION FOR INTERFACE TYPE 3RP6

Appendix E. Chapter X, DSN Special Service Interfaces - New text

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CHAPTER X. DSN SPECIAL SERVICE INTERFACES

1. <u>Introduction.</u> This chapter describes some of the DSN special service interfaces. These special service interfaces include data and video. The data interfaces section of this chapter provides an understanding of the existing data interfaces within the DSN. It also discusses the anticipated future architecture of the DCS and the role of data services in the future ISDN DCS network. The discussion of video interfaces includes a description of the environment and the types of services found within the DSN charter. The first part of this chapter includes a description of the DSN and the data services found within that environment. Given this foundation, information is then presented that defines the interfaces used to provide the data services and describes the current network architectures, services, and interfaces for the current and future networks.

2. <u>Data Transmission Within the DCS.</u> The DCS environment currently includes two major switched subnetworks: the DSN (Defense Switched Network) and the DDN (Defense Data Network). As shown in figure X-1, DSN handles the voice and associated voice grade services and DDN is designed to handle pure data services at multiple data rates. At the present time, these networks are totally separate and distinct networks; however, some overlapping may exist in the joint use of supporting long-haul transmission facilities for interconnect services. In accordance with published DSN policy, use of the DSN is restricted to voicegrade data service at rates of 4.8 kb/s or lower. The electrical and physical interface specifications for this level of service are identical to the voice and voice grade interfaces found in previous chapters of this document; no further discussion is necessary. Any subscriber or end user needing full-time, dedicated data services or data service at rates higher than 4.8 kb/s must first consider the use of DDN to respond to the requirement. The following paragraphs provide a short summary discussion of the DDN network. However, a detailed discussion of DDN interfaces has been considered out of the scope of this document.

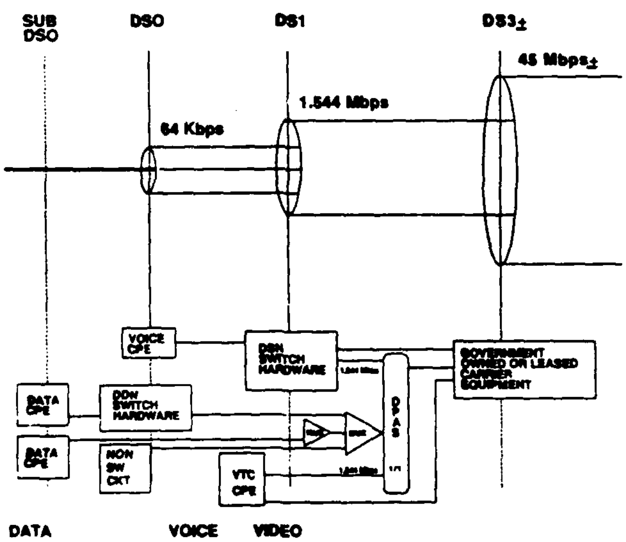


FIGURE X-1. 1990's DCS CONFIGURATION

a. Defense Data Network (DDN). The DDN, as a part of the DCS, provides long-haul switched data communications service for DoD subscribers. It is intended to replace point-to-point single purpose data communications systems and provides for interoperability between systems using the network. The DDN design and implementation is based on proven technology; much of the hardware, software, and operation and maintenance have been adapted from the Advanced Research Project Agency Network (ARPANET).

(1) Current Networks. Four distinct DDN networks now exist: (1) Military Network (MILNET); (2) Defense Secure Network 1 (DSNET1) - previously referred to as Defense Integrated Secure Network (DISNET); (3) Defense Secure Network 2 (DSNET2) - previously called World Wide Military Command and Control System (WWMCCS) Intercomputer Network Communications Subsystems (WINCS); and (4) Defense Secure Network 3 (DSNET3) - previously known as the Sensitive Compartmented Information Network (SCINET). All four current networks have similar components: Packet Switch Nodes (PSN's); Terminal Access Controllers (TAC's); Monitoring Centers (MC's); and gateways. Packet switches are connected by carrier-provided interswitch digital data trunks with circuit speeds ranging from 9.6 to 56 kb/s. Host computers are connected to the network with 56, 19.2, or 9.6 kb/s circuits. Carrier-provided T-1 (1.544 Mb/s) service is not employed within the data network transmission carrier scheme at this time.

(2) Planned Networks. Future plans call for DDN to evolve into two fully-integrated networks. The composite Military Network (MILNET) consists of operationally-oriented subscribers that were originally supported by ARPANET, former Movement Information Network (MINET) subscribers, and new unclassified subscribers in the unclassified segment of the DDN. The classified segment of the DDN will be established by integrating the three classified networks (DSNET1, DSNET2, and DSNET3) into a single network that will be known as the Defense Integrated Secure Network (DISNET). This integration is dependent upon availability of multilevel secure end-to-end encryption (E^3) devices.

(3) DDN Backbone. The DDN backbone consists of the packet switches and their interconnecting 56 kb/s digital data trunks. The backbone is sized to ensure meeting or exceeding the specified level of performance for handling critical traffic. Network statistics are collected quarterly to evaluate overall network performance, to analyze and characterize the traffic on the network, and to determine the performance of the individual nodes. The resulting statistics are used to create a report based on performance of network traffic measurements. Through network monitoring, DCA is able to compare operation of any node with any other node. The operational baselines derived from these reports characterize the health of the data networks and provide the information necessary to initiate service improvements. All documentation reviewed concerning DDN performance monitoring systems, including those under development, are oriented toward the operational health of the network (i.e., traffic flow, congestion, throughput, and utilization). The technical parameters of circuit performance in accordance with specific criteria is left to the carrier providing the interconnecting facilities.

(a) Services. DDN provides packet-mode services using packet switches and 56 kb/s links to interconnect these switches, as discussed before. DDN has replaced the point-to-point single purpose data communications systems. The DDN network is controlled by a main processing device responsible for the interoperability of all the components of this packet data network.

(b) Data Interfaces. The network interface (NI) points are identified in figure X-1. The quality of all interconnecting circuits is assumed to be provided by the supporting carrier at the specified levels requested in the circuit orders that established the connectivity.

b. Defense Switched Network (DSN). The Defense Switched Network (DSN), also a part of the DCS, provides terminal-to-terminal long distance telephone, data, and video services. In addition, DSN will provide transport services to the secure voice system, which includes Secure Telephone Units (STU-III's) and Red Switches. These services are provided through the DSN switching and transmission facilities, which provide long distance switched service to various users. Types of transmission media used within the DSN include microwave radio, satellite, and coaxial and fiber optic cable systems.

(1) DSN Data Services. DSN provides standard voiceband secure voice (such as STU II-2400 b/s and STU-III) and voice band digital data (for example, DDN 2400 b/s dial-ups). DSN supports rates equal to or less than 4800 b/s, provided that the user's modem/terminal equipment furnishes the appropriate level of signal processing. Since this terminal equipment is designed to operate over unconditioned VF circuits, these services are supported by common grade DSN trunks. Today, however, DSN assures service quality by requiring circuit conditioning, as stated in the data conditioning policy. As this policy states, these data-conditioned DSN IST's can be accessed by dialing 11 in the route code portion of the worldwide numbering and dialing plan. These IST's, however, will not grow in size. They will be used for a limited time until common grade trunking is available throughout the DSN.

(a) Common Grade Trunking. Common grade trunking implementation is an evolutionary process. When enough digital transmission and STU-III secure voice terminals exist in the DSN, the program management office of the DSN will issue a new policy to remove all the data conditioning equipment. At that time, the DSN will be considered to have common grade trunking. Presently, higher speed voiceband data services such as DDN host access (9600 b/s) and Vinson (16 kb/s) services must be supported by either dedicated conditioned circuits or a special subnetwork.

(b) DDS. Within the DSN, the network provides DDS (Digital Data Services) for common channel signaling (DSN CCS No. 7) and 64 kb/s switched digital data services for selected user communities.

(c) Bulk Data Transfer Services. In addition to the data services described above, the DSN PMO provides bulk data transfer services within CONUS via a subnetwork called DCTN. This subnetwork allows for the use of up to a 1.544 Mb/s T-1 link for bulk data transfer. This data transfer service is primarily a short term service that requires advanced reservation.

(2) DSN Data Interfaces. As shown in figure X-2, data interfaces in the current DSN architecture include the interface between a DTE (Data Terminal Equipment) and a DCE (Data Circuit-terminating Equipment). An example of a DTE in a digital data processing device such as a computer. A DCE example is a modem. Various standards exist for the DCE and DTE interfaces. These include RS-232-C, RS-449/442-A/423-A, and X.21. The specification standards for these interfaces are not included in this document because the DTE and DCE interface is not within the responsibility of the DSN.

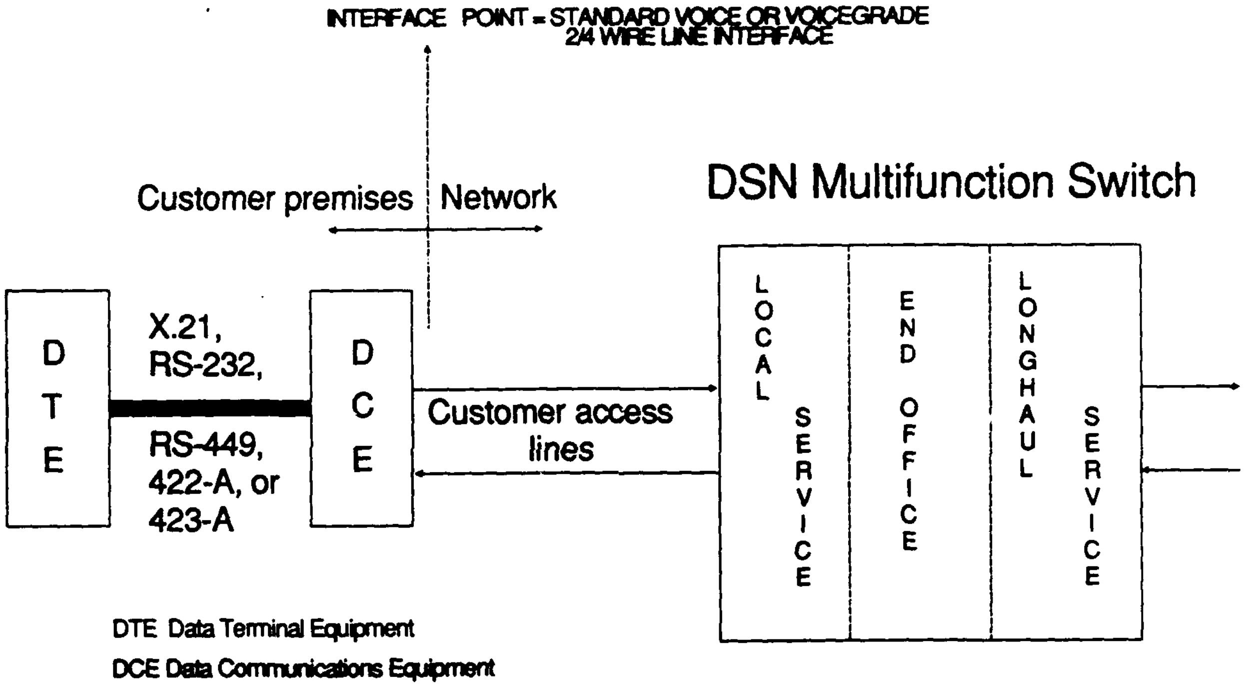


FIGURE X-2. DSN DATA INTERFACES

(a) Analog Versus Digital Data. All interfaces for voiceband data services are the same as those used for voice grade services provided by DSN. For example, the DCE is linked to the first DSN switching facility via a two-wire or four-wire connection. Thus, the electrical characteristics of the interface points for a typical voice grade connection apply. Two basic types of data exist: analog and digital. The concept of a data interface can be clarified by discussing the differences between digital/analog data and digital/analog signals. The following paragraphs discuss these concepts in detail. Analog data take on continuous values, while digital data take on discrete values. An example of analog data is audio, which is in the form of sound waves can be perceived by the human ear. Digital data examples include text and integers. Digital or analog data can be encoded to analog or digital signals for transmission. The following paragraphs discusses the four basic combinations that can occur:

1. Digital Data, Digital Signal. Digital data are sent by encoding each data bit into signal elements, a sequence of discontinuous voltage pulses. Several encoding schemes have been defined:

a. Nonreturn to zero.

b. Return to Zero.

c. Biphase.

d. Delay modulation.

e. Multilevel binary.

2. Digital Data, Analog Signal. Transmission of digital data through the DSN (a switched telephone network) is an example of this case. As long as analog transmission facilities exist within the DSN, this network is not suitable for sending digital signals from the customer location. Therefore, customer data communications equipment (DCE's) (i.e., modems) are attached to the multifunction switch via data communications equipment (DCE), which converts the digital data into analog signals (see Figure X-3). DCEs produce signals in the voice frequency range using various encoding techniques, including Amplitude-shift keying (ASK), Frequency-shift keying (FSK), and Phase-shift keying (PSK).

3. Analog Data, Digital Signals. Codecs (coders-decoders) transform analog data into digital signals and recover the analog signal from the transmitted digital signal at the other end. The two principal techniques used in codecs are pulse code modulation (PCM) and delta modulation. The first step toward PCM is sampling performed at a rate of 2B (where B is the bandwidth of the original signal). This sampling process is known as pulse amplitude modulation (PAM). After sampling, the PAM signals are quantized. Finally, the PCM signal is encoded and sent over the transmission facility.

4. Analog Data, Analog Signal. Analog data is modulated using various analog modulation schemes, such as amplitude modulation (AM), frequency modulation (FM), or pulse modulation (PM). An example includes voice signal transmission over analog facilities.

(b) Future Data Interface Requirements. In the future, with the advent of ISDN and its implementation within the DCS, data interface requirements will differ. For a more detailed discussion of the DCS ISDN architecture, refer to chapter twelve of this document. Due to its relevance, the discussion of packet switching services is included here. Existing packet-mode services will include the services of the Defense Data Network (DDN), Commercial packet switching networks and Value Added Networks (VANs). ISDN packet-mode services will include minimum and maximum integration scenarios. In the minimum integration scenario, the DSN will provide "dial-up" connections to DDN nodes for DDN users. Therefore, the future DCS network will merge the capabilities of its two primary subnetworks to provide the interoperability required for an integrated digital network. After the transition period, the fully integrated DSC ISDN network will have different data interfaces. ISDN provides two types of interfaces: basic rate interface and primary rate interface. All end user telecommunications requirements - including data and voice - will be handled through the same user-network interface (see figure X-3).

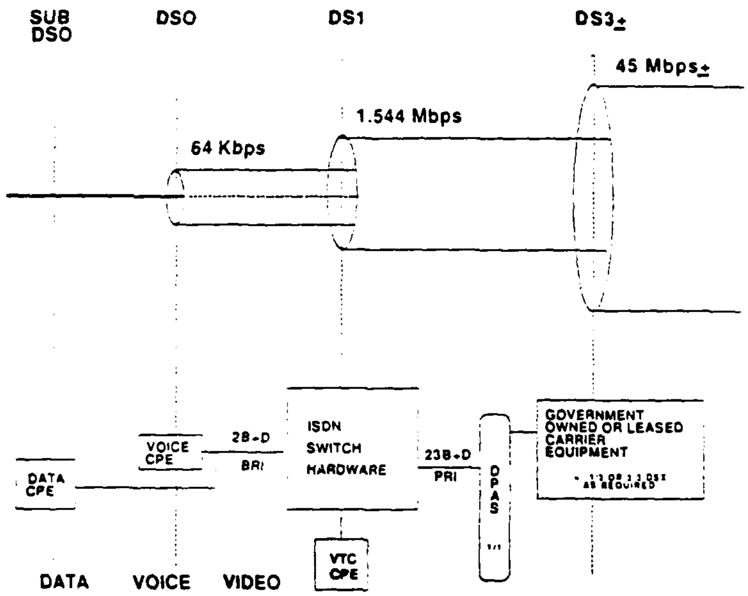


FIGURE X-3. *DCS ISDN CONFIGURATION*

3. Video Services. Video service is a relatively new area of communications technology which is rapidly expanding. This technology, however, has not progressed in an orderly manner; individual vendors have proceeded to market proprietary systems. Video services are generally divided into several categories. These categories are identified as: freeze frame, slow speed, full motion, or near full motion. Freeze frame and near full motion services are interactive end user services within the scope of DCS/DSN services. Freeze frame video is supplied through end user-provided video terminal equipment over standard voice or voice grade data lines; no special interface requirements are necessary. Near full motion video services are provided via special T-1 (1.544 Mb/s) links that interconnect specifically designed Video Teleconference Centers (VTC) systems. For the purposes of this document, VTC's are considered as Customer Premises Equipment (CPE); interfaces within the VTC are outside the scope of this document and are not included. Interfaces required to interconnect two or more VTC's are identified and discussed, as appropriate.

a. Background. The Defense Switched Network Program Management Office (DSN PMO) has been designated as the principal service provider to satisfy Department of Defense (DoD) video teleconferencing requirements. The DSN PMO acts as the service manager for the provision of video teleconferencing services. Video services are currently provided to DoD customers within CONUS via a DSN PMO separately-managed subprogram entitled Defense Commercial

Telecommunications Network (DCTN). DCTN includes leased video services from AT&T, including the Video Teleconferencing Centers (VTC's). In its current system configuration, the DSN is a MLPP private line network that provides voice and voice grade data services through multiple levels of DSN Multifunction Switches (MFS's), End Offices (EO's), and selected MILDEP-provided Private Branch Exchanges (PBX's). The interconnect facilities needed by the VTC's require direct DS1.(1.544 Mb/s) service. As it is currently configured, the DSN does not provide direct DS1 (1.544 Mb/s) services to CPE. The interfaces required to support the interconnect requirements for DS1 level video service are found at the same interface point that provides interexchange carrier services to current DSN switches. It is envisioned that with the evolution to ISDN, DS1 service offering will be provided from the supporting ISDN switch, thus permitting DSN system-provided video teleconferencing service. The video systems that are currently available do employ standard digital transmission rates to supporting interconnect facilities. These interconnecting interfaces are identified in this section, along with a discussion on currently available video services. Current Video Teleconferencing Center (VTC) systems must use fully compatible encoder-decoders in order to be interoperable with each other. These proprietary processors are required due to the lack of system standardization with respect to data compression algorithms, operating modes, and video processing formats. This lack of standardization requires multiple locations to be served by the same vendor equipment when considering interoperability issues and interface requirements. Current DoD VTC requirements within CONUS are being provided by the Defense Commercial Telecommunication Network (DCTN). An interim standard interface criteria for DoD VTC users was developed on May 27, 1987, and is being used in Phase I as an interim solution. International standards are just beginning to be addressed by CCITT; national standards will be developed by ANSI. As these reach maturity, current interface criteria may need to be revisited for verification or change.

b. Operational Modes. The VTC is capable of operating in three modes: point-to-point, broadcast, and multipoint.

(1) Point-to-Point operations allow each of two sites to participate in a fully-interactive two-way video and audio conference.

(2) Broadcast mode allows one-way transmission of both video and audio from one site to all other sites in the conference.

(3) Multipoint operations normally allow video transmission to two or more sites, but simultaneously interactive transmission only between two sites. The multiple conference sites are interconnected via a fully-interactive audio bridge for multisite voice discussions independent of the video transmission.

c. Secure Operations.

(1) Encryption. Conferences within DCTN are currently encrypted through commercial Data Encryption Standard (DES) 1A encryptors at the DCTN earth stations. This encryption provides privacy only and is not suitable for classified conferences. Users may hold classified conferences using

customer-provided encryption devices at the studio site. Implementation of current and future plans will allow classified video teleconferencing in any format.

(2) Audio Conferencing. Two forms of audio conferencing are employed, external and embedded. Unclassified Sessions employ a distributed audio bridge with a VF patch external to the transmitted video signal. Classified Sessions require government-furnished encryption equipment at the conference end points. In this situation, audio signals are embedded within the video signal and transmitted in a composite DS1 (1.544 Mb/s) signal.

d. Physical and Electrical Interface. The physical and electrical interface points are defined in figure X-4. The four-wire access lines supporting the audio and control data are not switched but are dedicated and transmitted along with the DS1 signal during the reservation process. The physical and electrical interface criteria for both the DS1 and four-wire interface are the same as found within the interexchange carrier facilities. No unique or special criteria are required. These physical and electrical characteristics are found in Chapter 14 of the existing DCAC under the "DS" interface code. The defined points represent two specific interface requirements:

(1) Encrypted. The interface is a DS1 1.536 Mb/s at the input to the encryption device from the VTC, and a standard 1.544 Mb/s after the protocol converter to the transmission network at the DACS unit. When encryption is used, the audio and data lines are multiplexed by the encoder-decoder into the DS1 digital signal; there is no four-wire access line interface point.

(2) Unencrypted. The defined points are standard DS1 1.544 Mb/s from the encoder-decoder to the DACS, and four-wire access lines for the audio and the data link (EIA-232-D).

e. DCTN Video Service Overview. Near-full Motion Video Teleconferencing--as provided by the DCTN lease arrangement with AT&T--is a scheduled, dedicated, switched video/audio conferencing service that utilizes two DS1 links provided over leased VSAT earth stations facilities. One link is dedicated to the conference chair and the other is shared among the remaining sites. Data links are used to exchange VTC control information via common communications channels established during the reservation process prior to the start of any session. The audio link is established utilizing a standard four-wire access line.

(1) Session Preparation. The video network, the audio bridging configuration, and the control channels must be scheduled by the network management control process well in advance of establishing a particular session. The chair's conference room is predesignated for a specific call. A permanent simplex DS1 channel is established for it and a second simplex DS1 channel is established as needed for the participating sites in turn by the Video Teleconference Switching Controller (VTSC). This allows fast reassignment of the shared link as the conference proceeds. A separate audio conference is established by a predetermined reservation service to keep all sites in the conference loop in contact. A VTSC is associated with each

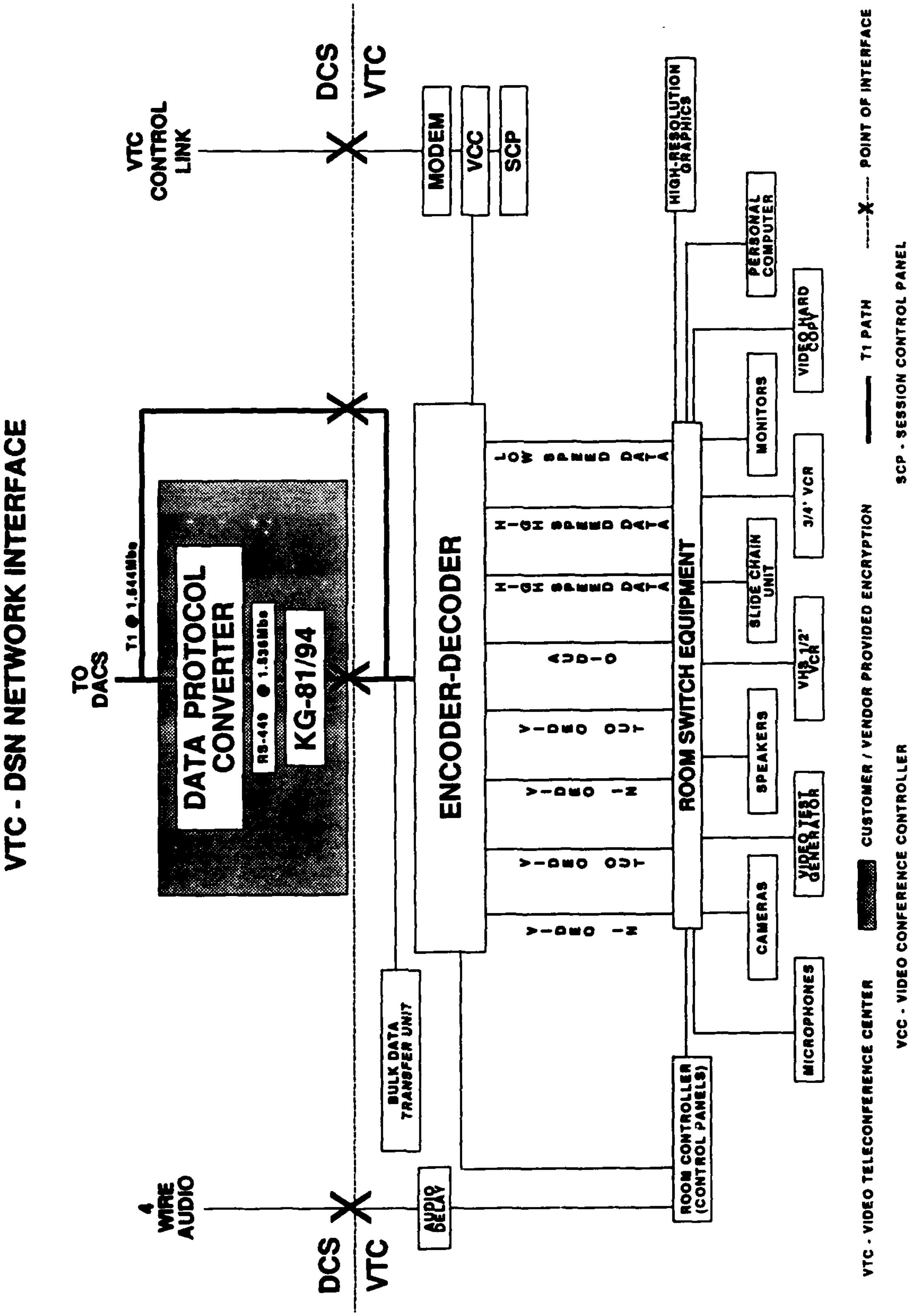
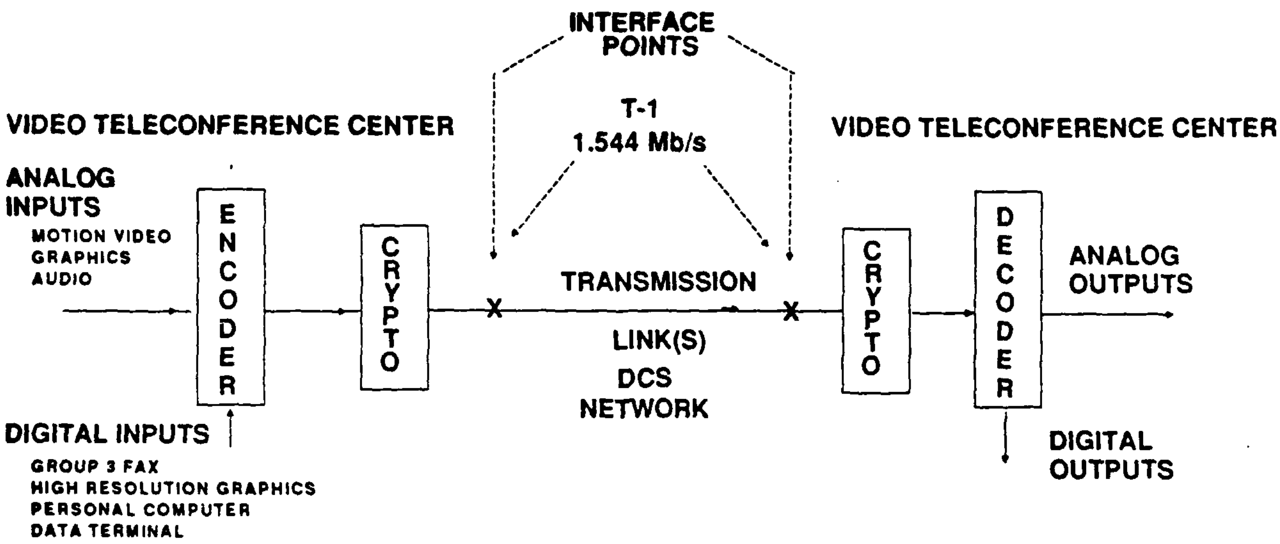


FIGURE X-4. VTC-DSN NETWORK INTERFACE

satellite earth terminal or terrestrial link control point. The Video Conference Controller (VCC) at each site is in direct contact with the VTSC at the site's serving earth station. The VCC is used to interface the control signals between the VTSC and the conference site equipment. The Session Control Panel (SCP) provides the human interface for the control of the communications link and display of the conference status. All sites are equipped with both the SCP and VCC. All conference sites in a VTC session will be connected so that audio contact is maintained at all times.

(2) VTC System Description. Figure X-5 simplistically represents a functional diagram of a typical VTC system. The basic elements consists of transmitting and receiving devices to handle digital video or digital information, interconnected by a digital transmission facility. Some applications may require the use of designated encryption devices. When government-provided encryption equipment is employed, a data protocol converter is required between the encryption device and the DS1 interface at each end to provide a clear text framing format. The data rate at the user side of the encryption device should not exceed 1.536 Mb/s.

4. Conclusion. The special services described in this chapter are in a transitional phase. The DSN network is migrating toward an all-digital network. The future DSN is an ISDN network with different interface points and requirements. Therefore, the specifications described for these and other services should be examined continuously to assure compatibility with the latest developments in network design and implementation. The purpose of this document is to specify DSN interfaces. The physical and electrical interface criteria for DSN special services interfaces are the same as found within the interexchange carrier facilities. No unique or special criteria are required. These physical and electrical characteristics are found in Chapter 14 of the existing DCAC under the "DS" interface code.



TYPICAL VTC / DCS FUNCTIONAL SYSTEM DIAGRAM

VTC INTERFACE TO TRANSMISSION LINK STANDARD T1 @ 1.544Mbs

FIGURE X-5. TYPICAL VTC/DCS FUNCTIONAL SYSTEM DIAGRAM