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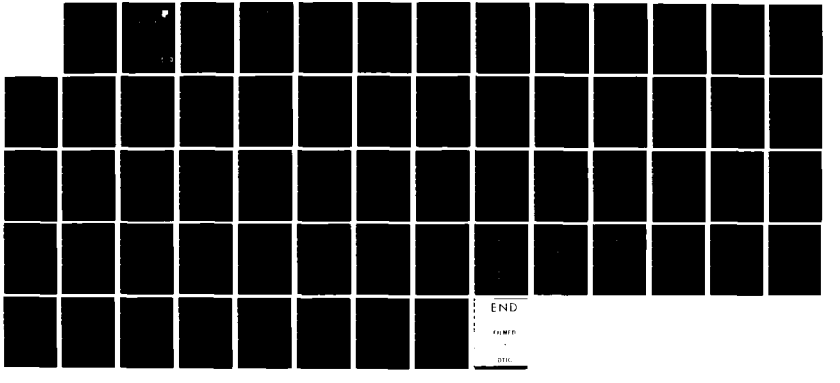

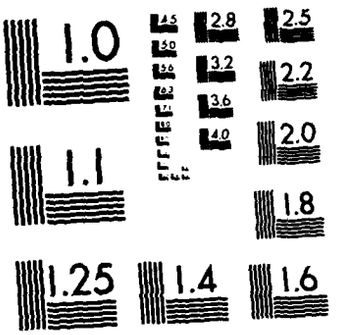

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RADC-TM-82-7
In-House Report
November 1982

SURVEY OF MODELS/SIMULATIONS AT RADC

Mary L. Denz

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Air Force Systems Command
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A survey was conducted to evaluate the current state of the art and technology of model/simulation capabilities at RADC, Griffiss AFB NY. This memo presents a tabulation of 28 such models/simulations. These models/simulations are being used within RADC in the development and evaluations of Command, Control, Communications and Intelligence (C^3I) technology. The results of this survey are incorporated in this memo.

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AEISS - Automatic Emitter Identification Software System
C3CM - Command Control and Communications Counter Measures
C3SAM - Command Control and Communications Systems Analysis Model
COMPUTER SIMULATION OF THE DETECTION AND TRACKING OF MULTIPLE TARGETS IN DIFFERENT ENVIRONMENTS
DDM - Distributed Database Model
DSS - Distributed System Simulator
DDG - Dynamic Data Generator
FAP - Forward Area Processor
HF Media Simulator - High Frequency Media Simulator
IDE - Integrated Data Entry
INTEGRATED SWITCH SIMULATION
ISL - Intelligence Systems Laboratory
ICS - Interactive Communications Simulator
ICSSM - Interactive Communications Systems Simulation Model
IEMCAP - Intrasystem Electromagnetic Compatibility Analysis Program
LOS ECM SIMULATOR - Line of Sight Electronic Counter Measures Simulator
NANODATA QM1 MICROPROGRAMMABLE COMPUTER
QPRIM - QM1 Programmer`s Research Instrument System
RADAR CLUTTER AND MULTIPATH SIMULATION
TAC CONTROLLER - Tactical Air Control Controller
TACOM II - Tactical Communication Simulation Model
TASRAN - Tactical Air Surveillance Radar Netting Simulator/Emulator
TRAFFIC SIMULATOR
TROPOSCATTER CHANNEL SIMULATOR
TROPO ECM SIMULATOR - Troposcatter Electronic Counter Measures Simulator

WIDEBAND LOS SIMULATOR - Wideband Line of Sight Simulator

WIRELINE SIMULATOR

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SECTION I

INTRODUCTION

This memo presents the results of a survey conducted by the System Design Development Environment (SDDE) to identify and document existing/ planned models and simulations being used in the development and evaluation of Command, Control, Communication and Intelligence (C3I) technology at RADC, Griffiss AFB and Hanscom AFB. Resource integration/ sharing will be facilitated by the Fiber Optic/Local Area Network Communications being implemented within the RADC complex at Griffiss AFB.

Background:

The RADC mission as an AF C3I Laboratory, is directed at the development and integration of collection, processing, exploitation, decision, communication and control technologies. Exploitation of existing and planned, physically separated laboratory resources and the integration of the functional elements they represent is to be achieved through an instrumental fiber optic and Local Area Network (Broadband Bus) communications capability to form a System Design Development Environment (SDDE). To accomplish the above, the program has been structured to encompass the following efforts:

a. Fiber Optic Network: RADC installed a fiber optics communications network between Buildings 3, 106, and 240 at Griffiss AFB. The Fiber Optic network will be used for wideband trunking between buildings and will provide point-to-point communications for high and ultra high bandwidth users (greater than 1 Mbit).

b. C2 Simulation Laboratory Construction: A C2 Simulation Facility will be constructed to allow for simulating, testing, evaluating, and demonstrating C3I concepts, designs, hardware and software. This laboratory is currently being designed. The laboratory will contain a computer complex capable of running major, interactive, real-time simulation programs. The same complex will be used for data reduction and analysis. The laboratory design allows for maximum reconfigurability to emulate a variety of C2 nodes. The laboratory will allow users from operational commands to interact with design engineers in all stages of systems design and development.

c. Local Area Network (LAN) Implementation: The term Local Area Network refers to a communication distribution (BUS) system, which is used to facilitate connectivity among various users and devices (computers and terminals) within the RADC complex. A LAN will be installed in Buildings 3, 106, and 240 with the individual networks connected via fiber optic cable between buildings. The network will be capable of handling simultaneous user requirements for transmitting digital data and voice as well as television over a single broadband 300 MHz CATV Cable.

Scope of Survey:

The survey focused on the identification of the models/simulations used by RADC engineers in the development and evaluation of C3I technology concepts, designs and systems. At this point in the SDDE program, no attempt was made to extend the survey beyond the RADC organization. Models/Simulations covered in the survey include communications, surveillance, and tactical C3.

Purpose of Survey:

The purpose of the survey was to collect information on the use of models/simulations at RADC in the development of C3I technologies. The information provided by the survey will be used to establish a requirements definition of a simulation or group of simulations for test and evaluation of new technology aimed at the tactical arena.

Survey Methodology:

A survey questionnaire (Appendix I) was developed to gather information from RADC engineers who were implementing or using a model/simulation. The questionnaire focused upon the identification of the models and simulations used by RADC engineers in the development and evaluation of C3I concepts, designs, and systems. Additional technical information regarding hardware/software operation, interface, limitations/assumptions, documentation and status was also solicited in an attempt to provide a brief but comprehensive description of the model/simulation. The Office of Primary Responsibility (OPR) for each model/simulation along with the responsible person and corresponding telephone numbers are provided if additional information is desired by the reader.

Scope and Content of Report:

Section II contains the model/simulation abstracts. Section III is a summary of the results of the survey. Section IV provides a summary of the survey and observations made by the SDDE regarding requirements for a C2 Simulation capability at RADC.

Terminology:

This section provides the reader with a general introduction into modeling and simulation as well as an aid in understanding the results of the survey.

Simulation:

Simulation consists of the construction of a state history of numerical results. A state history is a chronological succession of state descriptions, i.e., the state of the system at a specific instant of time. A simulation model is not a type of model, but merely a statement that the model is being used to produce a state history. The term computer simulation refers to the use of a digital computer to simulate the model. It does not mean a computer is being simulated.

Model:

For purposes of this survey, the term model will be limited to mean the symbolic representation of the system or subsystem being studied. In general, a model represents the most significant aspects of the system being studied. Models can be either analytical (mathematical) or numerical. Simulation models of mathematical expressions solvable by "hand" calculations or with the aid of a computer, are used extensively to evaluate computer communications systems and subsystems. Such models are precise because they consist of symbolic expressions. Numerical models operate on numerical valves, not symbols, and use a brute force numerical approach that make solutions feasible only through the use of digital computers. Numerical models result in approximations that are only as precise as time and money will allow. Simulation models are numerical models as they are based on random event driven occurrences rather than on precise mathematical relationships.

Pure Models, Aggregate Models, and Wargaming Models:

Pure models are generally phenomenological models. They simulate a small piece of technology. These simulations are very fine in technological detail and should be left in the hands of the people with expertise in the phenomenology being modeled in order to keep the model accurate and up to date.

Aggregate models simulate technicalogical systems. They generally have less detail than the pure models. Models such as C3SAM (Command, Control, and Communications Systems Analysis Model) are aggregate-type models. Due to their lack of fine detail, aggregate models can be separated from the

people with expertise in the subject, and so may be placed in a general purpose simulation library.

Wargaming models test technology and/or tactics against the backdrop of the battle field. Systems in a wargame are tested for effectiveness in a war time environment, as opposed to being tested for capability and efficiency.

Simulation Languages:

Special high-order language compilers have been developed for the implementation of simulation models. These compilers simplify the coding of models in the same way that general purpose compilers simplify the coding of other problems. Modeling languages are designed for the implementation of models, and hence have special features unique to modeling requirements. Some of the more commonly used simulation languages are SIMSCRIPT, GPSS, ECSS and GASP. SIMSCRIPT and ECSS have been used almost exclusively by the Federal Computer Performance Evaluation and Simulation Center (FEDSIM) in the implementation of models for ESD SPOs. FORTRAN, while not specifically designed as a simulation language, has been used extensively in the implementation of simulation models. It is also the basis of the GASP language.

SECTION II

SIMULATION SURVEY CATALOG

ASE Advanced Sensor Exploitation

STATUS:	Operational
RESIDENCE:	VAX 11/780 DEC PDP 11/45 DEC PDP 11/60 DEC PDP 11/70
OPERATING SYSTEM:	VAX-VMS RSX 11M, V3.2
LANGUAGE:	DGTS-PASCAL Other components-Fortran
EXECUTION TIME:	Near Real Time
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Wargaming

ABSTRACT:

The Advanced Sensor Exploitation (ASE) program is an automated data handling, collective exploitation and display of near real time ground target information from diverse advanced sensor systems. This development effort reflects a top-down system approach to developing and testing automated processing capabilities including multisensor correlation, military unit identification, and high priority target tracking.

The complexity, cost, rapidly changing technology base and the empirical nature (man/machine interaction) in handling, processing, and assessing enemy ground situations from diverse sensor systems has resulted in an approach which provides a simulated tactical environment to test implemented processing techniques. The test environment being developed is focused on demonstration and testing concepts, algorithms and techniques related to the collective exploitation of information generated by a variety of sensors. The environment currently being implemented includes a ground truth generator capability which provides automated assistance to the process of generating high detail ground target activities. The current ground truth generator is implemented on a VAX 11/780 and utilizes a PASCAL based language to aid in the generation of ground truth. Initial demonstration will be based on a 200 km x 200 km area and

simulates a divisional size enemy force. The sensor simulator subsystem includes a platform simulator, the sensor model and ground processing system simulation for generating sensor reports for each of the four generic sensors. The generic sensors are MTI radar, radar and radio detection systems and an imaging sensor. The data flow within the network is controlled by the timing and control subsystem which also serves as the major performance data collection element. The ASE element being implemented on a VAX 11/780 system performs the following functions: route and filtering of incoming reports, automated threat assessment, automated correlation based on time/location which takes into account movement information derived from the MTI radar, military unit identification also known as aggregation or templating, sensor management for retasking of sensors and overall composite display of the ground targets/forces on a digital cartographic background.

For further information regarding ASE, contact Mr. L. Converse, Jr., RADC/IRRP, Griffiss AFB NY 13441, AV 587-2217.

AEISS Automatic Emitter Identification Software System

STATUS:	Operational
RESIDENCE:	On classified RM03 Systems disc
OPERATING SYSTEM:	RSX 11M version 3.2C
LANGUAGE:	Fortran and Macro-11 assembly
EXECUTION TIME:	N/A
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Secret
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Automatic Emitter Identification Software System (AEISS) provides a test bed for use in developing algorithms as well as an off-line demonstration system for the resulting algorithms. AEISS implements an automatic emitter identification system algorithm at Rome Air Development Center for test and evaluation against real data. AEISS was developed in 1981 and is classified at the secret level.

For further information regarding the AEISS, contact Mr. M. Manor, RADC/IRAA, Griffiss AFB NY, AV 587-4024.

C3CM Command, Control, and Communication Countermeasures

STATUS:	In development: 82-84
RESIDENCE:	TBD
OPERATING SYSTEM:	Not defined (DEL DBMS-11 probably)
LANGUAGE:	Not specified (probably fortran)
EXECUTION TIME:	Not defined
OPERATION:	Interactive, real time/near real time
SECURITY CLASSIFICATION:	TBD
PROBLEM CATEGORY:	Wargaming

ABSTRACT:

The Command, Control, and Communication Countermeasures (C3CM) Simulation will provide Air Force engineers and developers with a laboratory tool to assist them in developing and testing countermeasure concepts and equipment to be used against enemy C3 systems. The simulation will permit consideration of the total C3CM mission. It will include the spectrum of C3 counter-mission functions, including SIGINT collection and processing, data communications, information fusion, C3 counter-mission force management, and countermeasure interactions.

The C3CM Simulation will assess the use and effectiveness of deception and jamming techniques and operational strategies against C3 targets. It will assess intelligence collection and processing requirements to support C3 counter-mission planning, where C3 counter-missions include signal exploitation, C2 deception, jamming, or weapon strikes. It will assess radio frequency transmission, propagation path, and reception between red force and blue force platforms, both ground-based and air-borne. The C3CM Simulation addresses the exploitation requirements for supporting C3CM missions and analyzing their mission effectiveness.

For further information regarding C3CM contact Mr. M. Clinch, RADC/COAM, Griffiss AFB NY 13441, AV 587-4361.

C3SAM Command, Control and Communications Systems Analysis Model

STATUS:	Operational
RESIDENCE:	Honeywell 6180
OPERATING SYSTEM:	GCOS
LANGUAGE:	COBOL
EXECUTION TIME:	1 - 3 hrs.
OPERATION:	INTERACTIVE
SECURITY CLASSIFICATION:	C3SAM-Unclassified NATO version-U.S. Secret
PROBLEM CATEGORY:	Technology (Functional Analysis Model)

ABSTRACT:

The Command, Control and Communications Systems Analysis Model (C3SAM) is an automated model to assist in tactical C3 Systems development, operational enhancement, configuration, and/or reconfiguration. C3SAM is a tool designed to enable individuals and groups to define, structure, and analyze tactical Air Force command and control. The basic structure and content of the C3SAM data base is representative of a "generic" Tactical Air Control System (TACS) and its command and control relationships with Army, Navy and Marine structures. The operational design of the data base is "user friendly". It will allow non-computer experts the ability to operate the system with relative ease.

The C3SAM data base is a modified, user friendly, version of the Tactical Information Exchange (TIE) data base developed by the Tactical Air Force Interoperability Group (TAFIG) located at Langley AFB VA. The TIE data base was a three year effort designed to collect, document and organize a complete functional analysis of a generic TACS and its associated information exchanges. RADC's support of this effort resulted in the installation of a copy of the TIE data base on the Honeywell processing system at this location.

For further information regarding the C3SAM data base contact Mr. P. Costianes, RADC/COAD, Griffiss AFB NY 13441, AV 587-7507.

Computer Simulation of the Detection and Tracking of Multiple Targets in Different Environments

STATUS:	Operational
RESIDENCE:	CDC 6600
OPERATING SYSTEM:	CDC 6600
LANGUAGE:	Fortran
EXECUTION TIME:	700 sec.
OPERATION:	Real Time (batch)
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

A computer model was developed to simulate the detection and tracking of multiple targets by ground based unattended radars. The model includes such effects as target fluctuations, log-normally distributed ground clutter receiver noise, multipath, surface roughness and finite dielectric constant of the earth's surface. The tracking performance of the radar may be evaluated for various targets in different environmental conditions.

For further information regarding this computer simulation, contact Dr. R. Papa, RADC/EEC, Hanscom AFB MA 01731, AV 478-3735.

DDM Distributed Database Model

STATUS:	Operational
RESIDENCE:	Honeywell 6180
OPERATING SYSTEM:	Multics
LANGUAGE:	Pascal
EXECUTION TIME:	Real time
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Distributed Database Model encompasses the problem of the combined communication network design and file allocation for distributed databases. It involves finding the allocation of database files over a set of computer sites and the design of the communication network. For example, it would consist of obtaining the design of the network topology, and the allocation of the communication channel capacities. It minimizes the total cost of storing the database files and of leasing the communication channels subject to the constraints of network reliability, file availability, and communication delay.

For further information regarding the DDM contact Ms. P. Baskinger, RADC/COTD, Griffiss AFB NY 13441, AV 587-7007.

DSS Distributed System Simulator

STATUS:	Under validation
RESIDENCE:	Honeywell 6180
OPERATING SYSTEM:	GCOS
LANGUAGE:	ECSS II; SIMSCRIPT II
EXECUTION TIME:	N/A
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Distributed System Simulator (DSS) was designed as a modeling tool to facilitate the performance analysis of distributed systems through the use of both analytical and simulation techniques. It has high level constructs that facilitate the development of simulators for a variety of networks at any level of detail. Trace facilities and a broad range of output reports aid in the debugging and validation phases for simulators.

The DSS addresses two broad problems in order to provide a tool for the simulation of computer networks. The first is the wide range of networks, architectures, and protocols that actually exist or have been proposed including message and circuit switched networks. The second major problem addressed by the DSS is the fact that building simulators of complex systems can be a time consuming and costly exercise.

The concept of the DSS model has evolved to meet these problems. The DSS model is basically a generalized Extendible Computer System Simulator (ECSS) program. As such there is no limit to the level of detail that may be simulated in the DSS model. It also has all of the trace and statistics gathering routines of any ECSS program. Each node in a computer network is associated with the DSS model. Different nodes may be associated with the same model if they share basically the same characteristics. For example, all of the host sites in a packet switched network might be identified with one DSS model while switching nodes may share another model. In this way only two model descriptions need be written and debugged. The DSS model is a prototype model

that may be duplicated any number of times depending on how many nodes share the same prototype. The DSS program is simply a set of DSS models.

For further information regarding the DSS contact Ms. P. Baskinger, RADC/COTD, Griffiss AFB NY 13441, AV 587-7007.

DDG Dynamic Data Generator

STATUS:	Under development
RESIDENCE:	VAX 11/780
OPERATING SYSTEM:	DEC VMS
LANGUAGE:	Fortran, Assembly
EXECUTION TIME:	Real time
OPERATION:	Real time and interactive
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Dynamic Data Generator (DDG) is a software package that communicates with a Data Processing Control System (DPCS). The DPCS is conceptually part of a larger operational unit, the Target Acquisition and Weapons Delivery Service (TAWDS). DDG accepts actual commands from the TAWDS DPCS. The DDG has the capability to simulate all timing constraints in order to realistically test a TAWDS DPCS in all its functions. However, it is general enough to drive airborne MTI processing systems other than the current TAWDS DPCS. Futhermore, DDG simulates the airborne portion of JOINT STARS (PAVEMOVER).

DDG simulates the presence of an airborne MTI Radar, accepting realistic uplink commands to steer and control the radar, and generating realistic downlink radar data. DDG also simulates the weapons deliveries that are initiated by TAWDS. It is capable of generating plausible weapon flight profiles and responding accurately to TAWDS guidance commands.

By referencing ground truth data describing the position and velocity of vehicles according to a known scenario the MTI simulation is accomplished. A requirement of the DDG project is the ability to generate ground truth data quickly and repeatably. This involves the use of a canned scenario file or the dynamic generation of ground truth data. The first approach emphasizes the real time capability of DDG. The second approach facilitates simulations that involve large vehicle counts or durations.

For further information regarding the DDG contact 1LT J. Thaden, RADC/COTA, Griffiss AFB NY 13441, AV 587-4494.

FAP Forward Area Processor

STATUS:	Operational
RESIDENCE:	Honeywell 6180
OPERATING SYSTEM:	GCOS
LANGUAGE:	FORTRAN
EXECUTION TIME:	Real time or faster on the 6180
OPERATION:	Batch with interactive start up and on-line modification of the scenario
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

The FAP was developed in the mid-seventies to demonstrate an architecture to support the interaction of simulators in an environment. The capability was demonstrated and evaluated using an ELINT platform in a RADAR environment with interactive users and communications. Currently, RADC is upgrading the capability from a batch process, integrating the Dynamic Ground Target Simulator program, expanding the environment, improving the sensor specification capability and interfacing to ASE.

The FAP architecture presently provides an ELINT simulation of up to 10 sensors, 100 emitters, 10 preprocessors, 1 processor, 25 communicators, 5 on-line users, a log of all transactions and timing to drive the simulation in an exactly repeatable fashion. This architecture is being expanded to handle SIGINT, create scenarios interactively and involve up to 25 sensors, 100,000 emitters, 100 processing configurations, 100 communications configurations, 20 on-line users with on-line reporting and monitoring. The expanded FAP will be compatible with ASE.

The FAP architecture is designed to permit the interface of simulated technology or where it exists, actual hardware. Therefore, the level of simulation is not constrained.

For further information regarding FAP, contact Mr. W. Hartnett, RADC/IRAE, Griffiss AFB NY 13441, AV 587-4517.

HF Media Simulator High Frequency Media Simulator

STATUS:	Operational
RESIDENCE:	DEC PDP 11/40
OPERATING SYSTEM:	DEC RSX 11M : version 3.1 minimum AP120B : version 2 minimum
EXECUTION TIME:	Real time.
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Communication

ABSTRACT:

The High Frequency (HF) Media Simulator provides a controlled HF media environment with a base band of 0-4 KHz for evaluation of HF devices (such as modems), HF technique developments, and Air Force Research. This simulator was developed during fiscal year 1979. The HF simulator has been tested, validated, and accepted. It is based on the Watterson Model which is well known in the trade. It has been successfully used since its acceptance and is planned for use in modem development work.

For further information regarding the HF Media Simulator, contact Mr. J. McEvoy, RADC/DCLF, Griffiss AFB NY 13441, AV 587-4092.

IDE Integrated Data Entry System

STATUS:	Operational
RESIDENCE:	DEC PDP 11/70
OPERATING SYSTEM:	RSX-11M version 3.2c
LANGUAGE:	Fortran and Macro-11 assembly
EXECUTION TIME:	0.5 seconds for word recognition
OPERATION:	Near real time speech recognition
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Integrated Data Entry (IDE) system currently consists of an Automatic Speech Recognition (ASR) device, a Drawn Character Recognition (DCR) device and any terminal on the PDP 11/70. The ASR is a VIP-100 speaker- dependent isolated word recognition system manufactured by Threshold Technology Inc. It consists of a speech preprocessor which extracts phonome and spectral based measurements for a spoken utterance and a NOVA 1200 minicomputer which time normalizes the input feature data and correlates the input feature array (FAR) with a reference array (RAR) to determine the word spoken.

For further information regarding the IDE System, contact Mr. M. Heffron, RADC/IRAA, Griffiss AFB NY 13441, AV 587-7672.

Integrated Switch

STATUS:	Operational
RESIDENCE:	Perkin Elmer
OPERATING SYSTEM:	Interdata 8/32 OS
LANGUAGE:	Assembly language
EXECUTION TIME:	In non-real time one hour of busy traffic is simulated in 3-4 hours.
OPERATION:	On-line with real traffic or in an off-line simulation mode.
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Communication

ABSTRACT:

The integrated switch was developed as a feasibility demonstration of integrated switching circa 1975. The integrated switch is a general purpose communications switching node. This node is called a "Unified" Node. The Unified Node provides for message switching, circuit switching, and packet switching. These services are designed to handle secure and non-secure digital voice users. These services also can handle real time data communications such as facsimile interactive graphics, video transmissions, and buffeted data services including direct links between manned terminals, and man-computer and computer-computer data interchanges. These unified nodes are modular in size. They are intended to serve as backbone nodes of future data communication systems and also base communication centers emplaced on Air Force bases.

For further information regarding the integrated switch, contact Mr. J. Salerno, RADC/DCLF, Griffiss AFB NY 13441, AV 587-7751.

ISL Intelligence Systems Laboratory

STATUS:	Expected delivery FY84/85
RESIDENCE:	N/A
OPERATING SYSTEM:	TBD - Available 1 May 83
LANGUAGE:	TBD - Available 1 May 83
EXECUTION TIME:	TBD - Available 1 May 83
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Up to Top Secret (Sensitive Information)
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Intelligence Systems Laboratory (ISL) is proposed to support a variety of models, primarily digital software models. It is anticipated that these models will be most probabilistic and non real time. A desired feature of the models is the capability to rapidly and interactively change input variables to validate technology under a range of environmental conditions.

The purpose of the models supported by the ISL is primarily the demonstration, test, and evaluation of exploratory development (6.2) intelligence technology. The models may at times be used to enhance a single technique, for example an analyst aid for indications and warning. However, it will be used mainly to enhance an interrelated system of several techniques within an overall intelligence data collection, exploitation, processing, analysis, production, and dissemination context.

The purpose of the ISL is to evaluate intelligence technology under a range of expected workloads, data rates, time constraints, and to determine additional areas for advanced development. It also will perform sensitivity analysis on parameters of the technique that may be modified in advanced development.

For further information regarding the ISL, contact Mr. J. Weber, RADC/IRDA Griffiss AFB NY, AV 587-3126.

ICS Interactive Communications Simulator

STATUS:	Operational
RESIDENCE:	DEC PDP 11/40 Array Processor 120B
OPERATING SYSTEM:	RT-11 : Single user RSX-11M : Multi-user
LANGUAGE:	DEC FORTRAN IV AP Assembly Code
EXECUTION TIME:	Example for moderately complex link: Probability of error of 10-8 can be processed in 10-12 hours or 10-5 in 2-3 hours.
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Communication

ABSTRACT:

The Interactive Communications Simulator (ICS) is a highly efficient, expandable, and user-friendly simulation and modeling tool for the evaluation and development of advanced digital communication signal processing techniques. The modeling structure of the ICS is a classical breakout of the various generic signal processing functions and environment in any communication link (i.e. source/sink, source encoding/decoding, channel encoding/decoding, modulation/demodulation, transmitter/receiver, and propagation channel). These signal processing functions are modeled using the Monte Carlo simulation.

The ICS provides a high speed high resolution specialized modeling/ simulation capability for the design and analysis of communication links and signal processing techniques. The current version (Version 1) of the ICS features a 3-path dispersive fading and an impulsive noise channel model. In addition, there is an Additive White Gaussian Noise (AWGN) channel model. Version 2, an improved version, will feature spread- spectrum modulation/demodulation, adaptive array nulling techniques, adaptive equalization, and jamming signal sources. This version is expected to be available by June 1983.

For further information regarding the ICS, contact Mr. P. Leong, RADC/DCLF, Griffiss AFB NY 13441, AV 587-4567.

ICSSM Interactive Communications Systems Simulation Model

STATUS:	Operational
RESIDENCE:	Honeywell 6180
OPERATING SYSTEM:	Multics
LANGUAGE:	ANSI Standard Fortran IV
EXECUTION TIME:	Dependent upon model
OPERATION:	Interactive, non-real time, or batch.
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Interactive Communications Systems Simulation Model (ICSSM) is a non- real-time digital-computer-based system intended for simulating point- to-point communication systems. The ICSSM has the capability of supporting simulation and modeling of a system which can be represented in terms of a network of multi-post functional blocks. Its applicability is restrained only by the modeler's ingenuity to decompose and represent algorithmically his system to these interconnected functional blocks. Therefore, the ICSSM has the capability to simulate multi-input, multi-output digital communication systems of practically any system.

There is an application library that is an integral part of ICSSM. This library is available to facilitate storage, and access of all application software whether it is modeling/simulation modules, analysis subroutines, or computer graphics subroutines.

Consequently, the user/analyst may benefit from the legacy of previous modeling efforts. The ICSSM also has a preconfigured programming structure which allows the user/analyst to concentrate on the model formulation itself. Thus, the construction of a special simulation framework or system for each simulation endeavor is avoided.

The ICSSM is a baseline simulation and modeling tool that can easily accommodate any conceivable future growths (i.e. both system and application related enhancements). Hence, it will be responsive to the modeling, simulation and

analysis requirements generated by new communication system development needs.

For further information regarding the ICSSM contact Mr. P. Leong, RADC/DCLF, Griffiss AFB NY 13441, AV 587-4567.

IEMCAP Intrasystem Electromagnetic Compatibility Analysis Program

STATUS:	Operational
RESIDENCE:	Honeywell 6180
OPERATING SYSTEM:	GCOS
LANGUAGE:	Fortran IV
EXECUTION TIME:	Depends on the system size. It can run from seconds to an hour of CPU on the Honeywell 6180.
OPERATION:	Batch
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Intrasystem Electromagnetic Compatibility Analysis Program (IEMCAP) is a deterministic model designed to provide the basic system-level intrasystem electromagnetic compatibility (EMC) analysis. Its output is in the form of a digitized EMC database. It performs four functions.

The first function is the baseline system EMC survey. The system is surveyed for interference. If the maximum of the electromagnetic interference margin over the frequency range for a coupled emitter- receptor port pair exceeds the user-specified printout limit, a summary of the interference is printed. Total received signal into each receptor from all emitters is also printed.

The second function is the trade-off analysis. This function compares the interference for a modified system to that stored from a previous specification generation or survey run. Thus, the effect on interference of antenna changes, filter changes, spectrum parameter changes, wire changes, etc. can be assessed.

The third function is specification waiver analysis. This function shifts portions of specific port spectra as specified and compares the resulting interference to that stored from previous analysis. Thus, the effect of granting waivers for specific ports can be assessed.

The final function is specification generation. The initial non- required emission and susceptibility spectrum is adjusted such that the system is compatible. The user-specified adjustment limit prevents too stringent adjustments. A summary of interference situations not controllable by EMC specifications is printed. The adjusted spectra are the maximum emission and minimum susceptibility specifications for use in EMC tests.

For further information regarding IEMCAP, contact Dr. G. Capraro, RADC/RBCT, Griffiss AFB NY 13441, AV 587-2563.

LOS ECM Simulator Line of Sight Electronic Counter Measures Simulator

STATUS:	Operational
RESIDENCE:	N/A
OPERATING SYSTEM:	N/A
LANGUAGE:	N/A
EXECUTION TIME:	Real time
OPERATION:	Real time, direct connection to equipment undergoing test
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Communication

ABSTRACT:

The Line of Sight (LOS) Electronic Counter Measures (ECM) Simulator operates in conjunction with a LOS communication simulator to simulate in a laboratory environment LOS communication with jamming. It provides jamming sources combined with signals from the LOS simulator creating an ECM environment for test and evaluation of LOS radio equipment at three radio frequencies (RF) and four intermediate frequencies (IF). The LOS ECM Simulator, can test modems at 70, 100, 300, and 700 MHz IF`s and receivers at 1-1.5, 4.4-5.0, and 7.1-8.4 GHz RF`s.

The ECM Simulator consists of four major sections. The first is the Single LOS/Dual Tropo Jammer source. This generates IF signals to simulate a jammer broadcasting to a LOS receiver. The second major section is the Jammer Delay-Combiner/AGC which combines the desired IF communications signals with appropriately delayed IF jammer signals for simulation of off- axis jamming. A 70 MHz AGC amplifier for testing modems requiring external AGC capability is also contained in this section. The IF/RF interface is the third major section. This section converts the previous mentioned IF signals to RF for testing of receiver front ends. The fourth major section is the power supply section.

For further information regarding the LOS ECM Simulator, contact P. Leong, RADC/DCLF, Griffiss AFB NY 13441, AV 587-4567.

Nanodata QM1 Microprogrammable Computer

STATUS:	Operational
RESIDENCE:	Honeywell 6180 Nanodata QM1
OPERATING SYSTEM:	MULTICS
LANGUAGE:	The Smite compiler is written in Pl1. The QM1 hosts several specific languages.
EXECUTION TIME:	For a medium size Smite emulations (about 500 lines), compilation requires about 30 minutes of CPU time.
OPERATION.	Smite compiler is operated in on-line batch mode. The QM1 is operated in real-time, interactively.
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Nanodata QM1 minicomputer is designed to allow users to evaluate various computer architectures by emulating the architecture. The computer is microprogrammable on two levels and by properly utilizing this flexibility, maximum performance can be achieved.

Traditional methods of exploring the usefulness of different computer architectures lie in the area of simulation. By using a microprogrammable machine to mimic the instruction set operations of the machine in question, one can create an evaluation set operations that operates at speeds ranging from 1/10 the speed of the target machine to as fast as the target machine. Thus, emulation represents a one thousand fold speed increase over simulation methods.

For users not willing to spend the large amount of time required to produce an assembly language description of their architecture, a high level language called Smite is available. This language is used to describe the machine at the register transfer level and compiles to QM1 assembly language.

The process of QM1 use is automated via the QPRIM software system. The QM1 is a logical and physical extension to the RADC TOPS-20 and is available to multiple interactive users simultaneously via the Arpanet. QPRIM requires that the user supply at least two input files; a Smite compiled emulator and a separate description of the emulator. QPRIM provides a complete interactive evaluation, test and debug facility for emulators and target code running on the emulator.

Another tool that is useful in the evaluation of computer architectures is a table driven generalized assembler. This Meta-Assembler will accept and assemble source code for most standard computer architectures. The only inputs for this tool are a description of the target machine's instruction set and the target source code. The output is machine language for the target machine and can be automatically targetted as input to QPRIM. Currently, descriptions exist for the Motorola 6800, Intel 8080 and MIL-STD-1750A instruction sets (approximately 200 lines of code each).

For further information regarding the Nanodata QM1 Microprogrammable Computer, contact 2Lt D. Gonzalez, RADC/COEA, Griffiss AFB NY 13441, AV 587-2558.

QPRIM QM1 Programmer's Research Instrument System

STATUS:	Operational
RESIDENCE:	RADC TOPS-20
OPERATING SYSTEM:	TOPS-20
LANGUAGE:	BLISS
EXECUTION TIME:	System is interactive, variable.
OPERATION:	Operation is interactive and emulators run in near real-time.
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

The Nanodata QM1 minicomputer is designed to allow users to evaluate various computer architectures by emulating the architecture. The computer is microprogrammable on two levels and by properly utilizing this flexibility, maximum performance can be achieved.

Traditional methods of exploring the usefulness of different computer architectures lie in the area of simulation. By using a microprogrammable machine to mimic the instruction set operations of the machine in question, one can create an evaluation tool that operates at speeds ranging from 1/10 the speed of the target machine to as fast as the target machine. Thus, emulation represents a one thousand fold speed increase over simulation methods.

For users not willing to spend the large amount of time required to produce an assembly language description of their architecture, a high level language called Smite is available. This language is used to describe the machine at the register transfer level and compiles to QM1 assembly language. Using a hardware data link, the compiled description is downloaded to the QM1 for execution.

Execution of emulators is supported by the Smite Application Support Software (SASS) package running on the QM1. This package allows the interactive user to test, debug and run his emulator, along with any target code running on the emulator.

For further information regarding QPRIM, contact 2Lt D. Gonzalez, RADC/COEA, Griffiss AFB NY 13441, AV 587-2558.

Radar Clutter and Multipath Simulation Program

STATUS:	Operational
RESIDENCE:	CDC 6600
OPERATING SYSTEM:	CDC 6600
LANGUAGE:	Fortran
EXECUTION TIME:	600 sec
OPERATION:	Real time (batch)
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Technology

ABSTRACT:

A computer program was developed to determine the amount of specular and diffuse multipath power reaching a monopulse receiver from a pulsed beacon and the associated boresight pointing error. Terrain inhomogeneities and multiple specular reflection points are included in the program.

The characteristics of electromagnetic signals scattered from rough terrain include contributions from clutter return and multipath return. These two aspects can be described by the theory of scattering from rough surfaces if properties of the terrain such as probability density function (PDF) for the surface height distribution, the covariance matrix, R, the variance in surface height , 0, and the complex dielectric constant characterizing the surface are known. The numerous theoretical models of electromagnetic wave scattering from rough surfaces all relate the normalized cross section of terrain to the foregoing parameters characterizing the rough surface.

In this program the physical parameters of the rough surface are obtained from digitized terrain maps (furnished by the Electromagnetic Compatibility Analysis Center, ECAC, and the Defense Mapping Agency, DMA). Estimation theory is employed to specify the corresponding statistical parameters. A hypothesis testing procedure determines the PDF for the surface heights.

For further information, contact Dr. R. Papa, RADC/EEC, Hanscom AFB MA 01731, AV 478-3735.

TAC CONTROLLER

STATUS:	Operational
RESIDENCE:	Honeywell 6180
OPERATING SYSTEM:	GCOS
LANGUAGE:	Fortran
EXECUTION TIME:	20 minutes
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Wargaming

ABSTRACT:

The TAC controller simulation is a large scale computer model of the 407L/412L/Airborne Warning Control System (AWACS) equipped Tactical Air Control System as deployed in USAFE. The air defense mission is emphasized by the simulation, with a dynamic threat scenario derived from estimates of an anticipated mass air raid against the 4 ATAF airbases.

TAC controller determines the effects of workload within tactical air command and control facilities when they are confronted with an enemy attack. The effects of various electronic sensor and communication capabilities on defensive counter air engagements can also be assessed. A network approach to modeling the system is used. This makes system reconfigurations such as additional hardware and operations, automation and changes in operations, automation of manual functions, workload sharing among operators, and changes in operation procedures, easier by allowing the user to modify the input data to implement these changes.

For further information regarding the TAC controller contact Mr. G. Ellis, RADC/OCTM, Griffiss AFB NY 13441, AV 587-4433.

TACOM II Tactical Communication Simulation Model

STATUS:	Operational
RESIDENCE:	Honeywell 6180
OPERATING SYSTEM:	MULTICS
LANGUAGE:	FORTRAN
EXECUTION TIME:	Variable - Real Time
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Communication System/Mission Effectiveness in Limited War Scenario

ABSTRACT:

The TACOM II model is a free play, dynamic, event keyed model of the tactical ultra high frequency (UHF) communication air/air, air/ground/air environment. The model employs spread spectrum modem and adaptive array antenna signal processors on a tactical aircraft in a dynamic tactical electronic warfare environment. Unit types which are modeled include friendly and hostile fighters, close air support aircraft, surface to air missiles, jammers, forward observers, forward air controllers, tactical air control party, command and reconnaissance posts and tanks. The TACOM II simulation models factors such as: ground multipath, obstacles, diffraction over obstacles, airframe scattering, signal propagation losses, radar, and visual sensors (the pilot's field of vision). The graphic outputs of the model are used to evaluate system performance in a given tactical environment. These include areas of usable communication throughout the aircraft flight profiles, adaptive antenna pattern plots, jammer to signal ratio (J/S) plots of the effectiveness of the adaptive antenna with respect to an omni antenna along the flight profile. Other ways of evaluating system effectiveness are the number of enemy targets destroyed and the number of returning friendly aircraft.

The run time of the simulation may be faster than the duration of the simulated mission or longer depending on the complexity of the scenario and the number of units.

This model may also be executed in a deterministic mode rather than a free play mode to allow the analysis of particular events which occur.

For further information regarding TACOM II, contact Mr. R. Hinman, RADC/ DCCD, Griffiss AFB NY 13441, AV 587-3225.

TASRAN Tactical Air Surveillance Radar Netting Simulator/Emulator

STATUS:	Operational
RESIDENCE:	Honeywell 6180
OPERATING SYSTEM:	Multics
LANGUAGE:	Fortran
EXECUTION TIME:	Dependent upon complexity of model
OPERATION:	Interactive
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Limited War

ABSTRACT:

TASRAN is a computer simulation for evaluating netted tactical air surveillance systems. The system can acquire and track friendly and hostile aircraft in a realistic threat environment. Networks of arbitrary configurations can be designed and examined against threat scenarios that include aircraft, jammers, and ground targets. TASRAN can also act as an emulator. It will accept actual radar measurements or radar track messages in standard formats and process these along with simulated measurements and simulated tracks. Tactical air operations which this system is designed to implement includes close air support, air interdiction, counter air, air reconnaissance, and tactical air lift.

The data processing functions of radar detection, track initiation and correlation, and automatic target tracking are performed, not just simulated, on the simulated measurements from the network of radars. Communication from site to site can be modeled in various levels of detail. There can be simple message routing to resource sharing or delays to detailed calculations of propagation and jamming degradation. Simulation output can be summarized in printed tables or in interactive displays at a tektronix graphics terminal.

For further information regarding TASRAN contact Mr. G. Ellis, Griffiss AFB NY 13441, AV 587-4433.

TSE Traffic Simulator for Experimental Integrated Satellite Network (EISN)

STATUS:	Expected Delivery Dec 82
RESIDENCE:	DEC PDP 11/40 UMC-Z280 Microprocessors
OPERATING SYSTEM:	DEC RSX-11M
LANGUAGE:	Fortran and Z80 assembly language
EXECUTION TIME:	Real time
OPERATION:	Real time
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Communication

ABSTRACT:

The Traffic Simulation for the EISN (TSE) generates "live" digital, CVSD voice, record and data communication traffic. The TSE consists of a Digital Equipment Corporation (DEC) 11/44 mini processor system configured with an optional floating point processor and one half mega byte memory. The TSE application software consists of three major programs. They are the preprocessor, operational processor, and post processor. The preprocessor is the program that accepts the scenario (test) description from the TSE user, prepares the internal representation of the scenario that is later utilized by the operation processor and stores it on the scenario file. The preprocessor uses the line and traffic definitions and the information on the configuration file to create message/call descriptors called scenario tickets. These tickets carry the description of a message or call. There is one scenario ticket for each message call. These tickets are stored on the scenario file. The operational processor is responsible for the execution of the scenario. The post processor analyzes the results of the operational phase. Various reports are generated, upon operation request, indicating scenario performance.

For further information regarding the TSE contact Lt D. Schmitt, RADC/DCLF, Griffiss AFB NY 13441, AV 587-4567.

Tropo ECM Simulator Troposcatter Electronic Counter Measures Simulator

STATUS: Operational

RESIDENCE: N/A

OPERATING SYSTEM: N/A

LANGUAGE: N/A

EXECUTION TIME: Real time

OPERATION: Real time

SECURITY CLASSIFICATION: Unclassified

PROBLEM CATEGORY: Communication

ABSTRACT:

The Tropo Electronic Counter Measures (ECM) Simulator operates in conjunction with a Troposcatter channel simulator to simulate in a laboratory environment Troposcatter communication with jamming. The jamming source module of the Line of Sight (LOS) ECM Simulator may be used to provide an additional direction of jamming. The Tropo ECM Simulator creates an ECM environment for test and evaluation of tropo radio equipment at a 70 MHz intermediate frequency (IF) and receivers at a 4.4-5.0 GHz radio frequency (RF).

Four major components make up the Tropo ECM Simulator. First, there is the Dual Tropo Jammer source which generates IF signals to simulate a jammer broadcasting to a Troposcatter receiver. The Jammer Delay-Combiner is the second major section. This section combines the IF communication signals with appropriately delayed IF jammer signals for simulation of off-axis jamming. The third major section is the IF/RF interface which converts the previously mentioned combined IF signals to RF for testing of receiver front ends. The fourth major section is the power supply section.

For further information regarding the Tropo ECM Simulator, contact Mr. P. Leong, RADC/DCLF, Griffiss AFB NY 13441, AV 587-4567.

Troposcatter Channel Simulator

STATUS:	Operational
RESIDENCE:	N/A
OPERATING SYSTEM:	N/A
LANGUAGE:	N/A
EXECUTION TIME:	Real time
OPERATION:	Real time, direct connection
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Communication

ABSTRACT:

The Troposcatter channel Simulator was developed in 1973. It is a versatile laboratory quality instrument which will provide accurate and repeatable simulation of multipath effects typical of troposcatter communication links. The Troposcatter Channel Simulator is designed to be used between modem equipment operating at an intermediate frequency of 70 MHz and with a signal bandwidth up to 10 MHz. It was updated to provide simulation of up to three tandem links, input-output linearization for AM- like modems, correlations of diversity outputs, and up to 8 diversities. The completion date of the modifications was in June 1981. Previously, it was used for test and evaluation of tropo modems/terminal equipment.

For further information regarding the Troposcatter Channel Simulator, contact P. Leong, RADC/DCLF, Griffiss AFB NY 13441, AV 587-4567.

Wideband LOS Simulator Wideband Line-of-Sight Channel Simulator

STATUS:	Operational
RESIDENCE:	DEC PDP 11/40
OPERATING SYSTEM:	N/A
LANGUAGE:	Assembly and Fortran
EXECUTION TIME:	N/A
OPERATION:	Real Time
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Communication

ABSTRACT:

The Wideband Line-of-Sight (LOS) Channel Simulator is a means for evaluating wideband digital modems designed to operate over LOS channels. The types of LOS channels handled by the system include: airplane-airplane, ground-airplane, ground-ground, and airplane-satellite. In addition, the simulator allows the introduction of controlled amounts of nonlinearity, phase jitter, and frequency offset. The simulator operates at selectable intermediate frequencies (IF) of 70, 300, or 700 MHz. Signal bandwidths up to 100 MHz may be accommodated at the two higher IF frequencies, while at 70 MHz, bandwidths up to 25 MHz may be handled.

For further information regarding the Wideband LOS Channel Simulator, contact Mr. J. Evanowsky, RADC/DCLF, Griffiss AFB NY 13441, AV 587-4567.

Wireline Simulator

STATUS:	Operational
RESIDENCE:	DEC PDP-8A
OPERATING SYSTEM:	Possesses its own self-contained, tailored operating system internal to the simulator. Operator communication is in basic-like English.
LANGUAGE:	Fortran
EXECUTION TIME:	N/A
OPERATION:	Real time
SECURITY CLASSIFICATION:	Unclassified
PROBLEM CATEGORY:	Communication

ABSTRACT:

The Wireline Simulator is a real time hardware/software simulation consisting of digital and special purpose processor components. It accepts analog input from wireline modems or other voice frequency (VF) devices. The Wireline is used for test and evaluation of telephone channel modems or other VF devices. Any amplitude and delay characteristic may be programmed. Thus, the simulator is capable of introducing impairments such as phase jitter, noise, and harmonic distortion.

The digital hardware portion was built in 1969 implementing about half the telephone channel parameters presently available. A second contract in 1976 incorporated the special purpose processor for the remaining parameters. The Wireline Simulation has been actively used since 1969 in DICEF evaluation.

For further information regarding the Wireline Simulator, contact Mr. J. McEvoy, RADC/DCLF, Griffiss AFB NY 13441, AV 587-4092.

SECTION III

SURVEY RESULTS SUMMARY TABLE

RADC
SIMULATION SURVEY RESULTS

Simulation/Model Name	Office Symbol and (OPR)	Application Area	Language and (Machine)	Documentation	Operating System	Status
ASE	IRRP (Converse)	Sensor Correlation Analysis	FORTRAN PASCAL (VAX 11/780, PDP 11/45, PDP 11/705, & 11/60)	Users Manual	VAX-VMS RSX-11M, V3.2	Operational
AEISS	IRAA (Manor)	Testbed for Algorithms	FORTRAN MACRO-11 ASSEMBLY (DEC PDP 11/70)	Users Manual	RSX-11M, V3.2	Operational
C^3CM	COAM (Clinch)	Model Critical Hostile C^2 Nets	Unknown (TBD)	Unknown (TBD)	Unknown (TBD)	In Develop 82-84
C^3SAM	ISCP (Shook)	Functional Analysis of TACS	COBOL (H6180)	Users Manual	GCOS	Operational

RADC
SIMULATION SURVEY RESULTS

Simulation/Model Name	Officer Symbol and (OPR)	Application Area	Language and (Machine)	Documentation	Operating System	Status
Detection and Tracking of Multiple Targets in Different Environments	EECT (Papa)	Ground Base Unattended Radars	FORTRAN (CDC 6600)	Report	CDC 6600	Operational
DDM	COTD (Baskinger)	Communication Network Design & File Allocation	PASCAL (H6180)	Doctorial Dissertation	MULTICS	Operational
DSS	COTD (Baskinger)	Operating Systems/ Data Base Analysis	ECSS II SIMSCRIPT II.5 (H6180)	Users Manual/TR	GCOS	Under Validation
DDG	COTA (Thaden)	Airborne Pavemover Radar	FORTRAN ASSEMBLY (VAX 11/780)	None Yet	DEC-VMS	Under Development

RADC
SIMULATION SURVEY RESULTS

Simulation/Model Name	Officer Symbol and (OPR)	Application Area	Language and (Machine)	Documentation	Operating System	Status
Forward Area Processor	IRAE (Hartnett)	Architecture to Support ELINT Simulations in an ELINT Environment	FORTRAN (H6180)	Flowcharts/Listings/ Program Descriptions/ Test Run Results	GCOS	Operational
HF Media Simulator	DCLF (McEvoy)	HF Comm Equipment Design & Analysis	FORTRAN (DEC PDP 11/40)	Operations Manual	RSX-11M, V3.2	Operational
IDE	IRAA (Heffron)	Automatic Speech Recognition	FORTRAN MACRO-11 ASSEMBLY (DEC PDP 11/70, NOVA 1200)	Available	RSX-11M, V3.2	Operational
Integrated Switch Simulation	DCLF (Salerno)	Switching Techniques Analysis	ASSEMBLY (Perkin Elmer)	Operations Manual	Interdata's 8/32 Available	Operational

RADC
SIMULATION SURVEY RESULTS

Simulation/Model Name	Office Symbol and (OPR)	Application Area	Language and (Machine)	Documentation	Operating System	Status
ISL	IRDA (Weber)	Digital Software Models	Unknown (TBD)	Available 1 May 83	Unknown (TBD)	Expected Delivery FY84/85
ICS	DCLF (Leong)	Comm Links/Processing	FORTRAN ASSEMBLY (DEC PDP 11/40, Array Processor)	Listings/TR/Memos	RT-11 RSX-11M	Operational
ICSSM	DCLF (Leong)	Comm System Design & Analysis	FORTRAN (H6180)	Functional Description/ TR/Specs	MULTICS	Operational
IEMCAP	RBCT (Capraro)	Electromagnetic Compatibility Analysis	FORTRAN (H6180)	Engineering Manual Users Manual	GCOS	Operational

RADC
SIMULATION SURVEY RESULTS

Simulation/Model Name	Office Symbol and (OPR)	Application Area	Language and (Machine)	Documentation	Operating System	Status
LOS ECM Simulator	DCLF (Leong)	LOS Comm Design & Analysis	N/A	Operations/Maintenance Manual & TR	N/A	Operational
Nanodata QM1 Microprogrammable Computer	COEA (Gonzalez)	Microprocessor Analysis	PL1 (H6180, Nanodata QM1)	Operations Manual	MULTICS	Operational
QPRIM	COEA (Gonzalez)	Emulation of Digital Computer Architectures	BLISS (TOPS-20)	Operations Manual	TOPS-20	Operational
Radar Clutter and Multipath Simulation	EEC (Papa)	Electromagnetic Signals	FORTRAN (CDC 6600)	Reports	CDC 6600	Operational

RADC
SIMULATION SURVEY RESULTS

Simulation/Model Name	Office Symbol and (OPR)	Application Area	Language and (Machine)	Documentation	Operating System	Status
TAC Controller	OCTM (Ellis)	Tactical Surveillance Systems Analysis	FORTRAN (H6180)	Users Manual Flow Chart Manual	GCOS	Operational
TASRAN	OCTM (Ellis)	Tactical Surveillance Systems Netting Analysis	FORTRAN (H6180)	Users Manual Functional Description	MULTICS	Operational
Traffic Simulator	DCLF (Schmitt)	Communications Traffic Loading Analysis	FORTRAN Z80 ASSEMBLY (DEC 11/40, UMC-Z280 Micro-processors)	Unknown	RSX-11M	Expected Delivery Dec 82
Troposcatter Channel Simulator	DCLF (Leong)	Tropo Comm Design & Analysis	N/A	Operations/Maintenance Manual & TR	N/A	Operational

RADC
SIMULATION SURVEY RESULTS

Simulation/Model Name	Officer Symbol and (OPR)	Application Area	Language and (Machine)	Documentation	Operating System	Status
TROPO ECM Simulator	DCLF (Leong)	Tropo Analysis within ECM Environment	N/A	Operations/Maintenance Manual & TR	N/A	Operational
Wideband LOS Simulator	DCLF (Evanowsky)	LOS Modem Analysis	FORTRAN ASSEMBLY (DEC PDP 11/40)	Operations Manual/TR	RSX-11M	Operational
Wireline Simulator	DCLF (McEvoy)	Telephone Channel Modem Analysis	FORTRAN (DEC PDP-8A)	Operations Manual	Possesses Own Self-Contained, Tailored OS	Operational

SECTION IV

SUMMARY AND RECOMMENDATIONS

The purpose of this survey is twofold: (1) to provide a comprehensive picture of current RADC simulation/model capabilities that would be of interest to the general Air Force community (2) to determine if any of the models/simulations could be interfaced to meet the performance requirements of the System Design Development Envrionment (SDDE).

Twenty-eight models/simulations were examined and tabulated against a list of desirable (in a C3 sense) attributes and capabilities. The models/simulations were separated into three major categories: Pure Models, Aggregate Models, and Wargaming Models. There were nine pure models, fourteen aggregate models, and five wargaming models. An environment where all three model types exist, and where the low level models can be used to "feed" the more general models, seems to be a reasonable approach in the development of a good, all around simulation capability.

A generic tactical systems simulator capable of simulating a wide range of C3I architectures using ground, air, and naval forces is needed to support tactical systems of the future. With the ever-changing technology and the shift toward better management of C3 systems, it appears that a survey like this or a comprehensive Department of Defense (DOD) survey is needed. The SDDE plans to accomplish this in FY83. The SDDE will systematically integrate issues on the C3I level down to technological issues. The resulting survey catalog should provide a good starting point for further study. It could also potentially reduce or eliminate redundant development efforts in the future. Furthermore, for the SDDE to develop a requirements definition of a simulation or group of existing simulations for test and evaluation of new technology aimed at the tactical arena, a common thread or element between DOD agencies needs to be established.

The five wargaming models listed in the catalog could not possibly fulfill the SDDE requirements needed to test and evaluate future tactical models/simulations. The RADC wargaming models do not span the whole tactical environment. The role of the SDDE consists of a large and complex task that requires the involvement of other DOD agencies.

APPENDIX I

QUESIONNAIRE

SDDE Model/Simulation Survey

NAME: What is the name of the model or simulation, and indicate whether it is a model or simulation in brackets after the name.

TYPE: What type of model/simulation is it? i.e. hardware, software, analog, digital, real time, non real time, deterministic, probabilistic, validation, etc. Is it a pure model, aggregate model, or wargamming model?

PURPOSE: Attach a 2-3 paragraph description of the purpose (existing or proposed use) of the model/simulation.

OPR: Identify the office and primary individual responsible for the simulation use.

STATUS: Identify the model/simulation development, history and current status, that is when was it developed?; When was it used?; Is it currently being used?; Is it currently being developed?; When is it intended to be used?; etc.

DOCUMENTATION: How well is the model/simulation documented? What documentation is available, i.e. operators manual, hardware/software documentation, listing etc. How good is the documentation? How current is the documentation?

RESIDENCE: Identify where the model/simulation physically resides i.e. H6068 MULTICS, Bldg 3; LOS Simulator, DICEF, Bldg 3; ACE DEC 11/70, Bldg 240; etc.

ACCESSIBILITY: How accessible is the model/simulation? How can it be accessed?

SPECIFICS: Provide the following model/simulation specific information.

Security Classification: Identify the security classification level of the model/simulation i.e. Unclassified, Confidential, Secret, etc.

Operation: Identify the type of operation required, i.e. batch, real time, and/or interactive.

Functions: Identify major and minor functions of the model/simulation.

Identify the scale and level of fidelity represented by the model/simulation e.g. simulation of a European scenario; to BN level simulation of a communications node, to include BIT patterns or model of a RADAR to include only BLIPS.

Identify the level of interaction with the model/simulation e.g. very high level with the model to very low level.

Software: Identify the computer's language that the model/simulation is written in e.g. FORTRAN, COBOL, BASIC, ASSEMBLY, etc.

Memory Requirements: Identify the memory requirements.

Execution Time: Identify execution time of the model/simulation.

Operating System: Identify the operating system used i.e. MULTICS, DEC, etc.

Support Requirements: Identify support requirements for model or simulation e.g. pre-processor, post-processor, graphics, data base, etc.

Hardware - Type: Identify type of hardware which the model or simulation resides on/or is an integral part of i.e. Honeywell 6080, IBM 3031, DEC 11/40, unique design, etc.

Terminal I/O: Identify the terminal I/O devices used with the simulation.

Data Ports: Identify the number of data ports available on systems.

Outputs - Type: Identify the type of data outputs available i.e. hard copy, visual, reports, etc.

Limitations/Assumptions: Identify any limitation/assumptions associated with the model/simulation.

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