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An Examination of Electronic File Transfer Between Host and Microcomputers for the AMPMODNET/AIMNET Classified Network Environment

Kerry A. Hake

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Energy Division

AN EXAMINATION OF ELECTRONIC FILE TRANSFER BETWEEN HOST AND MICROCOMPUTERS FOR THE AMPMODNET/AIMNET CLASSIFIED NETWORK ENVIRONMENT

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LIST OF ABBREVIATIONS, ACRONYMS, AND INITIALISMS

ACF/VTAM	Advanced Communication Function/Virtual Telecommunications Access Method
AIMNET	Acquisition Information Management Network
AMPMOD	Army Materiel Plan Modernization
AMSNET	Army Management System Network
APA	All Points Addressable
ASCII	American Standard Code for Information Interchange
AMCCOM	Army Munitions and Chemicals Command
AVSCOM	Aviation Support Command
BSC	Binary Synchronous Communications, Bisync
CECOM	Communications and Electronics Command
CGA	Color Graphics Adapter
CICS	Customer Information Control System
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
CSLA	Communications Security Logistics Agency
CSW	Center for Signal Warfare
CUT	Control Unit Terminal
DASD	Direct Access Storage Device
DBMS	Data Base Management System
DEC	Digital Equipment Corporation
DESCOM	Depot Systems Command, Letterkeyyn Army Depot
DISOSS	Distributed Office Support System
DNA	Digital Network Architecture
DOS	Disk Operating System
DSDD	Double Sided Double Density
EARA	Equipment Authorization and Review Agency (now USAFISA)
EBCDIC	Extended Binary-Coded-Decimal Interchange Code
FDC	Federal Data Corporation, Bethesda, Maryland
FDS	Federal Data Systems (a division of IBM)
HQ-AMC	Headquarters Army Materiel Command
I/O	Input/Output
IBM	International Business Machines, Incorporated
ISC-P	Information Systems Command, Pentagon
ISPF	Interactive System Productivity Facility
KB	Kilobyte

LAN	Local Area Network
LIU	Logical Input Unit
LPSA	Logistics Programs Support Activity, Letterkenny Army Depot
MAF/RHO	Multiple Access Facility/Remote Host Operation
MB	Megabyte
MICOM	Missile Command
MISM	Major Item Systems Mapping, Major Items Systems Map
MVS	Multiple Virtual Storage
NCR	National Cash Register
ORNL	Oak Ridge National Laboratory
PS/PC	Personal Services/Personal Computer
RCC	Remote Cluster Controller
RDAISA-P	Research, Development and Acquisition Information Support Activity - Pentagon
RDAISA-R	Research, Development and Acquisition Information Support Activity - Radford, VA
SDLC	Synchronous Data Link Control
SNA	Standard Network Architecture
TACOM	Tank Automotive Command
TCA	TeleCommunications Adapter
TCAM	TeleCommunications Access Method
TECOM	Test and Evaluation Command
TPC3	Tempest Personal Computer 3
TROSCOM	Troop Support Command
TSO	Time Share Option
USAFISA	U.S. Army Force Integration Support Agency
VDT	Visual Display Terminal
VTAM	Virtual Telecommunications Access Method
WIS	Worldwide Military Command and Control System Information System
WWMCCS	Worldwide Military Command and Control System

1. INTRODUCTION

This report presents the results of investigation and testing conducted by Oak Ridge National Laboratory (ORNL) for the Project Manager - Acquisition Information Management (PM-AIM), and the United States Army Materiel Command Headquarters (HQ-AMC). It concerns the establishment of file transfer capabilities on the Army Materiel Plan Modernization (AMPMOD) classified computer system. The discussion provides a general context for micro-to-mainframe connectivity and focuses specifically upon two possible solutions for file transfer capabilities.

The second section of this report contains a statement of the problem to be examined, a brief description of the institutional setting of the investigation, and a concise declaration of purpose.

The third section lays a conceptual foundation for micro-to-mainframe connectivity and provides a more detailed description of the AMPMOD computing environment. It gives emphasis to the generalized International Business Machines, Inc. (IBM) standard of connectivity because of the predominance of this vendor in the AMPMOD computing environment.

The fourth section discusses two test cases as possible solutions for file transfer. The first solution used is the IBM 3270 Control Program telecommunications and terminal emulation software. A version of this software was available on all the IBM Tempest Personal Computer 3s (TPC3s). The second solution used is Distributed Office Support System (DISOSS) host electronic mail software (the term e-mail with be used from now on) with Personal Services/Personal Computer (PS/PC) microcomputer e-mail software running with IBM 3270 Workstation Program for terminal emulation. Test conditions and results are presented for both test cases.

The fifth section provides a summary of findings for the two possible solutions tested for AMPMOD file transfer.

The report concludes with observations on current AMPMOD understanding of file transfer and includes recommendations for future consideration by the sponsor.

2. STATEMENT OF THE PROBLEM

An AMPMOD group was established in 1979 to improve all aspects of the planning, programming, and budgeting system. It was recognized that a major hardware and software system would have to be put in place to meet the group's major goals, which included a significant improvement in the capability for enhanced automated preparation, analysis, and computer defense of budgeting requirements. An AMPMOD plan was developed which resulted in a functional description. Two major software applications have been developed and implemented: the AMPMOD Phase 1, and the Major Item Systems Mapping (MISM).

A new hardware and telecommunications secure environment was put in place in order to run the initial two applications as well as the expected enhancements. In addition, tempest microcomputers, TPC3s, were added to the AMPMOD system in 1986. The addition of the TPC3s established a requirement for full microcomputer to mainframe computer interaction. This meant going beyond the initial functionality of terminal interaction with a host and providing the ability of taking information residing in files on the floppy disk or removable data cartridges of the TPC3 and transferring it to an AMPMOD host computers (IBM 4381s) Direct Access Storage Device (DASD). Likewise, the ability was needed to provide information transfer from AMPMOD host datasets residing on DASDs to the TPC3s. Because of the AMPMOD connectivity with various depot program offices, this technology was viewed by PM-AIM as a likely test candidate for testing a secure e-mail system.

Oak Ridge National Laboratory was tasked with testing the mechanisms, hardware and software, to establish a file transfer capability between the TPC3s and the AMPMOD hosts.

3. CONNECTIVITY AND AMPMOD

3.1 CONNECTIVITY

Connectivity among computers describes the extent to which any given computer platform, PC, Minicomputer, or Mainframe can exchange information. It may be viewed as both a physical and logical interchange of computing resources.

3.1.1 Physical Connectivity

The physical aspect of connectivity refers to the manner in which one computer system is attached to another. Although a microcomputer with an attached printer for output or a document scanner for input may technically be considered a form of connectivity, it is localized and does not define any interaction with other computers. One straightforward form of physical connectivity is a microcomputer linked to another microcomputer via a cable. Each micro would require a dual purpose input/output (I/O) channel, usually a RS-232 or Serial port that may be an extra board plugged into the motherboard. The physical connection alone will not permit exchange of information. This requires a cooperating operating system and quite possibly some specialized application software.

By contrast, a highly connective microcomputer may have a locally attached printer or scanner, but it also would have an attached modem for communicating to another computer. This communication could be made in a variety of ways: by a modem over telephone lines, for example, or by a cable connection to a terminal control device attached to another computer, or by some type of wire connection to other microcomputers in a Local Area Network (LAN). Additionally, it may or may not be linked directly to other LANs or host computing systems. Offering multiple paths to numerous computers can quickly become a complex matter. The ability of the attached computers to understand each other generally determines the degree of connectivity.

3.1.2 Logical Connectivity

Logical connectivity is highly dependent upon specific physical connections to perform distinct functions (usually referred to as protocols) which may vary between hardware vendors. A connection may be as simple as a terminal solely dependent on a host for all its processing, or it also may be as complex as a mainframe central processing unit (CPU) interacting with a microprocessor CPU in a peer-to-peer relationship. The degree to which this connectivity is accomplished may be generalized into four levels (Figure 1). These levels are Terminal or Emulation, File Transfer, Application Interaction, and Distributed Function. These terms are explained in detail in the following section.

The illustration (Figure 1) depicts a non-linear relationship between the **Level of Complexity** and the **Level of Connectivity**. As the functionality changes from left to right along the curve, the relative amount of complexity increases more rapidly than the relative amount of connectivity. Notice that the change in complexity between **Terminal Emulation** and **File Transfer** is much less than the change between **File Transfer** and **Application Interaction**. Also note that no attempt has been made to quantify these relationships or to justify this information from empirical evidence. The illustration comes from conventional assessments and generally accepted observations.

Succinctly stated, the illustration shows that the jump from **Terminal Emulation** to **File Transfer** is many times easier than going from **File Transfer** to **Application Interaction** or from **Application Interaction** to **Distributed Function.**

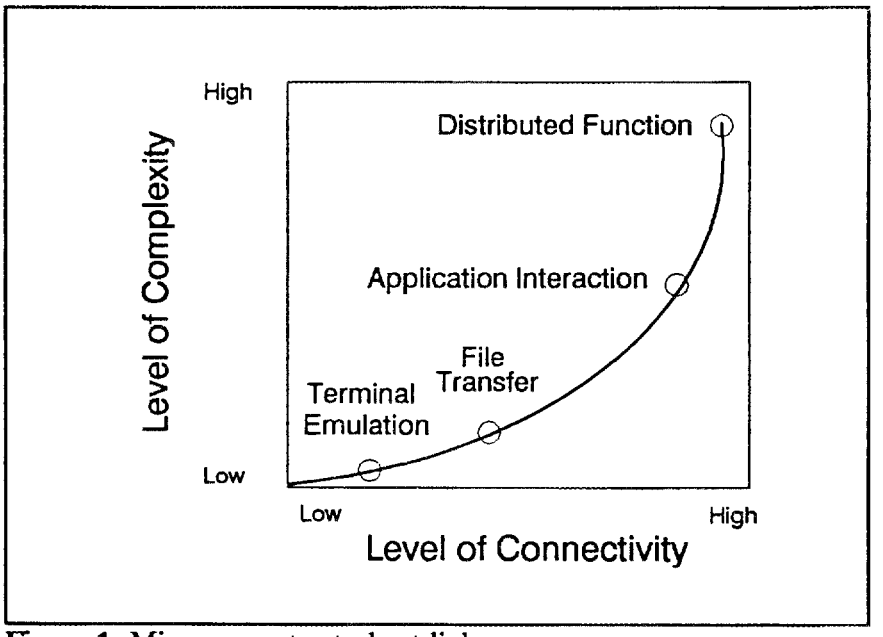

Figure 1 Microcomputer to host linkages.

3.1.2.1 Terminal Emulation

The Terminal or Terminal Emulation level is where an alphanumeric device, usually a keyboard and visual display device (commonly referred to as a Visual Display Terminal, VDT, or sometimes called a Cathode Ray Tube device, CRT) can interact with a host computer on a basic level of interaction. If the VDT is a microcomputer, it will have its own operating system and will run an application program which allows the host to identify and understand it as a terminal. This means the microcomputer can imitate the attributes, actions, and reactions of a specific terminal.

Terminal emulation can be split into two categories based on the type of terminal/host communication in use, either asynchronous[1] or synchronous[2] communication. A microcomputer can serve as terminal through the use of a serial port and application software run by the micro's operating system. Some examples of asynchronous terminals for which application software is available are: the Digital Equipment Corporation (DEC) VT-100 Series terminals, considered an

---

[1] Asynchronous communications describes a method of data transmission whereby start/stop bits are used to define a character, formalizing the data by separating characters. The start/stop bit can be the first/last element of a character. It helps to synchronize the receiver or return the transmission to an at-rest position.

[2] Synchronous communications describes a mode of data transmission where a continuous, discrete group or block of characters are separated by control bits at the beginning and end of each block. The data are formalized into blocks of data comprised of many characters.

industry standard for ASCII terminals; [3] the Tektronix 4000 and 4100 series graphics terminals; the DEC VT-200 and VT-300 Series, and the Televideo 900 Series. Most asynchronous communications application software packages incorporate a fundamental type of asynchronous communications termed the XON/XOFF handshake protocol.

The primary type of terminal/host communications used in an IBM environment is not asynchronous, but synchronous. Some examples of the terminals for this are the IBM 3270 Series, terminal models 3278, 3279, 3274, and 3276. A microcomputer will usually require an add-in circuit board and concomitant application software to achieve terminal emulation in a synchronous environment. IBM offers its own 3270 emulation boards for the IBM PC and PS/2.[4] Many other manufacturers offer full-function and enhanced-function versions of this add-in board. IBM also offers the companion software for the 3270 emulation board called Entry Level Program, 3270 Control Program (no longer available), and 3270 Workstation Program. Other manufacturers offer application software capable of duplicating and enhancing the capabilities of these IBM offerings.

3.1.2.2 File Transfer

File transfer describes the act of exchanging data between computer storage media. In a typical microcomputer/host setting, a file from a floppy disk or hard disk would be sent from a microcomputer to a host computer and stored on its DASD. The reverse also is true, where a host DASD dataset would be sent by the host and stored on a microcomputer's floppy disk or hard disk. A compatible communications software package must run on both machines. This enables each machine to understand how the file should be sent, where it is located, its destination, what type of file it is, and what, if any, translation must be performed on the file. Typically a 'flat' file, usually meaning a humanly readable file, will be sent which contains alphanumeric information. On the IBM PC microcomputer, the standard for this is the ACSII character set. For a host like an IBM, the character set standard is EBCDIC (Extended Binary-Coded-Decimal Interchange Code). A translation must take place at the time of the file transfer to modify the file for the appropriate character set or else the destination computer will not be able to properly read, display, or otherwise work with the file it receives.

File transfer parlance uses the terminology **download** and **upload**. This terminology has its roots in the master/slave relationship of early microcomputing where the mainframe as master of all data and processing power allowed a slave microcomputer to download information from its storage and it in turn would allow a microcomputer to upload information from its storage media. With more peer-to-peer transactions in today's computing world, this terminology must be used in relative terms where the computer initiating the communications is considered the **guest** unit and the remote or contacted computer acts as the **host** system. Each computer in turn either sends or receives, puts or gets depending on the perspective.

---

[3] The VT-100 is based on an American Standard Code for Information Interchange (ASCII) standard.

[4] IBM PC and PS/2 which stand for Personal Computer and Personal System/2 are registered trademarks of International Business Machines, Inc.

3.1.2.3 Application Interaction

Application interaction is defined by similar application software on two computers transferring information within the context of the application. Data exchanged between a microcomputer and host comes directly form the storage media and has a structure recognizable by both systems. Any needed data conversions take place within the context of the application program. These files may be a subset of database files which not only include data but the relationships of the data within the context of the Data Base Management System (DBMS). Typically, this is a closed environment where a particular DBMS vendor has written proprietary code to run on several different machines and possesses the ability to transfer information. For example, an intelligent microcomputer interface may automatically make a connection with a host or other microcomputer, log onto that computer, selectively query the "remote" database, perform a computation, select a subset of the results, convert the results for the destination computer's specific data standard requirements, and return the results. File transfer is involved with this process but it is generally an intrinsic part of the application and not necessarily a separate program.

3.1.2.4 Distributed Function

Distributed function connectivity embodies the concepts discussed for application interaction; in addition, the process power may migrate between the differing computers unknown to the user. The distributed database concept aspires to embody this approach. In this case, portions of a database may be physically located on several machines of different performance characteristics and storage capacities. For the sake of the DBMS application, the entire database is logically viewed as residing in one location. A user knows only about a singular portion of the database that they administrate. The distributed function application software performs all the oversight, determines such factors as when another computer will be linked into the process and how to interact with the remote computer (as a peer, host, or subordinate). File transfer is involved with this process but it is generally an intrinsic part of the application and not necessarily a separate program.

3.2 CONNECTIVITY ARCHITECTURE

Two major network architectures have surfaced as industry standards: DEC's Digital Network Architecture (DNA) and IBM's Standard Network Architecture (SNA). The term architecture is used here to include both hardware and software components necessary to provide a telecommunications network.

3.2.1 DNA Architecture

DNA relies on an industry standard Ethernet cable with connections for terminals, peripherals, and various sizes of computers (Malamud, 1989 and Computer Technology Corporation Staff, 1988). This Ethernet 'backbone,' as it is usually called, may include connections for clustered CPUs as well as 'bridges' to other Ethernet backbones and 'gateways' to other networks such as IBM's SNA.

3.2.2 SNA Architecture

SNA is the complex yet versatile connectivity solution from IBM for today and into the foreseeable future (Martin and Chapman, 1987 and Computer Technology Research Corporation Staff, 1988). Although the AMPMOD system does not use SNA, it can be incorporated into an existing SNA network. As such it would not have the same functionality as the SNA system to which it was attached, but it would retain its own capabilities as a bisynchronous communication system.[5] A likely upgrade path for the AMPMOD system is to SNA, therefore, a brief introduction to the topic is appropriate. This section will provide an overview to SNA topology and does not attempt to describe SNA in any detail.

Central to SNA is a host or a set of linked host computers. Each host may have one or more **channel adapters** to connect with the world outside the Central Processing Unit (CPU) (Figure 2). A seventy foot maximum coaxial cable can run from a channel adapter to one of three types of 'feeder' processors which concentrate data from numerous sources. These three types of processors are generally referred to as a **cluster controller**, a **front end processor**, and an **ASCII interface unit**. Other variations exist but these three are the dominant connection to a host channel adapter.

3.2.2.1 Cluster Controller

The cluster controller, sometimes termed a Remote Cluster Controller (RCC), manages I/O from specific types of terminals and peripherals. Examples of terminal types would be an IBM model 3178 data entry terminal, an IBM model 3179 graphics terminal, or an IBM PS/2 or PC running software to make it look like a device acceptable to the cluster controller. The number of devices a cluster controller can handle depends on how new it is and the current version of the supporting software.

Current commercially available cluster controller technology allows 32 physical connections and up to 256 logical computer sessions. This means that 32 terminals could be physically connected with coaxial cable running from the back of the terminal to a cable connection on the back of the cluster controller. The connection on the cluster controller is called a port and has a specific number so the physical connection can be identified to a host. Each terminal could then establish communication with a host attached to the other end of the cluster controller. An established communication link with a host is termed a session, sometimes called a login session. If each of the terminals were capable of splitting the screen into eight sections or windows, each user could logically establish seven more sessions. These sessions may all be with the same host running a variety of application software or with several hosts depending on how many hosts are on the network. Thus, even though the cluster controller only has physical connections for 32 terminals, it actually can keep track of eight simultaneous sessions per port for a maximum of 256 sessions per controller.

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[5] The term bisynchronous or BSC is a type of data transmission based on moving individual characters in a sequential, two-way manner where transmission may only occur in one direction at a time. BSC was the precursor to the current IBM standard of SNA.

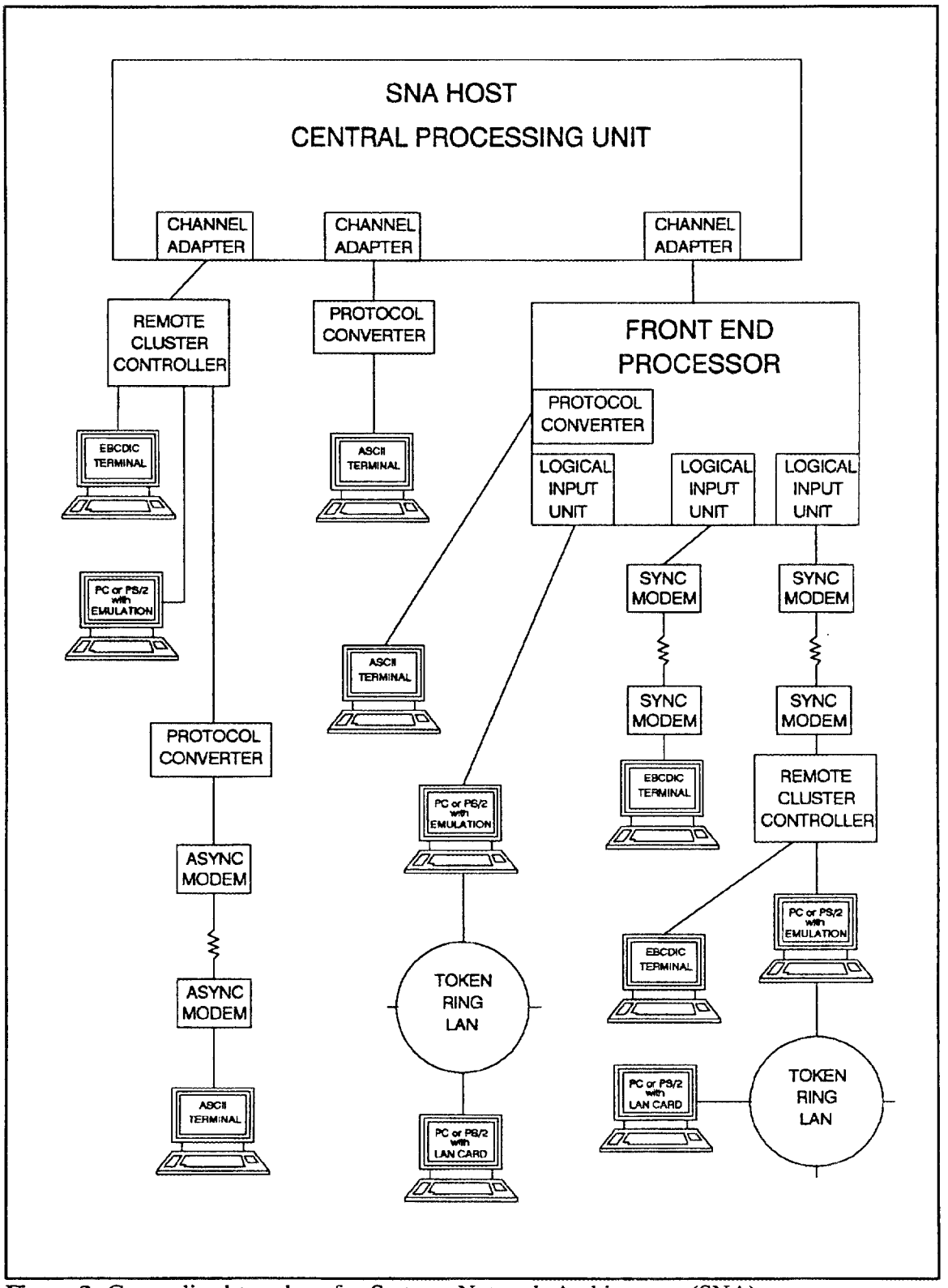

Figure 2 Generalized topology for Systems Network Architecture (SNA).

3.2.2.2 ASCII Interface Unit

Another way to accommodate asynchronous terminal emulation is to provide a translation or conversion device between asynchronous terminals and the synchronous host. A protocol converter is available from various vendors specifically designed for this task. Depending on the manufacturer it will allow several terminal connections. This may be by direct RS-232 cable connection or via a modem connection. A protocol converter may in turn be connected by a coaxial cable to a channel adapter on a host or to a cluster controller which may be either directly or remotely attached to a host via modems (Figure 2). Network configurations for this are not limited to these two specific examples.

3.2.2.3 Front-End Processor

The most full-featured means of SNA connectivity is through a front end processor, or FEP. A FEP is basically another computer, usually a minicomputer class, whose primary service is to handle communications for a host. It is equipped with Logical Input Units (LIUs); the number depends on the model and manufacturer. Each LIU usually has a specific function. There may be a LIU for synchronous communications lines for individual terminals, modems, or cluster controllers, a LIU for protocol conversion, a LIU for IBM's Token Ring or PC Network Local Area Networks (LANs), and a LIU for the coaxial cable connection to a host or other network processor such as a gateway to ethernet.

3.3 AMPMOD/AIMNET SYSTEM CONFIGURATION

3.3.1 Overall System

The AMPMOD portion of the system consists of six IBM 4381 host computers in a hub or centroid topology network centered on DESCOM (Figure 3). Minimal hardware configurations for a basic AMPMOD host include 4 megabytes of memory, 4.8 GB of DASD using Storage Technology Corporation 3380 Series units, a National Cash Register COMTEN 3695 FEPs, and Mohawk 9174T tempested RCCs. The RCCs emulate an IBM 3274 cluster controller models 1C, 21C, or 41C for Control Unit Terminal (CUT) operations. Because of the secret data maintained on the system, KG-84 encryption devices are used throughout the network allowing secure remote connections. Originally there were from 13 to 47 terminals remotely connected to each computer. Each AMPMOD host computer remotely links with one or more of the 11 tempest versions of the IBM 3270 Personal Computer (Figure 3). These microcomputers are located varying distances from the computers, many of them in different buildings and some located at distances from the FEP measured in miles.

Three hosts were added in 1987. ISC-P was positioned as a secondary hub of classified e-mail. This host is an AMDAHL 5860. The eighth and ninth hosts were a Unisys 1100/72 at RDAISA-R and a Unisys DCP-40 at RDAISA-P (Figure 3). Plans include additional links with host computers at LABCOM, Adelphi, MD, Fort Leavenworth, KS, HQ-AMC in Alexandria, VA; and HQ-TRADOC at Ft. Monroe, VA.

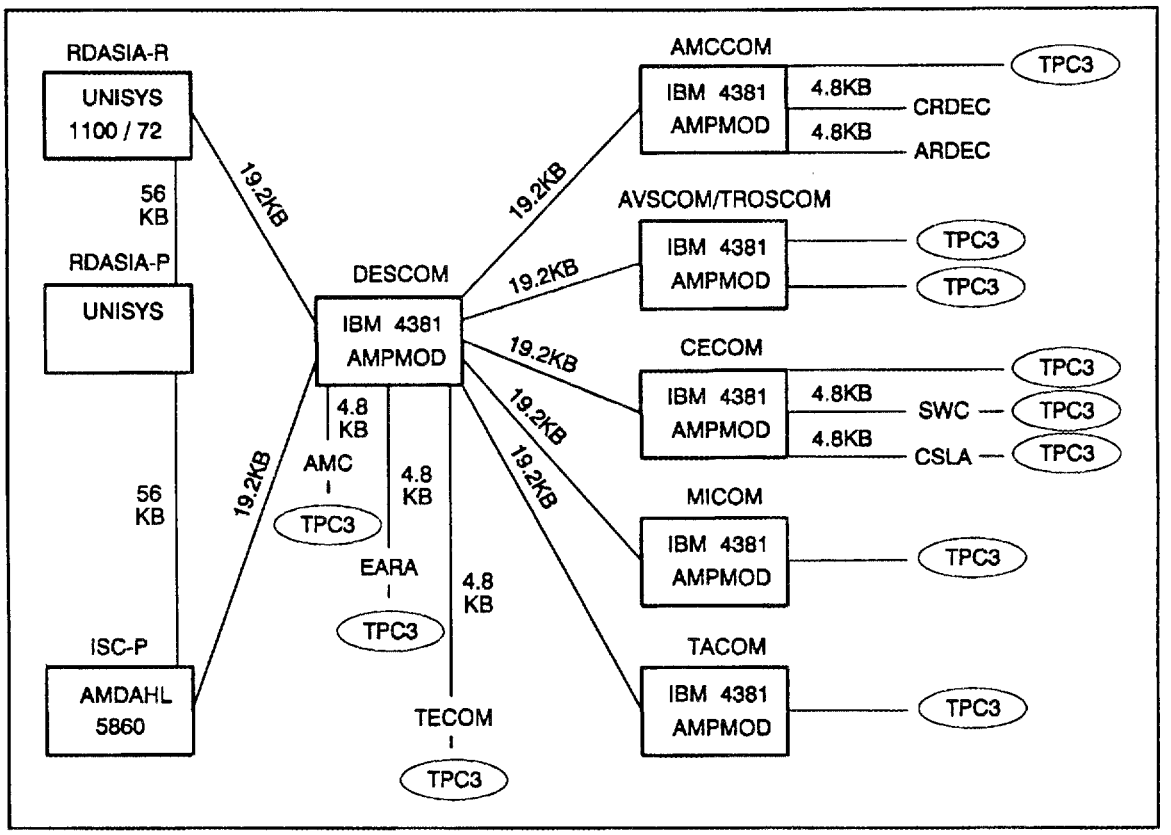

Figure 3 AMPMODNET/AIMNET architecture.

The primary suite of software for the AMPMOD hosts includes IBM's Multiple Virtual Storage (MVS) operating system and Terminal Control Access Method (TCAM) upgraded as of 1988 to Advanced Communication Function/Virtual Telecommunications Access Method (ACF/VTAM). Numerous utility and application programs are installed on each of the AMPMOD hosts. Those utilities worth mentioning as important to the context of this report are Customer Information Control System (CICS) from IBM for application control, Interactive System Productivity Facility (ISPF) from IBM for screen handling/user interface, System 2000 (S2K) from SAS Institute, Inc., Cary, NC for hierarchical database programming, and the basic, non-enhanced version user interaction capabilities supplied with MVS called Time Share Option (TSO). Appendix A contains a more detailed list software typical for the AMPMOD system.

Basic software for the FEPs includes COS2 and Multiple Access Facility/Remote Host Operation (MAF/RHO). (See Appendix A for additional software).

AMPMOD runs as a bisynchronous network with cluster controllers providing CUT support to attached 3270 Series terminals. This includes 132-columns mode terminals.

3.3.2 TPC3

The eleven tempest qualified microcomputers added to the AMPMOD system in 1986 are TPC3s. These microcomputers are electromagnetically shielded IBM 3270 PCs with twin removable 5 Megabyte disk cartridges. These micros are based on the Intel 8088 processor capable of running IBM PC Disk Operating System (DOS). Each was supplied with an additional memory card to bring the total memory to the 640 Kilobyte DOS maximum.

The TPC3 TeleCommunications Adapter (TCA) card provides bisynchronous communications for attachment to an IBM 3274 cluster controller. A triaxial cable connection is provided on the TCA for this feature. A triax-to-coax cable adapter was supplied with each system in order to attach with the coaxial connection on the Mohawk 9174T RCC. Additional I/O ports include one 25-pin D connection for a RS-232 or serial/asynchronous communications and one Centronix, parallel, printer connection.

Each TPC3 has a color monitor and was supplied with an All Points Addressable (APA) card capable of 132 column display in 3270 text mode, and an IBM PC Color Graphics Adapter (CGA) for use under DOS. The aspect ratio or squareness of the graphics images does not conform exactly to CGA and graphics images generated for CGA, and when displayed with the APA turn out rectangular and elliptical instead of square and circular. The APA card does not present this problem when driven by graphics drivers specifically engineered for the IBM 3270 PC display, such as those available in Freelance Plus from Lotus Corporation.

The keyboard of the TPC3 differs from any other IBM keyboard most closely resembling the IBM 3270 PC keyboard. These differences are:

TPC3 Key	3270 PC Key
Blank	Tilde and Grave
Caret and 6	Special IBM character and 6
Tilde and Grave plus small left arrow	Large left arrow key in upper right
] and [	! and Cent sign
! and 1	Vertical Bar and 1
< and ,	, and ,
> and .	. and .
Large up arrow (left side)	Small up arrow key plus > and > key

The TPC3s were purchased from the Air Force contract supporting the Worldwide Military Command and Control System (WWMCCS) Information System (WIS). As WIS workstations, they were configured with a suite of software and an application menu interface. AMPMOD deliveries of these systems were not intended to duplicate the full application functionality of the WIS workstations and the full set of application software was not procured. Three software packages that came with the TPC3s were IBM DOS version 2.1, IBM Control Program version 1.0 for 3270 terminal emulation, the predecessor to Workstation Program, and WIS Workstation diagnostics. Federal Data Systems (FDS) configured each system based on this software.

Performance characteristics for the TPC3 are roughly that of an IBM PC/XT. Appendix B contains a brief specification comparison.

4. TESTS OF POTENTIAL SOLUTIONS

4.1 TWO CATEGORIES OF SOLUTIONS

A number of options for file transfer are commercially available for the existing AMPMOD computing environment.[6] They can be generalized into two categories: basic file transfer or e-mail. In either case, compatible application software is required both on the microcomputer and on the host (Figures 4 and 5). Note that the microcomputer must be able to emulate a 3270 device, usually an IBM 3278 or IBM 3279 terminal. This is accomplished through an add-in card or a specialized integrated circuit chip on the microcomputer motherboard. The TPC3 is shipped with an adapter card for this purpose.

4.1.1 Basic File Transfer Option

IBM markets a basic file transfer product for both the DOS microcomputer and a MVS/TSO host like AMPMOD. The host product is called IBM 3270-PC File Transfer for MVS/TSO, IBM product #5665-311. It works in conjunction with the IBM PC DOS application programs 3270 Control Program, Entry Level Program, and 3270 Workstation Program.

Two of the best received third-party solutions are from Attachmate Corporation and DCA, Inc. These vendor solutions augment or replace the above mentioned IBM PC offerings. Each vendor sells the microcomputer 3270 emulation microcomputer card, PC DOS application programs. They are both capable of interacting with the IBM MVS/TSO File Transfer product for the host. These offerings provide options in addition to the basic IBM offerings.

The basic offerings from these companies meet or exceed the basic requirement of this investigation for a fundamental file transfer capability. The appropriate products from Attachmate Corporation are the 3270 Coax Adapter for the 3270 emulation microcomputer card, the 3278/79 emulation software called EXTRA! EXTRA!. The related items from DCA, Inc. are the IRMA card, sold in various configurations for the 3270 emulation microcomputer card, and 3278/79 emulation software named E78.

4.1.2 Electronic Mail Option

IBM markets two major e-mail host computer products DISOSS and PRofessional OFfice System (PROFS). Both are sophisticated products with integrated word processing and message filing systems requiring system administrators and additional specialized support software. Both are designed to work with the IBM 3270 emulation microcomputer card and the supporting IBM PC DOS application software for 3270 emulation. DISOSS works with the MVS operating system used by AMPMOD/AIMNET, whereas PROFS uses the Virtual Machine or VM operating system.

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[6] The vendor products mentioned in this section are discussed because they are products licensed to the report sponsors and were available as technical resources.

4.1.3 Selected Options

HQ-AMC decided to test the IBM MVS/TSO File Transfer option on the AMPMOD system at Letterkenny Army Depot. The TPC3s were shipped with WIS 3270 Control Program. This is the equivalent of IBM 3270 Control Program Version 1.22 for IBM PC DOS microcomputers. It works with the companion host MVS/TSO File Transfer product from IBM. ISC-Letterkenny took the initiative to procure the host application software, making this option immediately available for testing.

PM-AIM elected to test the DISOSS option for e-mail available on the ISC-Pentagon computer. The AMPMOD network telecommunications line to ISC-Pentagon was used to link DISOSS and support software as a secondary hub (Figure 3) with DESCOM as a passthrough point. The augmented AMPMOD network is referred to as Acquisition Information Management NETwork (AIMNET).

4.2 TSO FILE TRANSFER

The TSO file transfer test was conducted at the DESCOM AMPMOD site with the assistance of ISC-Letterkenny personnel and also at the HQ-AMC AMPMOD terminal room in Alexandria, VA. The TPC3 was located in a terminal room at Letterkenny attached to a Mohawk 9274T RCC and connected via a 4800 baud modem line to the COMTEM front end. The TPC3 at HQ-AMC was attached to the Mohawk 9274T and connected to the DESCOM host via a 4800 baud leased telecommunications line. Primary goals for these tests were to analyze existing equipment and software to determine if file transfer was feasible, what changes, if any, were necessary to facilitate file transfer, and what types of files could be transferred.

ORNL assisted in the loading of the MVS/TSO File Transfer software on the DESCOM host. At the time of installation, the host met the minimum requirement of ACF/TCAM Release 2.4. The TPC3 software, DOS 2.1 and WIS 3270 Control Program, was used as configured by FDS.

The MVS/TSO File Transfer software consists of a library module identified as IND$FILE. It works in conjunction with a PUT or a GET command. The command IND$FILE PUT will place a file into a dataset on DASD that was received from the PC's 3270 emulation software SEND command (Figure 4). The IND$FILE GET will retrieve a file from a dataset on DASD as requested from the PC's 3270 emulation software RECEIVE command.

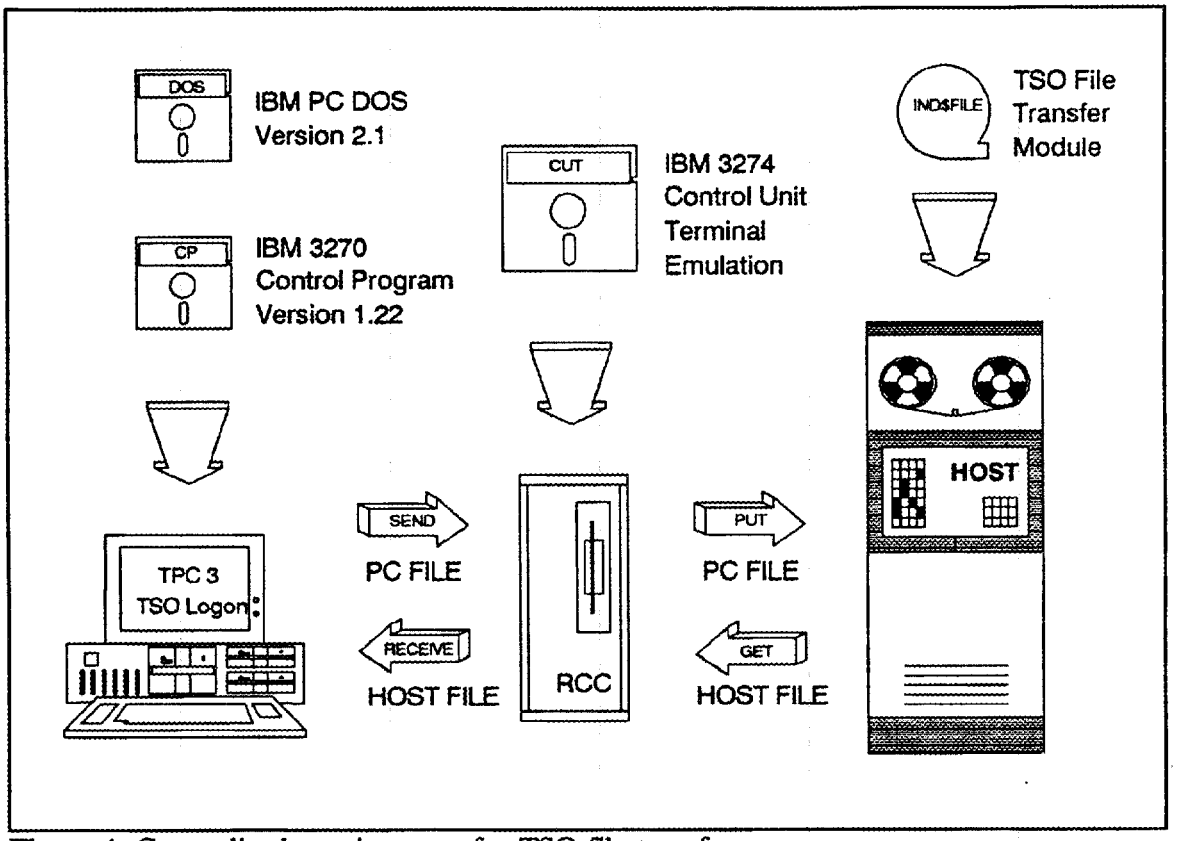

Figure 4 Generalized requirements for TSO file transfer.

A series of files of known size, type, and function were transferred to the host and back to the TPC3. Transmissions were timed manually in both directions. A cyclic redundancy check (CRC) was performed on each file before it was sent to the host and after it returned to the TPC3. The values from each CRC were compared for discrepancies.

4.2.1 TSO file Transfer Test Results

File transfer between the TPC3 and the DESCOM AMPMOD host was feasible with the existing equipment and hardware given the addition of the MVS/TSO File Transfer software on the host. Host configuration requirements included: an updated system generation (sometimes referred to as a sysgen or simply gen) to identify the exact RCC ports where a TPC3 was located; host security system authorization for TSO use on the identified RCC ports with a TPC3; TSO authorized logon for TPC3 user; and read, write, edit, and delete privileges to a partitioned dataset on the host DASD.

Various types of files were successfully transferred between the TPC3 and host. PC DOS file types included ASCII or text files as well as machine code or binary files. The following files types were tested:

1. Executable files with the .EXE extension;
2. Compiled files with the .COM extension;
3. BASIC language files with the .BAS extension;
4. Lotus 123 spreadsheet files with the .WKS and .WK1 extensions;
5. Dbase III Plus database files with the .DBS extension; and
6. Freelance Plus graphics files with the .DRW extension.

A 500 kilobyte (KB) file on the TPC3 hard disk transferred to the host took approximately 26 minutes. A transfer back to the TPC3 also took less than 30 minutes. This is an effective transfer rate of roughly 275 characters per second. These times were based on elapsed time from the time of the last initiation keystroke to the appearance of the system generated completion message. The times varied depending on the number of terminals concurrently using the same RCC as the TPC3. A reasonable generalization would be to estimate the file transfer of one megabyte (MB) at one hour with a maximum of three other concurrent RCC users.

Files over 30 KB received from DESCOM host to the Letterkenny TPC3 (a host GET command) required operator intervention by depressing the PA3 key when the host session Operator Information Area, the bottom status line, indicated a wait symbol that lasted more that 15 seconds. A wait symbol that remained for 20 seconds or more resulted in an unsuccessful transfer and a failure message was displayed if this occurred. Files sent by the TPC3 (host PUT command) did not experience this difficulty. The TPC3 at HQ-AMC did not experience this difficulty.

4.3 DISOSS ELECTRONIC MAIL

The DISOSS e-mail test was conducted with the assistance of ISC-Pentagon, PM/AIM personnel as well as local command personnel from 12 AMPMODNET sites. These sites included HQ-AMC, EARA, TECOM, TACOM, MICOM, AVSCOM, TROSCOM, CECOM, CSW, CSLA (ISC-HQ), ISC-P, and RDAISA. These sites were visited as part of an initial test of AIMNET. Primary goals for these tests were to analyze existing equipment and software to determine if e-mail was feasible; what changes, if any, were necessary to facilitate e-mail; what types of files could be transferred; and what kind of performance could be expected.

The complete test was run at two of the sites, CSLA-HQ and RDAISA. Each site represented an extreme in telecommunications speed. CSLA-HQ was at the lower end of the scale and RDAISA at the upper. During the time of the testing, CSLA-HQ had a 4800 baud connection to the FEP at CECOM, and CECOM also had a 4800 baud connection to the DESCOM FEP which was in turn linked to ISC-P with a 9600 baud line. (Note that Figure 5 represents an update from the time this test occurred). RDAISA-Radford had a 56KB connection to RDAISA-Pentagon and an inter Pentagon connection to the ISC host (Figure 5). The sites represented a worst and best case for AIMNET.

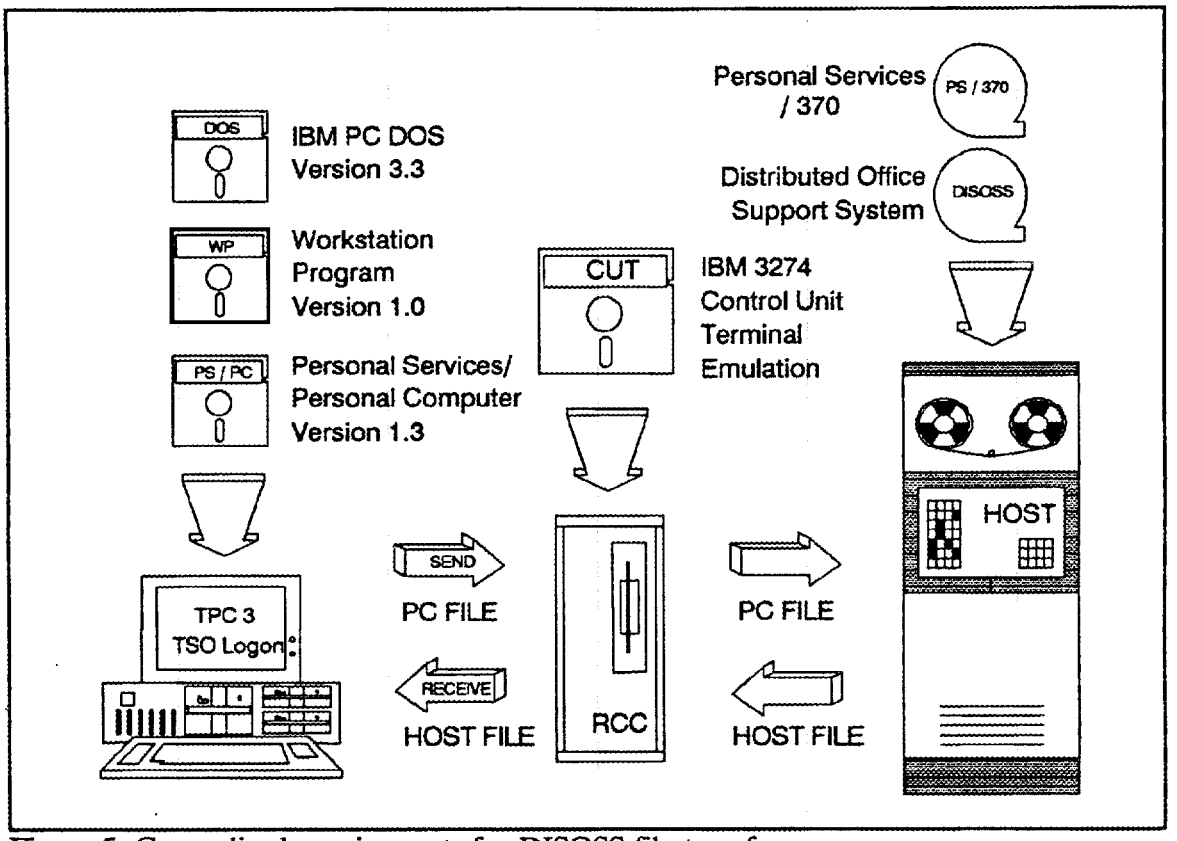

Figure 5 Generalized requirements for DISOSS file transfer.

ORNL assisted in the configuration of the TPC3 system for a new version of DOS, the e-mail application software, and developed a suite of test files and a basic procedure for evaluating the AIMNET e-mail system (Figure 5). AMPMOD was engaged in upgrading from TCAM to VTAM and upgrading existing telecommunications lines during the time of testing. TPC3s were not available at all of the AIMNET sites and substitutes were used. These substitutes were all IBM PC DOS-based, functional equivalents of the TPC3 and included the IBM TPC2, the Zenith 248, and the IBM 3270 PC with Bernoulli Box II twin, removable, 20 MB hard disk cartridges.

A suite of ASCII files was transferred to the e-mail host and back to the TP3 or other microcomputer. Transmissions were timed manually in both directions. A CRC was performed on each file before it was sent to the host and after it returned to the TPC3. The values from each CRC were compared for discrepancies. Files included an ASCII file with all possible ASCII characters, except the DOS end of file marker, and plain text ACSII files of the following sizes: 1, 5, 10, 15, 20, 60, and 100 KB. Each file consisted of a repetition of a 10KB, 93 keyboard character, clear text pattern. The pattern is as follows:

abcdefghijlkmnopqrstuvwxyz
ABCDEFGHIJLLMNOPQRSTUVWXYZ
0123456789
!@#$%^&*()_+-={|[\:"};']<>?,.

Each line ended with a space, carriage return, and line feed. There was no preceding tab or space.

Other types of transferred files included an executable file with the .EXE extension, a compiled file with the .COM extension, a BASIC language file with the .BAS extension, a WordStar wordprocessing software file, a MultiMate wordprocessing software file, a WordPerfect wordprocessing software file, and a Document Interchange Format (DIF) file.

4.3.1 DISOSS Electronic Mail Test Results

It was determined that DISOSS required IBM DOS version 3.3, IBM 3270 Workstation Program version 1.0, and PS/PC version 1.3. PM/AIM procured multiple copies of these software packages and ORNL configured DOS, the file systems for each TPC3 removable data cartridges, the Workstation Program, and PS/PC (see Appendix C). A systematic procedure for testing was developed by ORNL and followed at each of the sites (Appendix D contains this procedure).

The test procedure was followed to completion at two of the 11 sites, AMC-HQ and CSLA. Seven of the sites experienced telecommunications difficulties owing to the newness and initial testing of the system. These difficulties included nonfunctioning telecommunications lines, disconnected modems, and improper system 'gens' (short for reestablishing system level parameters through a regeneration or restarting of a major part of the operating system). Two of the sites experienced microcomputer hardware and/or software problems. The Zenith 248 at MICOM could not successfully establish a host link through PS/PC even though the Workstation Program performed properly. This was in direct opposition to the findings at RDAISA, where an identically configured Zenith 248 performed efficiently. At ISC-P, an IBM PC with an IOMEGA Bernoulli Box II and an IBM 3278/79 adapter card had problems where PS/PC was unable to load into memory during the DOS loading of the CONFIG.SYS parameters.

Results indicate a linear relationship between the time needed to send a file and the file size (Figure 6). A 100 KB file took about 22 minutes to transfer to the Pentagon host and 28 minutes to transfer back to the TPC3 at CSLA. The same file took about nine minutes to ISC-P and 14 minutes back to RDAISA.

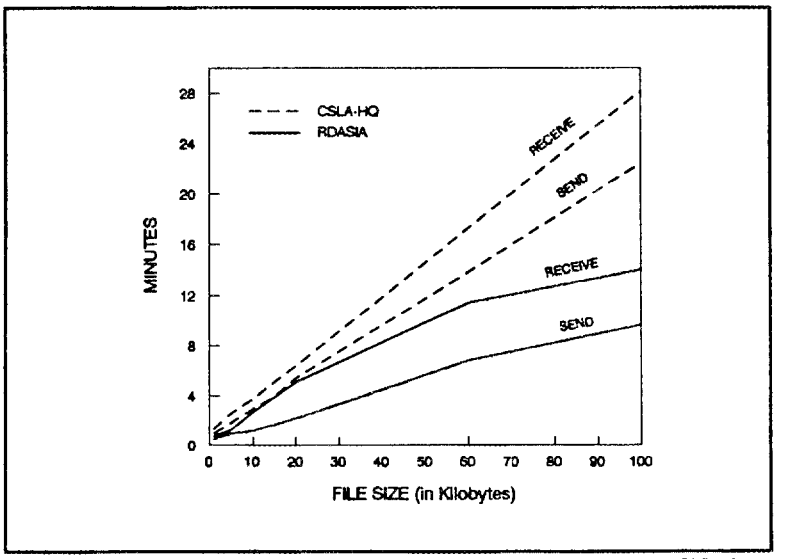

Figure 6 Elapsed time of file transfer for two AIMNET sites using DISOSS.

The effective transmission rates appeared to flatten out after a 5KB file (Figure 7). The startup effect appears to be related to the DISOSS overhead of establishing a send or receive file transfer 'session.' This was further supported when empty files, blank PS/PC messages, blank PS/PC notes, and PS/PC Message Status queries were timed. Times varied between 30 seconds to 1.5 minutes and visual inspection of the host screen on the TPC3 during transmission indicated an exchange of protocol messages between the host and TPC3 software.

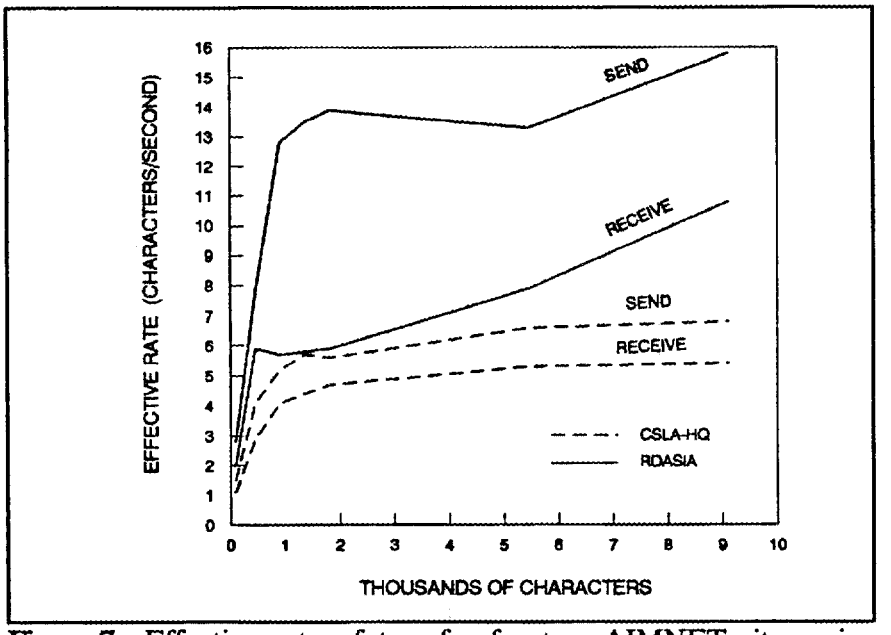

Figure 7 Effective rate of transfer for two AIMNET sites using DISOSS.

Files over 5KB received from the DISOSS host to RDASIA Zenith 248 required operator intervention by depressing the Jump key sequence when the host session Operator Information Area indicated a wait symbol that lasted more than 15 seconds. A wait symbol that remained for 20 seconds or more resulted in an unsuccessful transfer. Notification of the file transfer failure was not consistently performed by the system in a timely manner. During several attempts, the system was automatically logged out because of inactivity exceeding the security limits. Files sent to the DISOSS host did not experience this difficulty. The TPC3 at CSLA did not experience this difficulty.

5. FINDINGS

5.1 PERFORMANCE ISSUES

File transfer has been shown to be feasible between an AMPMOD host and its attached TPC3 microcomputers and among AIMNET attached TPC3s or DOS based microcomputers using DISOSS e-mail.

The most effective throughput was seen in the TSO environment. A file the size of a DSDD 5 1/4 inch floppy may be transferred in 20 to 25 minutes over a 4800 baud line. This system, however, is geared for a more sophisticated computer user. It requires host security access to TSO not normally afforded an AMPMOD user. This includes the specification of TSO capable terminals on a specific RCC defined in the operating system 'gen.' It also requires direct user privilege for host dataset creation and deletion. The command line interface is for a knowledgeable user who understands concepts of computer file structure and storage.

The most acceptable user interface was evident in the DISOSS system; however, the throughput was poor. A series of binary-tree menus allowed a user to send, receive, and locally store and manipulate files. Little knowledge of file structure was necessary, only the understanding of file types, such as print or clear text or ASCII, Final Format Text (FFT), and Revisable Format Text (RFT). The last two file types were developed by IBM for their word processing environment. It is estimated that transferring a file the size of one DSDD floppy would take somewhere between 1/2 hour and 1 1/2 hours to transfer. Additionally, the transfer rates indicated a time burden imposed by the application software protocols. This also may imply that performance could be affected by parameter adjustments of the operating system host application software.

Both tested solutions performed more quickly while sending, rather than while receiving. Some user intervention was required at certain sites to prevent the file transfer process from failing. This was less than optimal performance for an automated process and biased the test values. It was, however, inconsistent and did not occur at every site, specifically at AMC-HQ for the TSO test and at CSLA for the DISOSS test. The DISOSS test demonstrated that at the lower speed site a PS/PC receive took about 25% longer than a send. The higher speed DISOSS test site test results were higher: PS/PC receive took 50% longer than a send. This doubling was unexpected. It was anticipated that the two processes would remain a near constant difference regardless of speed. It is unknown what part of this is attributable to time delays introduced by necessary user intervention at the higher speed site.

The effective transfer rate for sending a 100KB file using PS/PC at RDAISA was almost three times faster than the similar test at CSLA. This is much smaller than expected based on the large difference in telecommunication line speeds. It is apparent that line traffic and RCC/FEP contention may play a significant part in the DISOSS e-mail performance.

The effective transfer rate for a 500KB file using TSO is estimated at 275 characters per second. This is about 17 times faster than the quickest DISOSS site. These comparisons, while empirically weak by being based on so few observations and operational qualifications, give some indication of the degraded performance experienced with the DISOSS file transfer system.

DOS performed significantly slower when Workstation Program was loaded in memory. To validate this observation a copy of EXTRA! EXTRA! from Attachmate corporation was loaded as the 3270 emulation program instead of Workstation Program. Simple DOS tasks such as CHKDSK, COPY, and CHKDSK were noticeably faster than under the Workstation Program environment. Additionally, the emulation program only took about 200KB less of DOS memory than the Workstation Program.

5.2 HARDWARE AND SOFTWARE ISSUES

The TPC3s proved difficult to use. Several TPC3 malfunctions were observed during the course of testing. Four sites had head crashes with the removable hard disk drive subsystems. The removable cartridges were not always interchangeable with TPC3s at other sites. It helped to wipe the finger oil off the bottom metal plate, let them adjust to room temperature, and never jar or drop them before inserting. Removable cartridges were not logically recognized if substitutions were made in the drive after booting. The power-on self test and boot strap operation (power-up) were lengthy by late 1989 standards for microcomputers, lasting in excess of two minutes. Warm booting via a Crtl-Alt-Del key sequence after encountering problems gave inconsistent results, and a complete power down and power up cold boot was always required. During the test period, IBM performed an engineering modification on all the TPC3s to enhance the system cooling with a more powerful fan and an air dam to route more cool air through the card cage area.

One problem encountered with the TPC3 was particularly difficult to diagnose. If the TPC3 was placed into Caps Lock mode, the Jump key was disabled. When this happened, the user was unable to switch or jump between the terminal mode for the host logon session and the DOS mode for TPC3 local operations. Since the TPC3 keyboard does not have a Caps Lock indicator light, it is difficult to ascertain when the Caps Lock is engaged.

It was determined that, in order to maintain compatibility, application software for the TPC3 must exactly match by version number with other installed software. Whenever one part of this integrated application software system is upgraded, it must carefully take into account the version levels of the operating system, the emulation software, and the PC resident e-mail software. For example, Workstation Program 1.0 will work with DOS version 3.1, 3.2, or 3.3, but not 2.1. This meant an upgrade for the version of DOS originally found on the TPC3s. It is worth noting that Workstation Program version 1.1 will only run with DOS versions 3.3 or 4.0. Since most of the Zenith 248 systems currently run MS-DOS version 3.1 or 3.2, the future software upgrades or enhancements must accept the possibility of upgrading the software system as a whole.

It was discovered during testing at ISC-P that the IBM 3174 RCC must have a configuration bit set to enable file transfer. This is part of the Miscellaneous Feature Option where the File Transfer Aid digit, digit 6, should be set to a value of 1. This does not apply to the Mohawk 9174T RCCs.

The ISC-P staff reported that the PCOX 3270 emulation board did not function properly when tested in the Zenith 248 microcomputer.

5.3 INSTITUTIONAL ISSUES

The term file transfer, as it is used among AMPMOD/AIMNET support staff and user population, has a more complex meaning in normal technical usage. It was evident after interacting with personnel at various technical and managerial levels across the country that the term "file transfer" is given to mean the entire range of microcomputer to mainframe linkages (see Section 3.1.2). The implied meaning goes beyond mere file transfer.

6. RECOMMENDATIONS

- The TSO file transfer solution should be strongly considered as a first step toward enhancing microcomputer to mainframe connectivity. Rates of transfer are acceptable and the software is inexpensive. Different vendors should be tested for a more acceptable user interface.

- Alternatives to the Workstation Program should be critically evaluated for performance, size of program, ease of use, and adaptability to differing PC platforms.

- A suite of file transfer software and emulation card should be identified and tested for the Zenith 248 PCs.

- A priority should be given to system tuning for the DISOSS e-mail system.

- Serious consideration should be given to investigating alternatives to DISOSS and to upgrading AMPMOD BSC to SNA to open other e-mail software opportunities.

- The potential user population has very high expectations and should be educated to the capabilities and restrictions of microcomputer to mainframe interactions in a secure environment.

REFERENCES

1. Computer Technology Research Corporation Staff, 1988, "Inside DEC," technical report, Computer Technology Research Corporation.

2. Computer Technology Research Corporation Staff, 1988, "SNA: An IBM Standard," technical report, Computer Technology Research Corporation.

3. Malamud, Carl, 1989, The Book of DEC Systems & Architectures, McGraw-Hill Publishing Company.

4. Martin, James, and Chapman, Kathleen K., 1987, SNA: IBM's Networking Solution, Prentice Hall.

APPENDIX A - Typical Ampmod Host and Fep Software Configuration

The following information was taken from electronic correspondence dated Mon, 20 Mar 89 14:36:35 EST from Jmckenzi@ALEXANDRIA-EMH4.ARMY.MIL and represents a sample configuration. It should not be construed a definitive or uniform configuration for all AMPMOD systems.

AMP MOD NETWORK MAJOR SOFTWARE

EXECUTIVE SOFTWARE	AMCCOM	AVSCOM
OPERATING SYSTEM 5752-VS2 OS/MVS IBM	RELEASE 3.80 SERVICE LEVEL 84.6	RELEASE 3.8 SERVICE LEVEL 86.01
5735-RC3 RC3 ACF/TCAM IBM	VERSION 2 RELEASE 4	VERSION 2 RELEASE 4
5665-268 ISPF/PDF 5668-960 BASE ISPR IBM	ISPF/PDF	ISPF/PDF
5740-XYS/02 MVS/SP/JES2 IBM	RELEASE 1.3.0	RELEASE 1.3.4 GOING TO 1.3.6
5740-CBI OS/VS COMPILER AND LIBRARY IBM	RELEASE 2.3	RELEASE 2.4
LIBRARIAN ADR	VERSION 3.4A	VERSION 3.1 GOING TO 3.5
5740-AM7 DATA FACILITY/ DEVICE SUPPORT IBM	INSTALLED	INSTALLED
5740-XY4 RESOURCE MANAGEMENT FACILITY (RMF)	CMF BOOLE AND BABBAGE VERSION 2.8	VERSION 2.4.1
ACF2	INSTALLED	NOT INSTALLED
OPTIMIZER III ANSI-75 CAPEX	RELEASE 5.0	RELEASE 5.1
SYNC/SORT	RELEASE 2.5.E	RELEASE 2.5.E

ABEND-AID COMPUWARE	RELEASE 4.1	RELEASE 5.0.3
5740-XX1 CUSTOMER INFO CONTROL SYSTEM (CICS) IBM	RELEASE 1.6.1	RELEASE 1.6.1
FAST DUMP RESTORE (FDR) INN DATA PROC	INSTALLED	INSTALLED
VALU-LIB II (VCI) VALUE COMPUTING	RELEASE B.0.1	CAJARS NOT VALU-LIB RELEASE 5.0
CPK COMPAKTOR INN DATA PROC	INSTALLED	INSTALLED
STAND ALONE RECOVERY (SAR) IBM	INSTALLED	INSTALLED
SYSTEM 2000	RELEASE 11	RELEASE 11

Date: 31 Aug 87 22:55:24-EST (Mon)
Subject: AMP MOD Comten SW List

AMP MOD FRONT END PROCESSOR (FEP) SOFTWARE (Same at all sites except as noted)

SCS63	R5	S-AA01D1	
CLSS1	R2	S-BC01B2	
NSS1	R2	S-DA01B1	
DLC6	R2	S-CA02B2	
EP4	R5	S-EB01E1	
MAF3	R2	S-EG04B1	
SRM1	R2	S-FD01B1	
CNS3	R1	S-??????	(Not on LPSA's 3695)
ACF/NCP2-1	R1	S-FB03A12	

APPENDIX B - Specification Comparison Between the IBM TPC3 and the IBM XT

System information routine for the TPC3:

SI-System Information, Advanced Edition, (C) Copr 1987, 1988, Peter Norton

Computer Name: IBM 3270 PC
Operating System: DOS 3.30
Built-in BIOS dated: Monday, November 8, 1982
Main Processor: Intel 8088 Serial Ports: 1
Co-Processor: None Parallel Ports: 1
Video Display Adapter: Color/Graphics
Current Video Mode: Text, 80 x 25 Color
Available Disk Drives: 4, A: - D:

DOS reports 640 K-bytes of memory:
305 K-bytes used by DOS and resident programs
335 K-bytes available for application programs
A search for active memory finds:
640 K-bytes main memory (at hex 0000-A000)
16 K-bytes display memory (at hex B000-B400)
16 K-bytes display memory (at hex B800-BC00)
4 K-bytes extra memory (at hex CE00-CF00)
ROM-BIOS Extensions are found at hex paragraphs: C000 C800 CA00

Computing Index (CI), relative to IBM/XT: Testing...1.0
Disk Index (DI), relative to IBM/XT: Testing...1.4
Performance Index (PI), relative to IBM/XT: 1.1

System information routine for an IBM XT:

SI-System Information, Advanced Edition, (C) Copr 1987, 1988, Peter Norton

Computer Name: IBM PC
Operating System: DOS 3.20
Built-in BIOS dated: Wednesday, October 27, 1982
Main Processor: Intel 8088 Serial Ports: 2
Co-Processor: None Parallel Ports: 2
Video Display Adapter: Monochrome (MDA)
Current Video Mode: Text, 80 x 25 Monochrome
Available Disk Drives: 3, A: - C:

DOS reports 640 K-bytes of memory:
57 K-bytes used by DOS and resident programs
583 K-bytes available for application programs
A search for active memory finds:
640 K-bytes main memory (at hex 0000-A000)
32 K-bytes display memory (at hex B000-B800)
ROM-BIOS Extensions are found at hex paragraphs: C800

Computing Index (CI), relative to IBM/XT: Testing...1.0
Disk Index (DI), relative to IBM/XT: Testing...1.1
Performance Index (PI), relative to IBM/XT: 1.0

APPENDIX C - TPC3 Configurations for DISOSS Testing

SOFTWARE CONFIGURATION OF TPC3 USED FOR DISOSS TESTING

This appendix contains listings of files and file structure for DOS as well as the default configurations for Workstation Program and PS/PC. This configuration was specifically designed for the TPC3 and used during the testing conducted for this study.

The following files were used to start up the TPC3 to interact with DISOSS on AIMNET. When the TPC3 was powered on the system automatically loaded the operating system (DOS), Workstation Program, and PS/PC. After depressing the Jump key a user was at the main menu screen of PS/PC. The DOS 3.3 convention of using the CALL statement of the DOS batch facility was employed. This allowed modularization of the startup code for debugging purposes. Both the C: drive and the D: drive 5 MB removable data cartridges were bootable and were configured for autonomous operation. Both sets of startup files are listed in this appendix.

CONFIG.SYS FILE FOR THE TPC3 C: DRIVE

```
files=40
buffers=24
break=off
device=\dos\ansi.sys
lastdrive=d
stacks=9,128
```

AUTOEXEC.BAT FILE FOR THE TPC3 C: DRIVE

```
@ECHO OFF

@rem   AUTOEXEC.BAT
@rem   REVISION 2.0   Wednesday, January 13, 1988 by Kerry Hake, ORNL
@rem   This is the automatically executed batch file used for AIMS.
@rem      It calls nested batch files to perform initial program
@rem      loading and establish DOS environment characteristics.

@rem   Run the Workstation Program

 CALL WSPROG

@rem   Set the DOS environment defaults

 CALL STARTUP

@rem   Run the Personal Services/Personal Computer (PS/PC) software

 CALL PSPC

 D:
 CD\PSPC.DOC
 BREAK=ON
```

STARTUP.BAT FILE FOR THE TPC3 C: DRIVE

```
@ECHO OFF

@rem   STARTUP.BAT
@rem   REVISION 2.0   Wednesday, January 13, 1988 by Kerry Hake, ORNL
@rem   This batch file is called by the AIMS AUTOEXEC.BAT file to set
@rem      the DOS environment parameters.  It also may be used to
@rem      set the DOS environment after booting from a diskette.

@rem   Transfer time and date to PC operating system

 CD\
 READTIME > NUL:
 SETTIME > NUL:

@rem   Memory resident secure file erase

 SERASFIL

@rem   Set the PC DOS environment including:
@rem      COMSPEC  for the location of the COMMAND.COM file
@rem      PROMPT   to display the current disk and directory
@rem      PATH     to find Workstation Program and PS/PC
@rem      FASTOPEN to allow quick recall of commonly used files
@rem      VERIFY   to check the disk media before writing

 SET COMSPEC=C:\COMMAND.COM
 PROMPT $P$G
 PATH C:\DOS;C:\;C:\WORKSTAT;C:\UTILITY;C:\PSPC.SYS
 FASTOPEN C:=150 D:=50
 VERIFY ON

@rem   Keyboard command (Patch from FDS?)

rem INDKEYAN

@rem   The following command does NOT currently work for color (5-7-87)
@rem      Enable the contents of the color graphics display to be
@rem      to be printed on the color printer (cyan, magenta, yellow,
@rem      black ribbon is required for this).  Please note that
@rem      black on the monitor will be white (or not printed) on the
@rem      printer and the background color will not be printed.

rem GRAPHICS COLOR8

@rem   Establish a printer buffer for PC DOS that is 4 KB size and
@rem      allows 16 files to be queued for printing

rem PRINT /D:PRN /B:4096 /Q:16 > NUL:

@rem   Set default to D drive and PS/PC document directory

 D:
 CD\PSPC.DOC
 CLS
```

WSPROG.BAT FILE FOR THE TPC3 C: DRIVE

```
@rem ECHO OFF

@rem   WSPROG.BAT
@rem   REVISION 2.0   Wednesday, January 13, 1988 by Kerry Hake, ORNL
@rem   This batch file is called by the AIMS AUTOEXEC.BAT file to
@rem     run the Workstation Program.

@rem   Load Workstation Program into memory

 CD\WORKSTAT
 INDCIPL
 CD\

@rem   Restore saved workstation screen & autokey setups

@rem CD\WORKSTAT
@rem INDRSTR
```

PSPC.BAT FILE FOR THE TPC3 C: DRIVE

```
@ECHO OFF

@rem   PSPC.BAT
@rem   REVISION 2.0   Wednesday, January 13, 1988 by Kerry Hake, ORNL
@rem   This batch file is called by the AIMS AUTOEXEC.BAT file to
@rem     startup the Personal Services/Personal Computer (PS/PC)
@rem     application software.

 C:
 CD\PSPC.SYS
 PSPCMAIN.EXE
 D:
 CD\PSPC.DOC
```

CONFIG.SYS FILE FOR THE TPC3 D: DRIVE

```
files=40
buffers=24
break=off
device=\dos\ansi.sys
lastdrive=d
stacks=9,128
```

AUTOEXEC.BAT FILE FOR THE TPC3 D: DRIVE

```
@ECHO OFF

@rem  AUTOEXEC.BAT  (For the D cartridge when used as the C drive)
@rem  REVISION 2.0  Wednesday, January 13, 1988 by Kerry Hake, ORNL
@rem  This is the automatically executed batch file used for AIMS.
@rem    It calls nested batch files to perform initial program
@rem    loading and establish DOS environment characteristics.

@rem  Run the Workstation Program

rem CALL WSPROG

@rem  Set the DOS environment defaults

 CALL STARTUP

@rem  Run the Personal Services/Personal Computer (PS/PC) software

rem CALL PSPC

rem D:
rem CD\PSPC.DOC
rem BREAK=ON
```

STARTUP.BAT FILE FOR THE TPC3 C: DRIVE

```
@ECHO OFF

@rem  STARTUP.BAT  (For the D cartridge when used as the C drive)
@rem  REVISION 2.0  Wednesday, January 13, 1988 by Kerry Hake, ORNL
@rem  This batch file is called by the AIMS AUTOEXEC.BAT file to set
@rem    the DOS environment parameters.  It also may be used to
@rem    set the DOS environment after booting from a diskette.

@rem  Transfer time and date to PC operating system

 CD\
 READTIME > NUL:
 SETTIME > NUL:

@rem  Memory resident secure file erase

 SERASFIL

@rem  Set the PC DOS environment including:
@rem    COMSPEC  for the location of the COMMAND.COM file
@rem    PROMPT   to display the current disk and directory
@rem    PATH     to find Workstation Program and PS/PC
@rem    FASTOPEN to allow quick recall of commonly used files
@rem    VERIFY   to check the disk media before writing
```

```
SET COMSPEC=C:\COMMAND.COM
PROMPT $P$G
FASTOPEN C:=150 D:=50
PATH C:\DOS;C:\
VERIFY ON

@rem   Keyboard command (Patch from FDS?)

rem INDKEYAN

@rem   The following command does NOT currently work for color (5-7-87)
@rem     Enable the contents of the color graphics display to be
@rem     to be printed on the color printer (cyan, magenta, yellow,
@rem     black ribbon is required for this).  Please note that
@rem     black on the monitor will be white (or not printed) on the
@rem     printer and the background color will not be printed.

rem GRAPHICS COLOR8

@rem   Establish a printer buffer for PC DOS that is 4 KB size and
@rem     allows 16 files to be queued for printing

rem PRINT /D:PRN /B:4096 /Q:16 > NUL:

@rem   Set default to D drive and PS/PC document directory

rem D:
rem CD\PSPC.DOC
rem CLS
```

The following listing represents the DOS file structure used for the TPC3.

DIRECTORY TREE FOR THE TPC3 C: DRIVE

```
├─ DOS
├─ MEMORY
├─ PSPC.DOC
├─ PSPC.M
├─ PSPC.SYS
├─ PSPC.TUT
├─ UTILITY
└─ WORKSTAT
```

FILE ATTRIBUTES FOR THE TPC3 C: DRIVE

FA-File Attributes, Version 3.10, (C) Copr 1984-86, Peter Norton

```
C:\
  Hidden System Read-only Archive  IBMBIO.COM
  Hidden System Read-only Archive  IBMDOS.COM
            Read-only Archive  AUTOEXEC.BAT
                   Archive  COMMAND.COM
            Read-only Archive  CONFIG.SYS
                   Archive  INDKEYAN.COM
            Read-only Archive  PSPC.BAT
                   Archive  READTIME.COM
                   Archive  SERASFIL.COM
                   Archive  SERASHF.COM
                   Archive  SERASMEM.COM
                   Archive  SETTIME.COM
            Read-only Archive  STARTUP.BAT
            Read-only Archive  WSPROG.BAT
```

All other files have Archive attribute only.

FILES AND FILE SIZED FOR THE TPC3 C: DRIVE

FS-File Size, Version 3.10, (C) Copr 1984-86, Peter Norton

```
C:\
    22,100 IBMBIO.COM
    30,159 IBMDOS.COM
       545 AUTOEXEC.BAT
    25,307 COMMAND.COM
        83 CONFIG.SYS
     2,528 INDKEYAN.COM
       327 PSPC.BAT
       706 READTIME.COM
     2,423 SERASFIL.COM
    11,712 SERASHF.COM
     1,181 SERASMEM.COM
```

```
    743 SETTIME.COM
  1,702 STARTUP.BAT
    390 WSPROG.BAT

 99,906 total bytes in 14 files in C:\
139,264 bytes disk space occupied, 28% slack

C:\DOS
 17,089 4201.CPI
    459 5202.CPI
  1,678 ANSI.SYS
  5,825 APPEND.EXE
  1,561 ASSIGN.COM
  9,529 ATTRIB.EXE
 31,913 BACKUP.COM
  1,063 BASIC.COM
    369 BASIC.PIF
 36,403 BASICA.COM
    369 BASICA.PIF
  9,850 CHKDSK.COM
 25,307 COMMAND.COM
  4,214 COMP.COM
 11,285 COUNTRY.SYS
 15,897 DEBUG.COM
  5,879 DISKCOMP.COM
  6,295 DISKCOPY.COM
 11,290 DISPLAY.SYS
  1,196 DRIVER.SYS
  7,526 EDLIN.COM
 49,065 EGA.CPI
  3,919 FASTOPEN.EXE
 48,216 FDISK.COM
  6,434 FIND.EXE
 11,616 FORMAT.COM
  6,128 GRAFTABL.COM
  3,300 GRAPHICS.COM
  8,969 JOIN.EXE
  9,056 KEYB.COM
 19,766 KEYBOARD.SYS
  2,377 LABEL.COM
 10,752 LCD.CPI
 15,487 MODE.COM
    313 MORE.COM
  6,251 MORTGAGE.BAS
  3,060 NLSFUNC.EXE
  9,026 PRINT.COM
 13,590 PRINTER.SYS
  4,299 RECOVER.COM
 11,775 REPLACE.EXE
 34,643 RESTORE.COM
  4,163 SELECT.COM
  8,608 SHARE.EXE
  1,977 SORT.EXE
  9,909 SUBST.EXE
```

```
   4,766 SYS.COM
   3,571 TREE.COM
   3,455 VDISK.SYS
  11,247 XCOPY.EXE

 530,735 total bytes in 50 files in C:\DOS
 634,880 bytes disk space occupied, 16% slack

C:\MEMORY
 190,619 PSPCSWAP.MEM

 192,512 bytes disk space occupied, 1% slack

C:\PSPC.DOC
   2,078 PSPCSAMP.PRT

   4,096 bytes disk space occupied, 49% slack

C:\PSPC.M
   4,224 PSPCFIND.PDA
     144 PSPCFIND.PIX
   4,928 PSPCITEM.PDA
     162 PSPCKEY.PIX

   9,458 total bytes in 4 files in C:\PSPC.M
  24,576 bytes disk space occupied, 62% slack

C:\PSPC.SYS
     963 PSPC-001.PAN
   1,654 PSPC-100.PAN
   6,725 PSPC-101.PAN
   6,386 PSPC-102.PAN
   6,791 PSPC-103.PAN
   6,146 PSPC-104.PAN
   4,534 PSPC-105.PAN
   5,370 PSPC-106.PAN
   4,930 PSPC-107.PAN
   5,565 PSPC-108.PAN
   5,375 PSPC-109.PAN
   5,656 PSPC-110.PAN
   6,411 PSPC-111.PAN
   5,334 PSPC-112.PAN
   5,717 PSPC-113.PAN
   4,728 PSPC-114.PAN
   6,573 PSPC-115.PAN
   4,049 PSPC-116.PAN
   6,918 PSPC-117.PAN
   3,288 PSPC-118.PAN
   5,317 PSPC-119.PAN
   6,847 PSPC-201.PAN
   7,028 PSPC-202.PAN
   6,460 PSPC-203.PAN
   7,035 PSPC-204.PAN
   7,283 PSPC-205.PAN
```

```
     6,655 PSPC-206.PAN
     6,989 PSPC-207.PAN
     7,449 PSPC-208.PAN
         3 PSPCADBK.PAB
       754 PSPCERR.LOG
         3 PSPCLDIS.PDL
   319,040 PSPCMAIN.EXE
     2,632 PSPCMSGF.PMG
    52,784 PSPCNOTE.EXE
    31,093 PSPCNPMP.DEF
     1,693 PSPCPROF.PRO
       327 PSPCRUN.BAT
        16 PSPCSAVE.PRO
       644 PSPCTAG.IDX
     4,866 PSPCTBLS.TBL

   578,031 total bytes in 41 files in C:\PSPC.SYS
   667,648 bytes disk space occupied, 13% slack

C:\PSPC.TUT
     4,068 LESSON00.SCN
     6,337 LESSON01.SCN
     5,398 LESSON02.SCN
     6,411 LESSON03.SCN
     6,006 LESSON04.SCN
     7,770 LESSON10.SCN
     4,614 LESSON11.SCN
     4,562 LESSON20.SCN
     4,569 LESSON21.SCN
     6,195 LESSON22.SCN
     3,940 LESSON30.SCN
     4,439 LESSON31.SCN
     4,686 LESSON32.SCN
     5,777 LESSON33.SCN
     3,933 LESSON40.SCN
     3,225 LESSON41.SCN
     6,681 LESSON42.SCN
     7,009 LESSON43.SCN
     3,933 LESSON50.SCN
     6,821 LESSON51.SCN
     6,949 LESSON52.SCN
     7,459 LESSON53.SCN
     3,720 LESSON60.SCN
     5,756 LESSON61.SCN
     6,625 LESSON62.SCN
     3,020 LESSON63.SCN
     4,107 LESSON64.SCN
     3,252 LESSON65.SCN
     3,765 LESSON70.SCN
     3,607 LESSON71.SCN
     3,530 LESSON72.SCN
     4,662 LESSON73.SCN
     5,155 LESSON74.SCN
     6,483 LESSON75.SCN
```

```
 5,160 LESSON80.SCN
 5,117 LESSON81.SCN
 4,915 LESSON82.SCN
 4,670 LESSON90.SCN
 4,347 LESSON91.SCN
 5,596 LESSON92.SCN
 7,555 LESSON93.SCN
 7,061 LESSON94.SCN
 2,013 LESSONXX.SCN
74,432 PSPCTUT.EXE
   210 PSPCTUT.PMG
   256 PSPCTUT.TBL

295,796 total bytes in 46 files in C:\PSPC.TUT
389,120 bytes disk space occupied, 24% slack
```

C:\UTILITY

Files included in this directory are up to the discretion of the individual facility and will vary. A large number of files roughly the size of two DSDD floppy disks were included to simulate a fully loaded file system.

```
770,263 total bytes in 191 files in C:\UTILITY
1,236,992 bytes disk space occupied, 38% slack
```

C:\WORKSTAT

```
   720 3270PC.PIF
     8 AUTOEXEC.BAT
     9 CONFIG.SYS
77,824 IDELTCAN.EXE
86,528 IDELTCAS.EXE
   400 INDAUTUS.BAT
 6,673 INDCFIG.DAT
66,048 INDCFIG.EXE
 2,614 INDCFIG.FIL
14,848 INDCIPL.EXE
   256 INDCPYRT.DAT
 4,608 INDDENV.COM
11,264 INDDISP.COM
11,904 INDEML.COM
    71 INDIBM1.SIF
    80 INDIBM2.SIF
 4,736 INDIDP.COM
11,264 INDMERGE.COM
12,672 INDPATCH.COM
 2,304 INDPREP.COM
   512 INDQPCH.DAT
24,576 INDRCTAB.COM
78,336 INDRKDU.EXE
 9,344 INDRSTR.COM
 6,144 INDSAOM.COM
 8,704 INDSAVE.COM
    80 INDSAVE.REC
   240 INDSAVE.SCR
 8,192 INDSCOM.COM
11,392 INDSCPM.COM
```

```
20,096 INDSDCM.COM
52,736 INDSDOM.COM
11,520 INDSDRW.COM
12,160 INDSEHM.COM
   417 INDSFILS.FIL
11,648 INDSFOMB.COM
10,240 INDSFOMC.COM
 6,144 INDSKTM.COM
 9,216 INDSKTMC.COM
 8,448 INDSKTMD.COM
 1,846 INDSLABS.DAT
 6,400 INDSNOMB.COM
36,480 INDSNUM.COM
23,680 INDSPCMB.COM
25,216 INDSPCMC.COM
14,336 INDSPIF.COM
14,848 INDSPLIT.COM
 5,376 INDSPRMB.COM
 6,016 INDSPRMI.COM
17,280 INDSROM.COM
20,352 INDSROMC.COM
19,584 INDSROMD.COM
 6,528 INDSSEM.COM
38,912 INDSWOM.COM
13,696 INDSXRT.COM
22,272 INDTABL.COM
22,272 INDTABN.COM
 1,367 NOV2.DAT
 9,344 RECEIVE.COM
 9,216 SEND.COM
    69 TESTNOV.DAT
 1,920 TRACE.COM
18,304 TRANSFER.COM
 1,498 UTILCOPY.BAT
 5,760 UUCCPRB.H
   390 UUCINIT.OBJ
   524 UUCSENDR.OBJ
 4,581 UUMCPRB.INC
36,049 UUMINFAC.MAC
 4,514 UUPCPRB.INC
   794 UUPINIT.OBJ
 1,715 UUPPROCS.INC
   400 UUPSENDR.OBJ
 7,360 XMA2EMS.SYS
 1,760 XMA2VDK.SYS

1,005,635 total bytes in 75 files in C:\WORKSTAT
1,183,744 bytes disk space occupied, 15% slack

Total of all files found
3,482,521 total bytes in 423 files
4,472,832 bytes disk space occupied, 22% slack
```

DIRECTORY TREE FOR THE TPC3 D: DRIVE

```
┬─ DOS
├─ PSPC.DOC
├─ PSPC.M
└─ TUTORIAL
```

FILE ATTRIBUTES FOR THE TPC3 D: DRIVE

FA-File Attributes, Version 3.10, (C) Copr 1984-86, Peter Norton

```
D:\
  Hidden System Read-only Archive  IBMBIO.COM
  Hidden System Read-only Archive  IBMDOS.COM
            Read-only Archive  AUTOEXEC.BAT
                   Archive  COMMAND.COM
            Read-only Archive  CONFIG.SYS
                   Archive  INDKEYAN.COM
                   Archive  READTIME.COM
                   Archive  SERASFIL.COM
                   Archive  SERASHF.COM
                   Archive  SERASMEM.COM
                   Archive  SETTIME.COM
            Read-only Archive  STARTUP.BAT
```

All other files have Archive attribute only.

FILES AND FILE SIZED FOR THE TPC3 D: DRIVE

FS-File Size, Version 3.10, (C) Copr 1984-86, Peter Norton

```
D:\
    22,100 IBMBIO.COM
    30,159 IBMDOS.COM
       607 AUTOEXEC.BAT
    25,307 COMMAND.COM
        83 CONFIG.SYS
     2,528 INDKEYAN.COM
       706 READTIME.COM
     2,423 SERASFIL.COM
    11,712 SERASHF.COM
     1,181 SERASMEM.COM
       743 SETTIME.COM
     1,724 STARTUP.BAT

    99,273 total bytes in 12 files in D:\
   131,072 bytes disk space occupied, 24% slack
```

```
D:\DOS
    17,089 4201.CPI
       459 5202.CPI
     1,678 ANSI.SYS
     5,825 APPEND.EXE
     1,561 ASSIGN.COM
     9,529 ATTRIB.EXE
    31,913 BACKUP.COM
     1,063 BASIC.COM
       369 BASIC.PIF
    36,403 BASICA.COM
       369 BASICA.PIF
     9,850 CHKDSK.COM
    25,307 COMMAND.COM
     4,214 COMP.COM
    11,285 COUNTRY.SYS
    15,897 DEBUG.COM
     5,879 DISKCOMP.COM
     6,295 DISKCOPY.COM
    11,290 DISPLAY.SYS
     1,196 DRIVER.SYS
     7,526 EDLIN.COM
    49,065 EGA.CPI
     3,919 FASTOPEN.EXE
    48,216 FDISK.COM
     6,434 FIND.EXE
    11,616 FORMAT.COM
     6,128 GRAFTABL.COM
     3,300 GRAPHICS.COM
     8,969 JOIN.EXE
     9,056 KEYB.COM
    19,766 KEYBOARD.SYS
     2,377 LABEL.COM
    10,752 LCD.CPI
    15,487 MODE.COM
       313 MORE.COM
     6,251 MORTGAGE.BAS
     3,060 NLSFUNC.EXE
     9,026 PRINT.COM
    13,590 PRINTER.SYS
     4,299 RECOVER.COM
    11,775 REPLACE.EXE
    34,643 RESTORE.COM
     4,163 SELECT.COM
     8,608 SHARE.EXE
     1,977 SORT.EXE
     9,909 SUBST.EXE
     4,766 SYS.COM
     3,571 TREE.COM
     3,455 VDISK.SYS
    11,247 XCOPY.EXE

   530,735 total bytes in 50 files in D:\DOS
   634,880 bytes disk space occupied, 16% slack
```

```
D:\PSPC.DOC
     2,078 PSPCSAMP.PRT

     4,096 bytes disk space occupied, 49% slack

D:\PSPC.M
     4,224 PSPCFIND.PDA
       144 PSPCFIND.PIX
     5,376 PSPCITEM.PDA
       198 PSPCKEY.PIX

     9,942 total bytes in 4 files in D:\PSPC.M
    24,576 bytes disk space occupied, 60% slack

D:\TUTORIAL
    25,600 HELPER.EXE
       369 HELPER.PIF
   227,840 TUTDATAB.BIN
     1,408 TUTINDEX.BIN

   255,217 total bytes in 4 files in D:\TUTORIAL
   266,240 bytes disk space occupied, 4% slack

Total of all files found
   897,245 total bytes in 71 files
 1,060,864 bytes disk space occupied, 15% slack
```

APPENDIX D - Test Procedure for DISOSS Testing with the TPC3

I. STARTUP AND SETUP

a. Turn key to cold boot the TPC3 system
b. Wait for the List of Allowable Applications screen
c. Press Jump key
d. Wait for PS/PC Main Tasks screen (panel)
e. Put file transfer diskette in A drive and close the drive door
f. Select #7, User Defaults, from Main Tasks panel
g. Select #2, Personal, from User Defaults panel
h. Enter your name in the highlighted, User's Name, field
i. Tab to next field and enter your AIMNET User ID
j. Press Enter key
k. Press PF8 key

II. LOGON AND RECEIVE ALL PENDING MAIL

a. Select #1, Receive, from Main Tasks panel
b. Select #1, Host, from Receive panel
c. When Manual Logon panel appears press the Jump key
d. Enter /PTG or appropriate allowable application for AIMNET
e. Wait for AMSNET screen
f. Type AIMNET and press Enter key
g. Wait for CICS screen
h. Press Clear key
i. Enter CSSN XXXX and press Enter key (XXXX is you AIMNET user ID)
(NOTE: Be sure to use UPPER CASE for CSSN)
j. When AIMNET logon screen appears enter you password and press Enter key
k. When one line of successful logon appears press the Jump key
l. Press the Enter key
m. Wait for Receive Mail panel to appear
n. Press PF8 key

III. CLEAN FILE CABINET

a. Select #5, File Cabinet, from Main Tasks panel
b. Select #1, Review, from File Cabinet panel
c. Tab to select a file cabinet entry
d. Select #8, Delete, from action menu
e. Tab to BOTH in Pop-up window and press Enter key
f. Repeat this section until the only file remaining is: PSPCSAMP
g. Press PF8 key

IV. SEND MAXIMUM MESSAGE

a. Select #2, Send, from Main Tasks panel
b. Select #2, Message, from Send panel
c. Hold down the z key until all four message lines are full on the Message panel
d. Press the Enter key
e. Select #1, Add/Change, from the Address Host Mail panel
f. Enter your AIMNET user ID in the Send to field
g. Tab to next field and enter DSVHOST
h. Press the Enter key
i. Select #2, Send, from the Address Host Mail panel
j. Wait for "Send Completed" message
k. Press PF8 key
l. Select #1, Receive, from Main Tasks panel
m. Select #1, Host, from Receive panel
n. Wait for Receive Mail panel to appear
o. Press PF8 key

V. SEND AND RECEIVE A SERIES OF FILES FROM FILE TRANSFER DISKETTE

a. Select #2, Send, from Main Tasks panel
b. Select #1, Document, from Send panel
c. The Send Document panel should now be displayed
d. Enter in the first field, PC Filename, the name of the file to be sent from the diskette. The first file is: ASCIIOUT.DAT
e. Tab to 2nd field, Doctype, and enter PVT
f. Tab to 3rd field, Drive/Path, and enter A:
g. Press Enter key
h. Select #1, Add/Change, from the Address Host Mail panel
i. Enter your AIMNET user ID in the Send to field
j Tab to next field and enter DSVHOST
k. Press the Enter key
l. Select #2, Send, from the Address Host Mail panel
m. Wait for Send Completed message
n. Press PF8 key
o. Select #1, Receive, from Main Tasks panel
p. Select #1, Host, from Receive panel
q. Wait for Receive Mail panel to appear
r. Press PF8 key
s. Repeat this Section V. for each of the other 7 files:

FILE.001
FILE.005
FILE.010
FILE.015
FILE.020
FILE.060
FILE.100

VI. SAVE 1ST ROUND OF FILE TRANSFER FILES TO A BLANK DISKETTE

(This section copies the results of the first series of 8 file transfers and is intended to be performed only once)

a. Press PF7 key
b. Open floppy drive door and remove file transfer diskette
c. Insert blank formatted diskette in floppy drive and close door
d. Type D: and press Enter
f. Type XCOPY *.* A: and press Enter
g. Wait until you see the prompt: D:\PSPC.DOC>
h. Open floppy drive door and remove diskette
i. Insert file transfer diskette in floppy drive and close door
j. Type EXIT and press Enter
k. Press PF8 key

VII. CLEAN UP FILE CABINET

a. Select #5, File Cabinet, from Main Tasks panel
b Select #1, Review, from File Cabinet panel
c. Tab to select a file cabinet entry
d Select #8, Delete, from action menu
e. Tab to BOTH in Pop-up window and press Enter key
f. Repeat this section until the only file remaining is: PSPCSAMP
g. Press PF8 key

VIII. LOGOFF AND SHUTDOWN

a. Press the PF9, Disconnect, key
b. Wait for the "Logged off"? message
c. Select #7, User Defaults, from Main Tasks panel
d. Select #2, Personal, from User Defaults panel
e. Type XXXX in the highlighted, User's Name, field
f. Tab to next field and type XXXX
g. Press Enter key
h. Press PF8 key

INTERNAL DISTRIBUTION

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