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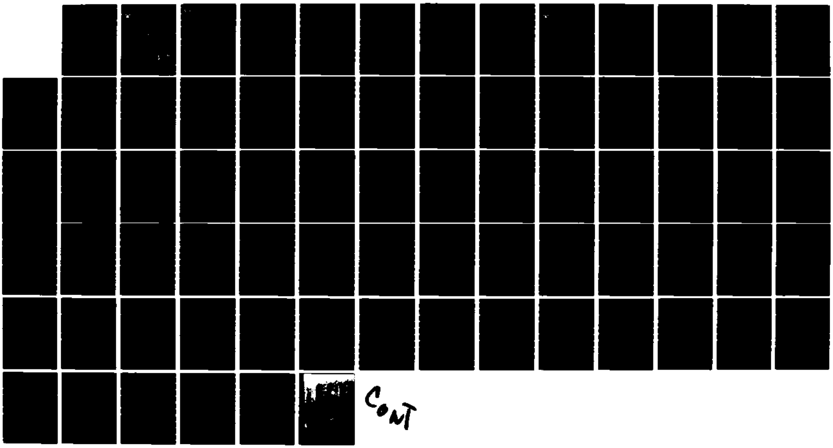

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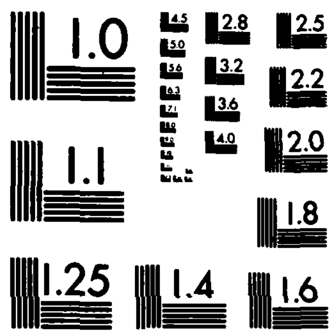

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DEFENSE COMMUNICATIONS AGENCY

AD A132877

DEFENSE DATA NETWORK SUBSCRIBER INTERFACE GUIDE

JULY 1983

DDN

DEFENSE COMMUNICATIONS AGENCY
DEFENSE COMMUNICATIONS SYSTEM ORGANIZATION
WASHINGTON, D.C. 20305

23 AUG 1983

IN REPLY
REFER TO: B615

TO: Distribution

SUBJECT: Defense Data Network (DDN) Subscriber Interface Guide

1. The Services and Agencies are responsible for interfacing their ADP host systems and terminals to the DDN. It is the intent of the DDN/PMO to support subscribers throughout the entire process of integrating systems to the DDN. The User Requirements and Integration personnel are currently working with respective elements of the Services and Agencies to assist in these efforts. The Subscriber Interface Guide (enclosure 1) has been prepared to:

a. Describe the methods of interconnection that are available to DDN subscribers and the strategies to obtain these interfaces.

b. Describe the communications technology used by the DDN and provide a summary of the services offered by the network, as well as the protocols that support these services.

c. Assist subscribers in the selection and acquisition of interfaces for connecting host and terminals to the DDN.

2. Appendix A of the Guide is a detailed interface specification which was prepared for Service/Agency acquisition and procurement activities to include in Request for Proposals (RFPs) that require DDN interfaces. In order to make copies available of the numerous specifications and reference documents the DDN/PMO intends to establish a repository of DDN documents at the Defense Technical Information Center (DTIC), Cameron Station, Alexandria, Virginia. Other specifications and standards are available from various documentation centers indicated in enclosure 2.

3. Additional copies and distribution of the guide can be obtained by contacting the User Requirements and Integration Branch (B615) Defense Data Network Program Management Office.

FOR THE DIRECTOR:

2 Enclosure a/s

HEIDI B. HEIDEN
Colonel, USA
Program Manager
Defense Data Network

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FIPS/ CCITT	National Technical Information Service (NTIS) U.S. Department of Commerce 5285 Port Royal Road Springfield, VA 22161 (703-487-4600--General Information (703-487-4650--Sales)
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ANSI	American National Standards Institute 1430 Boradway New york, NY 10018
EIA	Electronic Industries Association Engineering Department 2001 Eye Street, N.W. Washington, D.C. 20006
DTIC	Defense Technical Information Center Cameron Station Alexandria, VA 22314

DEFENSE COMMUNICATIONS AGENCY

DEFENSE DATA NETWORK SUBSCRIBER INTERFACE GUIDE

JULY 1983

Prepared by The MITRE Corporation

DDN

ABSTRACT

Subscribers of the Defense Data Network (DDN) will be responsible for interfacing their host systems and terminals to the network. This Guide describes the methods of interconnection that are available to DDN subscribers and the strategies to obtain these interfaces. The Guide also describes the communications tethnology used by the DDN and provides a summary of the services offered by the network as well as the protocols that support these services. Appendix A is a detailed interface specification which could be included in subscriber interface acquisition packages.

ACKNOWLEDGEMENTS

This Guide was prepared by The MITRE Corporation, with assistance from Network Strategies Incorporated, for the Defense Data Network Program Management Office of the Defense Communications Agency under Contract Number F19628-82-C-0001.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES

1.0 INTRODUCTION

All currently operational and planned automatic data processing systems and data networks of the Department of Defense (DoD) that require long-haul and area data communications support are slated to become subscribers to the Defense Data Network (DDN) as required by the Office of the Secretary of Defense[1]. The term "subscriber" refers not only to systems but also to those individuals with the managerial and technical responsibilities for the systems. Since the advent of the DDN, this group of action officers, managers, and systems analysts has been faced with the issue of how to connect their systems to the DDN. This Guide has been prepared to assist these decision-makers.

The Guide will explain the available alternatives for connecting systems to the DDN and the rationale for choosing among them. The selection options are based upon the communication requirements of the subscriber and the interfacing methods that will support these requirements.

The Guide is organized to facilitate the decision-making process. The reader is introduced to the DDN in Sections 2 and 3 with a subscriber's perspective of its services and protocol architecture. With this foundation, the reader can proceed to Section 4 for a discussion of interfacing strategies and to Section 5 for a summary of how to acquire these interfaces. Section 6 provides a summary of the information presented in the Guide. Finally, Appendix A provides a detailed interface specification that could be included in subscriber interface acquisition packages.

Further information can be obtained by directly contacting the DDN Program Management Office (PMO) of the Defense Communications Agency (DCA). The DDN PMO has published an information brochure that discusses the entire DDN program.

2.0 DDN COMMUNICATION CONCEPTS

DoD data communication requirements are expanding rapidly. The purpose of the DDN is to meet these requirements. Packet switching technology developed for the Advanced Research Projects Agency Network (ARPANET) enables the DDN to achieve this purpose with a high degree of economy and performance. Over the past decade, the ARPANET has provided a research and development environment for state-of-the-art techniques in data communications. The DDN is a direct beneficiary of the ARPANET accomplishments. The DDN is employing ARPANET technology and in fact is subsuming a major portion of the existing ARPANET as well as other military networks that use ARPANET technology.

The communications services that the ARPANET has been providing since the late sixties are significant because they enable computer systems from different vendors with different operating systems to exchange data. The data can be files, programs, or electronic mail. This type of communication is known as heterogeneous host-to-host communication. The vehicle for providing heterogeneous host-to-host communication is a layered protocol architecture. Vendor-specific protocol architectures such as Digital Equipment Corporation's DECNET and IBM's SNA provide similar services for a particular vendor's product line, or homogeneous communication.

The advantage offered to DDN subscribers by a protocol architecture that supports heterogeneous communication is significant; a very diverse group of users and their software systems can interoperate. Such interoperability ensures that critical DoD systems will be able to communicate with one another in the future, even if the requirement to do so is not now anticipated.

Recently, after years of design, implementation, and testing funded by the Defense Advanced Research Projects Agency, the ARPANET protocol hierarchy was enhanced. The enhancements broadened the scope of the architecture to include multiple interconnected networks. In extending the architecture to span network boundaries, no assumptions were made about the underlying communications technology of each individual network. This permits subscribers with networks using different technologies, such as local area networks, to interoperate with ARPANET subscribers. Successful interoperation of many different types of networks has been demonstrated, and the architecture has been operational since 1 January 1983.

The DDN is using this protocol architecture for its DoD subscribers. The enhancements are embodied in the Transmission Control Protocol (TCP) and the Internet Protocol (IP), which are DoD standards. As DoD standards, these protocols form the basis for ongoing security research and development efforts which, over time, will be incorporated into the DDN without impacting subscribers.

The DDN protocol suite provides a set of interoperable subscriber services. In the research community, all subscribers implemented the complete protocol suite; therefore, all ARPANET subscribers could communicate with all other ARPANET subscribers. Since the DDN subscriber community is vast, with an accompanying set of unique requirements, waiver procedures have been established to permit subscribers to utilize the DDN even though they may not have implemented all the required DoD standard protocols at connection time. However, it is incumbent on all subscribers (and also to their benefit) to implement the full DDN protocol suite in a timely manner.

Over the short term, subscribers may use the DDN as a "wire-replacement" for existing hard-wired or leased-line connections. The DDN is funding a hardware and software development that will allow computer systems to access the DDN using the X.25 international protocol standard. Thus, subscribers will be able to preserve their existing investments in applications specifically dependent on X.25

and to use the DDN as a wire-replacement while they are developing implementations of the DDN protocol suite.

X.25 is only the base network access component of a yet to be developed international protocol suite. It will be many years before a full international protocol suite is adopted. The DDN X.25 development facilitates a dual implementation strategy - the DDN suite on one hand and vendor-specific protocols on the other, both sitting atop X.25 - that will allow a graceful evolution when the international protocols mature. However, it is important to note that security requirements may prevent certain communities from making this transition.

3.0 DDN SERVICES AND PROTOCOLS

Subscribers are responsible for selecting interfaces to the DDN. In order to make their selections, they need to understand the services offered by the DDN and the relationship between the DDN services and the DDN protocols.

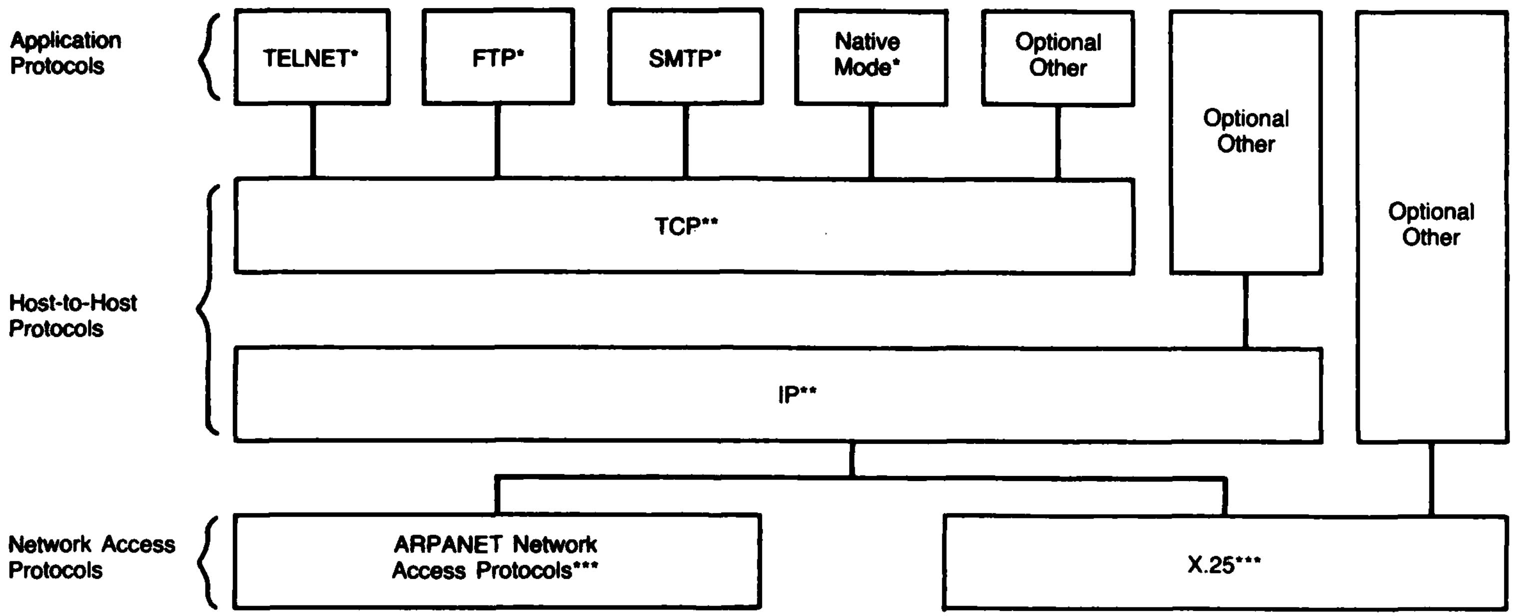
The DDN protocols, as illustrated in Figure 1, are organized into a hierarchical architecture. The protocols at each level of the hierarchy provide certain services to higher level protocols or to users, and utilize the services provided by lower level protocols. At the top of the hierarchy are the application protocols, which support specific user requirements. Beneath the application protocols are TCP and IP, which together provide a reliable data communication service between processes in hosts on the DDN or on other TCP/IP networks connected to the DDN. A host is a subscriber computer system or other computing device such as a TAC or mini-TAC, which are described in Section 4 of this Guide. At the bottom of the hierarchy are two sets of network access protocols, the ARPANET network access protocols and X.25, which comprise the two host-to-network interfaces that are supported by the DDN.

The application, host-to-host, and network access protocols and their associated services are described in more detail in the following subsections. The protocols are formally specified, largely by reference to other specification documents, in Appendix A. Copies of many of the referenced documents appear in the Internet Transition Workbook [2].

3.1 Application Services and Protocols

As shown in Figure 1, a number of protocols may be required to satisfy the subscriber's networking application requirements. The ARPANET TELNET protocol, File Transfer Protocol (FTP), and Simple Mail Transfer Protocol (SMTP) are the standard DDN application proto-

Figure 1
DDN Protocol Architecture



*Recommended for Each DDN Subscriber Host

**Mandatory for Each DDN Subscriber Host

***One Set of Network Access Protocols (Either the ARPANET Protocols or X.25) is Mandatory for Each DDN Subscriber Host cols. They support scroll mode terminal-to-host communication, file transfer service, and electronic mail service. "Native Mode" is not a standard DDN protocol, but rather a standard way of referring to the existing variety of terminal-specific (e.g., IBM 3270) protocols, each of which supports communication between synchronous terminals of a specific class and their compatible, or native, hosts. It is recommended that each subscriber host implement TELNET, FTP, SMTP, and the applicable Native Mode protocol.

In addition to the application protocol implementations, the subscriber must acquire application programs that provide user interfaces (and in the case of file transfer and mail, local file system interfaces) to the application protocols. <u>The user interface portions of these application programs are not standardized, and the specification of their functionality is completely the user's responsibility</u>.

Although TELNET, FTP, SMTP, and Native Mode are the typical users of TCP, vendors are free to develop new TCP-based application protocols, which DDN subscribers may then utilize. Also, DDN subscribers may develop, or have developed for them, additional application protocols to meet their unique requirements.

3.1.1 Terminal-to-Host Communication Service

The TELNET protocol facilitates communication between hosts and terminals from different vendors. The TELNET protocol provides a standard view of a network terminal, i.e., a "virtual terminal." The standard virtual terminal is an asynchronous ASCII terminal operating in scroll mode. The TELNET protocol also provides a method of negotiating options above the standard virtual terminal. The negotiated virtual terminal exists for the duration of the session between the network terminal and the host, and it resolves differences between the actual characteristics of the terminals.

When TELNET and its supporting protocols are implemented and in use, the terminal user has the impression that he or she is logged on to a host that is directly connected to the terminal. The user may execute all tasks normally possible on that host, including logging in, editing, compiling, running application programs, manipulating files, etc. The TELNET protocol, in the meantime, is handling the conversions necessary for host-terminal compatibility.

3.1.2 File Transfer Service

File-related activities such as copying, appending, deleting and renaming are common requirements of network users. They may be carried out both under the direction of a terminal user or under the direction of an application program. Subscribers of the DDN may use the network and the standard File Transfer Protocol to direct the transfer of data files between network hosts and to access other file management services.

FTP implementations are integrated with a host's file management system to provide the following common network capabilities:

- access to both the source and destination file management systems - in effect, simultaneous log-ins;
- transformation between source and destination file formats;
- directing the transfer of large volumes of data in the presence of potential network failures, and
- providing other file manipulation functions such as directory listings, appending, deleting, etc.

3.1.3 Electronic Mail Service

The ARPANET Simple Mail Transfer Protocol supports electronic message transfers over the DDN. The SMTP is implemented on hosts that support user "mailboxes" - file spaces into which messages may be written and later read by the owner. The SMTP is essentially a "file transfer" protocol optimized for message transfer. Electronic mail service will be provided for many DDN users in designated "mail hosts." These will be hosts supporting message sending, receiving, and manipulation capabilities, and numerous user accounts.

To send a message, the user logs on to a SMTP host and invokes a message-sending program. The user supplies the program with the network addresses of the message addressees and with the text of the message. The program formats these items as a standard network message and invokes DDN network services to send the message to the destination. The time required for this process may depend upon loading and scheduling of other jobs in the sender's host, but a moderate-sized text message can often be processed in only a few minutes. The receiver may depend upon the host's operating system for notification of the receipt of new mail, or the receiver may actively check the mailbox. When a new message is received, the user invokes the host's text manipulation utilities to print the message or transfer it to another medium, etc.

3.2 Data Transport Services and Protocols

The ARPANET Transmission Control Protocol and its associated Internet Protocol are the standard DDN transport protocols. The TCP/IP protocols provide the reliable host-to-host peer level communication necessary to support the application protocols above.

3.2.1 Transmission Control Protocol

TCP provides a reliable data communication service for interprocess communication over the DDN and other TCP/IP networks connected to the DDN. It is connection-oriented; that is, it maintains a connection, or virtual circuit, for each pair of communicating processes. TCP incorporates mechanisms to ensure the reliability of the connections and to control the flow of data over the connections.

3.2.2 Internet Protocol

IP transmits and receives data across the DDN and networks connected to the DDN. Unlike TCP, it is connectionless; it treats each packet as an independent entity. Furthermore, it neither checks users' data for errors nor performs flow control. Instead, its purpose is to provide a means for communication across multiple networks. To this end, it supports a global addressing system, and it accommodates differences in maximum packet sizes allowed by networks.

TCP and TCP-based application protocols are the typical users of IP. However, certain applications do not require the extent of reliability provided by TCP as much as they require high throughput and low delay. For example, the User Datagram Protocol (UDP) [3], a much simpler protocol than TCP, can be used in conjunction with IP to provide (potentially unreliable) interprocess communication across the DDN and other interconnected IP networks, and UDP-based application protocols can be developed to support the applications.

3.3 Network Access Protocols

The network access protocols define the interface between a host and the network. The DDN is intended to support two sets of network access protocols:

- o the ARPANET network access protocols, which are currently supported, and
- o X.25, which will be supported beginning in December 1983.

The initial DDN X.25 capability is designed to support communication between hosts that implement X.25. In mid 1984, this capability will be extended to support interoperability among hosts that implement either X.25 or the ARPANET network access protocols.

Although it is mandatory for TCP and IP to reside above X.25 in all X.25-based host interfaces to the DDN, other protocols, such as vendor-supplied protocols that implement services not provided by the standard DDN application protocols, may reside above X.25 as well. Of course, the optional services would exist only within the community of hosts that implement the optional protocols.

4.0 SUBSCRIBER INTERFACING STRATEGIES

Surveys conducted by the DDN PMO have indicated that potential subscribers plan to connect a variety of host computers and terminals, as well as local networks, to the DDN. This section identifies alternative interfacing strategies available to DoD managers:

- For hosts:
  - Full service interfaces, or
  - Limited service interfaces;
- For terminals:
  - Host pass-through interfaces,
  - Direct interfaces, or
  - Subscriber-supplied interfaces; and
- For networks:
  - Gateways.

This section also provides the guidelines and background necessary for subscribers to understand the different methods of interconnecting to the DDN and highlights the responsibilities of subscribers associated with the interfaces they have selected. DDN PMO personnel will assist subscribers in obtaining information about alternatives and in comparing their strengths and weaknesses. Subscribers should contact the DDN PMO to request such assistance. Host interfacing strategies are discussed first, followed by a discussion of terminal interfacing strategies. Although they are organized into separate subsections, the subscriber must select compatible host and terminal interfacing strategies in order to provide an effective data communication capability. This section concludes with a brief description of DDN gateway plans.

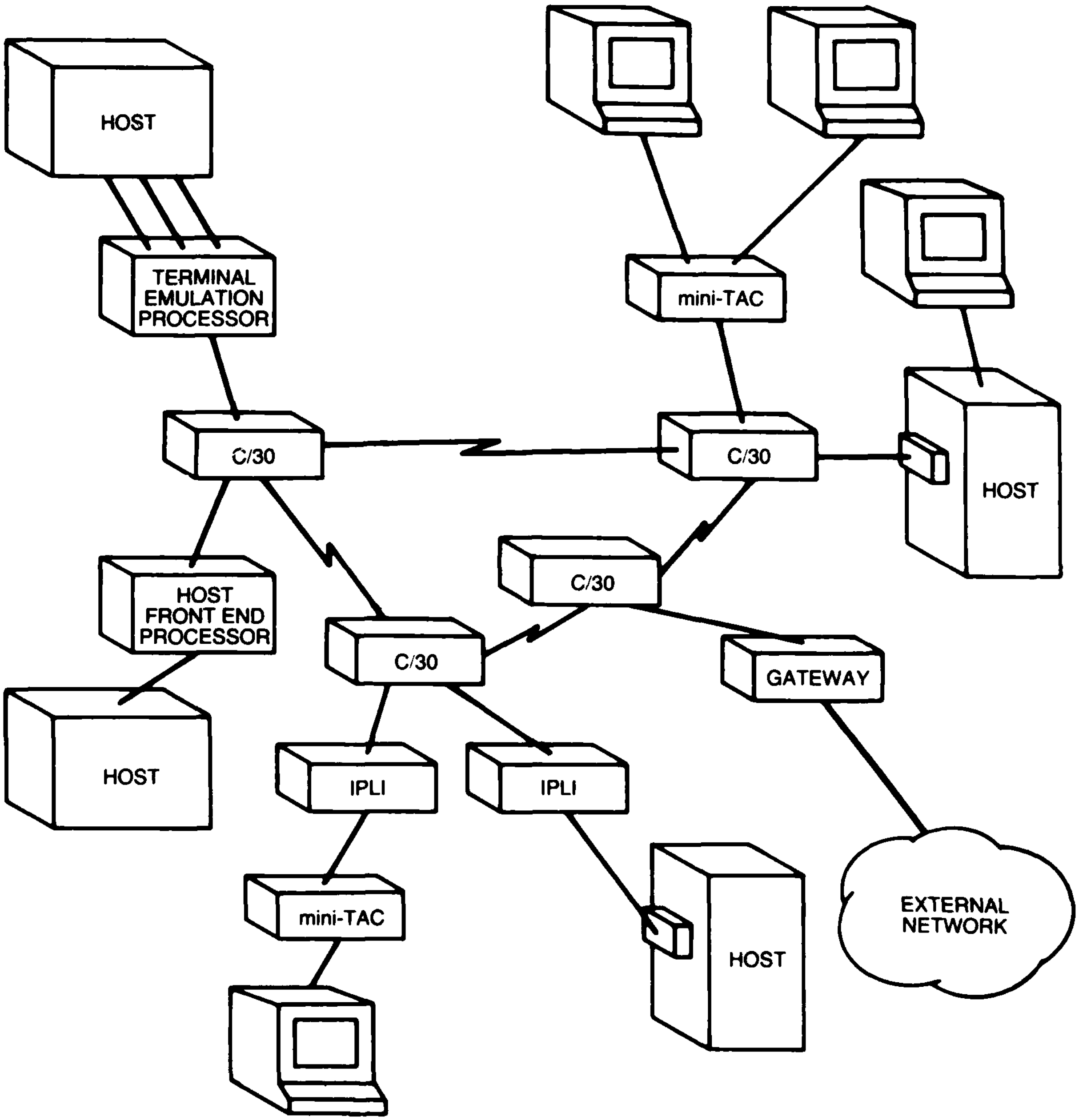
Figure 2 is a simple representation of network components of the DDN illustrating various standard methods of interfacing. The C/30 is the component that serves as the DDN packet switching node. The Internet Private Line Interface (IPLI) is the security component that will perform end-to-end encryption. The IPLI is being acquired by the DDN PMO and will be available to subscribers by early 1985. Due to long lead times, requirements for IPLIs must be identified fourteen months in advance of date of service. The interfacing methods and their associated components are described in the following subsections.

4.1 <u>Hosts</u>

Host interfaces can be categorized by the degree of support provided for network services and the method used to connect the host computer to the network. The full service interface supports al the standard DDN protocols. The full service interface is the most versatile alternative and is recommended for host subscribers whenever feasible. Several architectural arrangements of the protocol suite are possible, depending on subscriber requirements and the characteristics of the host computer hardware and operating system. The selection of an appropriate strategy that will provide a full service capability is discussed in Section 4.1.1.

Any interface that does not support the full functionality offered by the DDN protocol suite should be considered a limited service interface. Limited service interfaces generally fall into two categories: those interfaces supported by vendor-specific suites of protocols, and terminal emulation interfaces. Either type of limited service interface may be used while subscribers are waiting for the development of a full service interface for their host family. However, in the long term, the use of limited service interfaces should be restricted to terminal emulation interfaces for those systems

Figure 2
DDN Components



where the cost of a full service interface is prohibitive. Limited service interfaces are discussed in Section 4.1.2.

4.1.1 Full Service Interfaces

Full service host interfaces implement the DDN protocol suite described in Section 3. Use of the ARPANET application protocols and TCP/IP is necessary to achieve interoperability between different host types. Beyond this common use of the ARPANET protocols, the characteristics of each full service interface are subject to decisions made by the subscriber. These decisions evolve around the following issues:

- which network access protocol should be used, and
- how the network protocols, i.e., host-to-host and network access, should be integrated into the architecture of the host computer.

The first question can be resolved fairly easily. The selection of a network access protocol, i.e., the ARPANET network access protocols vs. X.25, will most likely be based on availability of hardware and software. The ARPANET interface is currently supported in the network node, and prototype or commercial implementations of the interface are available for some host families. The X.25 interface is a popular commercial interface that is available through a number of vendors. Upon completion of the DDN X.25 specification in September 1983, subscribers may select X.25 as a means of communication between their hosts and the network.

Integrating the network protocols into an existing system is a more difficult problem. Fundamentally, there are two basic implementation options - inboard (in the host computer) or outboard (in a communications processor attached to the host computer).

In inboard implementations, the network protocols can be written as user-level applications or as operating system functions. The user-level approach has the advantage of simplicity; the protocols can be implemented in a familiar, well-structured programming environment. However, the execution environment provided by operating systems to user processes is, in general, not well suited to the requirements of network protocols; therefore, user-level implementations may result in poor performance. The operating system approach, on the other hand, offers a less favorable programming environment but a more favorable execution environment. Unfortunately, some of the requirements of network protocols are not met by the services and capabilities available to operating system processes. Attempting to meet those requirements while still preserving the integrity of the operating system can be a formidable task.[4]

The other alternative is an outboard implementation, where the network protocols are moved to a separate front-end processor. This approach provides a dedicated environment that can be tailored to the specific needs of the network protocols. The outboard approach is not completely free of problems, however. The cost of a separate box may be incurred. Also, a communication mechanism must be provided between the host system and the front-end processor. Although it is subject to the same processing considerations as the inboard implementation, this mechanism, commonly referred to as a host-to-front-end protocol, is normally easier to implement. In addition to the host-to-front-end protocol implementation in the host, the application protocols must also be implemented.

A standard implementation of the outboard approach that will be available to subscribers is the DDN Host Front End Processor (HFEP). The HFEP is a standard configuration of the DDN Network Access Component (NAC) that is being acquired by the DDN PMO and should be available to subscribers by 1986. The HFEP implements TCP/IP and provides a standard ARPANET connection to the network. Communication between the subscriber host and the HFEP is supported via a standard interface connection implementing the DDN Host Front-end Protocol (HFP). Development of the host portions of the HFP, together with network services such as TELNET, native synchronous terminal support, and application protocols, are the responsibility of the subscriber and need to be implemented in the host.

In general, the selection of the approach (inboard vs. outboard) to be taken for a particular host family should be made by the implementor of the interface for that family. The selection should be based on subscriber requirements, host hardware, and operating system characteristics. Subscriber requirements, such as system performance, may dictate that an inboard approach be used. The character of the operating system may be the overriding consideration, however. Older types of operating systems tend to be more difficult to interface to networks, and an outboard approach may be substantially easier. On the other hand, a contemporary operating system, with a process structure and inherent networking capabilities, may accommodate an inboard implementation fairly easily.

4.1.2 Limited Service Interfaces

A limited service interface is any interface to the DDN that is not capable of supporting the full functionality offered by the DDN protocol architecture. The two most common types of limited service interfaces of interest to DDN subscribers are those interfaces supported by vendor-specific protocol architectures and terminal emulation interfaces.

Under certain circumstances, the DDN PMO may permit subscribers to connect to the network without using TCP/IP as the network protocols. These cases are limited to subscribers without immediate interoperability requirements who are waiting for a full service interface development to be completed. This form of limited service interface is based on one of the commercial networking strategies that uses X.25. Communication among these subscribers would be limited to subscribers with similar architectures, i.e., homogenous communication. A waiver must be requested for this mode of operation.

The simplest form of host connection, which avoids implementation problems, is the terminal emulation interface. The essence of this approach is to attach a protocol device to existing terminal ports on the host, emulating a cluster of terminals. This approach facilitates only remote terminal-to-host communication; i.e., local terminals connected to the host cannot access the network. The subscriber will not be able to take advantage of other network services, since the higher level protocols are not implemented with this approach. The advantage of the terminal emulation interface is that no modifications to the host system software are required to connect a host to the network.

Several devices are available that support the terminal emulation approach. One is a standard configuration of the DDN Network Access Component known as the Terminal Emulation Processor (TEP). A standard TEP will support sixteen terminal connections to the host. Like the other configurations of the NAC, the TEP implements TCP/IP and provides a standard ARPANET connection to the network. In addition, the TEP implements the "server," or host, portion of the TELNET protocol. In its basic configuration, the TEP will support only asynchronous connections to the host. With the addition of synchronous interface support, the TEP may be used to provide remote synchronous terminal-to-host communication.

Other devices that may be used to support terminal emulation interfaces include those commercial host interfaces that complement the terminal interfaces described in Section 4.2.3.

4.1.3 Combinations of Interfaces

For some sets of user requirements, a combination of interfaces may be most appropriate. For example, hosts for which implementations of all the DDN protocols except Native Mode are available might use a combination of a full service interface and a terminal emulation interface with built-in synchronous terminal support. The full service interface would support scroll mode terminal-to-host communication, file transfer, and electronic mail service. The terminal emulation interface would support native mode communication between remote synchronous terminals and the host.

4.2 Terminals

Subscribers have three options for connecting their terminals to the DDN. The first is to implement a pass-through application using the "user" portion of the TELNET protocol in a host system that is connected to the network. The second option is to request that a direct connection to the network be provided by the DDN PMO. The final option is for the subscriber to obtain Packet Assembly/Disassembly facilities (PADs) or other similar devices that can be used to connect terminals to the network. Since this method does not support the standard DDN protocols, it is not recommended by the DDN PMO, and connections of this type will be handled similarly to limited service host interfaces. These options are discussed in the following subsections.

4.2.1 Pass-through Interfaces

A pass-through interface is actually part of a subscriber host interface to the DDN. The pass-through interface is implemented as part of the host system's standard network software and can be used by local terminals to access the DDN through the host or its associated front-end processor. The local host must implement the "user" portion of the ARPANET TELNET protocol, and the remote host must implement the "server" portion. The terminals appear to the remote host as though they were locally connected.

4.2.2 Direct Interfaces

Direct connection of terminals to the network is supported by two devices provided by the DDN PMO. The devices are the Terminal Access Controller (TAC) and a smaller version known as the mini-TAC.

The Terminal Access Controller[5] is an existing operational component of the ARPANET and will continue to be utilized in the DDN. The TAC is a BBN C/30 minicomputer that supports up to 63 asynchronous terminal access ports. Currently, subscribers can connect terminals and modems that conform to the RS-232-C specification and terminals that use 20 milliampere current loop to the TAC. The TAC supports communication at data rates from 75 to 9,600 bits per second. The TAC supports the standard suite of ARPANET protocols, including TCP/IP, a standard ARPANET network connection, and the "user" portion of the TELNET protocol. The TAC allows a terminal user to communicate with any host on the network without going through an intervening local host. All terminal-to-host connections are multiplexed over a single link between the TAC and the switching node.

Subscribers have indicated that a low cost means of terminal access is required in locations with fewer terminals than are currently supported by the TAC. In these situations, a microprocessor-based device known as the mini-TAC will be provided to support up to 16 terminal connections to the DDN. The mini-TAC is a standard configuration of the DDN Network Access Component. Like the other configurations of the NAC, the mini-TAC implements TCP/IP and provides a standard ARPANET connection to the network. In addition, the mini-TAC implements the "user" portion of the TELNET protocol. The mini-TAC will meet TEMPEST and HEMP requirements. Multiple network interface ports will be provided to allow dual-homing.

The mini-TAC will support both asynchronous and synchronous terminals. The types of vendor-unique synchronous terminals to be supported will be based on subscriber requirements and priorities. The protocols implemented in a particular mini-TAC will be those necessary to support the terminals that are attached to it. Terminals connected in asynchronous mode will be able to communicate at data rates from 110 to 19,200 bits per second and in synchronous mode from 1,200 to 19,200 bits per second.

4.2.3 Subscriber-supplied Interfaces

Subscribers can support terminal connections to the DDN through various commercial devices. These devices fall into two general categories: PADs and X.25 interface adapters.

The PAD is a device designed to provide access to public data networks. PADs perform functions similar to those of a TAC or mini-TAC, but do not support the ARPANET protocols. A standard X.25 PAD, defined by the CCITT recommendation X.3, communicates with asynchronous terminals according to the X.28 recommendation and with hosts according to the X.29 recommendation. The PAD takes inputs from attached scroll-mode asynchronous terminals, forms them into X.25 packets, and transmits the packets across the DDN to a remote host.

For those terminals that are not supported by a PAD, an X.25 terminal interface adapter may be used to communicate with an X.25 host. Such terminals include synchronous and page-mode terminals. An X.25 terminal interface adapter functions exactly like a PAD, except that it usually supports a particular class of synchronous terminal protocols. In some cases, these adapters will also support the PAD function. In general, a reverse adapter is also required at any host to which communication using the adapter is required.

4.2.4 Combinations of Terminal Interfaces

For some subscribers, combinations of interfaces might best meet their requirements. For example, subscribers with a combination of asynchronous terminals, synchronous terminals for which there is mini-TAC support, synchronous terminals for which there is an X.25 terminal interface adapter, and synchronous devices for which there is no DDN support might use a combination of TACs, mini-TACs, X.25 terminal interface adapters, and dedicated lines to the host to support the full requirement. The optimal design of such a configuration should be done in conjunction with the DDN PMO.

4.3 Other Networks

The DDN Program Plan identifies the need for external network gateways, although none have been defined or provided for in the plan. The gateways will provide the interface between local networks and the DDN. The external network side of a gateway will be designed to support the protocols necessary to connect to the local network. The DDN side of a gateway will be designed to support the network access protocols necessary to connect to a DDN network device. To provide Internet service, the gateways will implement IP. The design of the Internet gateway is described in ARPANET Request for Comments 823.[6] Communication between a "stub" gateway, used for a local network connection, and an Internet gateway is defined by the Exterior Gateway Protocol.[7] Definition of gateways for the DDN will proceed as requirements for external networks are identified.

5.0 SUBSCRIBER INTERFACE ACQUISITION STRATEGIES

This section discusses four strategies for acquiring full service host interfaces and complementary synchronous terminal interfaces. The strategies correspond to the four primary sources of these interfaces:

- o new vendor products,
- o DCA-sponsored developments,
- o existing ARPANET implementations, and
- o subscriber-sponsored developments.

The other interfaces that were described in the previous section are either existing commercial products or standard configurations of the NAC, and as such have well-defined sources.

5.1 New Vendor Products

Motivated by the increasing visibility of the DDN Program, some of the major computer vendors are initiating, under corporate sponsorship, the development of DDN interfaces for selected host and terminal families within their standard product lines. As these corporation-sponsored developments or other developments (e.g., DCA-sponsored or subscriber-sponsored) are completed and incorporated into vendors' standard product lines, they will become the preferred sources of DDN interfaces. Subscribers will be able to acquire, install, and maintain these interfaces in the same way as other vendor products.

5.2 DCA-sponsored Developments

From the beginning of the DDN Program, DCA has been committed to ensuring the development and availability of host and synchronous terminal interfaces for the most common host families within its subscriber community. To this end, DCA is planning to fund the development of DDN interfaces for those major host families whose manufacturers are unable or unwilling to internally fund the necessary development efforts. Ideally, these developments would evolve into new vendor products, with all the inherent advantages thereof.

Each DCA-sponsored development effort will include not only the development of host and synchronous terminal interfaces, but also the installation of the interfaces at a DDN subscriber site. The test site will be given the interfaces free of charge, although computer time will be needed by the developers. Other subscribers will be able to purchase or lease the interfaces directly from the vendors.

5.3 Existing ARPANET Implementations

A large number of implementations of the DDN protocols are currently in use on the ARPANET. However, the developers of these implementations are typically universities or research institutions that have neither the resources nor the desire to convert their implementations to commercial quality, to tailor their implementations to other sites, or to assume responsibility for making needed modifications to keep abreast of changes to the protocols or to the subscriber's operating system. Subscribers may be able to make arrangements to transport these existing implementations to their own systems if they are willing to undertake the task of tailoring and maintaining them or if they can find a developer or other programming group willing to undertake these tasks. The "Internet Protocol Implementation Guide"(8) and the "ARPANET Directory"(9) list hosts with existing network protocol implementations.

5.4 Subscriber-sponsored Developments

Subscribers whose requirements cannot be met by any of the above strategies will have to sponsor their own interface development efforts, either in-house or contracted-out. DCA will coordinate these efforts to ensure that unnecessary duplications are avoided.

There are several valuable resources available to subscribers who utilize this strategy. The foremost is the DDN HFEP, which provides implementations of TCP, IP, and the ARPANET network access protocols that are accessible through the DDN standard Host Front-end Protocol. Another very useful resource is a testing facility, housed at the Defense Communications Engineering Center (DCEC), that DCA will provide to implementors. Other resources include Appendix A (attached), which specifies the DDN protocol suite, and the "Internet Protocol Implementation Guide,"[8] which offers general guidelines to implementors of DDN protocols.

6.0 SUMMARY

This section summarizes in table form the information presented in this Guide. Table 1 summarizes the protocols and interfaces that are needed for particular network services. For example, the table shows that subscribers who require network-based file transfer services must implement the standard FTP and must implement a full service host interface. Table 2 summarizes the guidelines for choosing between competing interface methods, such as whether to connect a terminal through a mini-TAC or through a host. Table 3 lists the advantages and disadvantages of the general strategies that are available for acquiring full service host interfaces.

Table 1:
Summary of Subscriber Interfaces

SERVICE	PROTOCOL*	INTERFACES
asynchronous terminal to host communication	TELNET	Terminal: TAC, standard mini-TAC (direct) full service host interface (pass through) Host: standard TEP, full service host interface
synchronous terminal to native host communication	Native Mode	Terminal: terminal-specific mini-TAC (direct) full service host interface (pass through) Host: terminal-specific TEP, full service host interface
synchronous terminal to nonnative host communication	TELNET	Terminal: terminal-specific mini-TAC (direct) full service host interface (pass through) Host: full service host interface
file transfer	FTP	full service host interface
electronic mail	SMTP	full service host interface
reliable internetwork process-to-process communication	TCP	full service host interface
internetwork host-to-host communication (potentially unreliable)	IP	full service host interface
support of vendor-provided services designed to run on Public Data Networks	X.25	X.25-based full service host interface

* This column references only the highest level protocol associated with each service.

Table 2:
Summary of Interfacing Strategies

Interface Strategy	Conditions for Employment
full service host interface (inboard implementation)	full interoperability at the application level is required
full service host interface (outboard implementation)	same as inboard, except that operating environment dictates outboard solution
limited service host interface (vendor-specific)	interim solution only, where interoperability is not required and vendor-specific protocols are available
limited service host interface (terminal emulation)	terminal-to-host communication is required immediately, prior to development of full service interface; or, cost of full service interface is prohibitive
terminal interface (pass through)	users with terminals directly connected to subscriber host also require communication with other hosts
terminal interface (direct)	user with stand-alone terminal requires communication with remote hosts
terminal interface (subscriber-supplied)	same as direct, except that terminal and host characteristics dictate subscriber-specific solution
external network interface	communication between terminals or hosts of a subscriber network, such as a local area network, and remote hosts is required

Table 3:
Summary of Interface Acquisition Strategies

Strategy (Source of Interface)	Advantages	Disadvantages
new vendor products	vendor funds development and establishes procedures for acquisition, installation and maintenance	not currently available
DCA-sponsored developments	DCA funds development and helps to establish procedures for acquistion, installation, and maintenance	not currently available
existing ARPANET implementations	currently available	subscriber must establish procedures for installation (i.e., site tailoring) and maintenance
subscriber-sponsored developments	interface can be customized to meet subscriber's unique requirements; subscriber establishes schedule of availability	subscriber must fund development and establish procedures for acquisition, installation, and maintenance

REFERENCES

1. Under Secretary of Defense R&D Memorandum, Subject: Defense Data Network (DDN) Implementation, 10 March 1983.

2. "Internet Protocol Transition Workbook," SRI International, Menlo Park, CA, March 1982.

3. Postel, J., "User Datagram Protocol," RFC 768, Information Sciences Institute, University of Southern California, Marina del Rey, CA, May 1979.

4. Clark, D.D., "Modularity and Efficiency in Protocol Implementation," RFC 817, MIT Laboratory for Computer Science, July 1982.

5. Clifford, R.S., "TAC Users' Guide," Report No. 4780, Bolt Beranek and Newman Inc., Cambridge, MA, October 1982.

6. Hinden, R., and Sheltzer, A., "The DARPA Internet Gateway," RFC 823, Bolt Beranek and Newman Inc., Cambridge, MA, September 1982.

7. Rosen, E.C., "Exterior Gateway Protocol," RFC 827, Bolt Beranek and Newman, Cambridge, MA, October 1982.

8. "Internet Protocol Implementation Guide," SRI International, Menlo Park, CA, August 1982.

9. "ARPANET Directory," SRI International, Menlo Park, CA, March 1982.

APPENDIX A

SUBSCRIBER INTERFACE SPECIFICATION

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

1. SCOPE

1.1 Purpose

The purpose of this specification is to define the standard data communication interfaces and protocols to be used by subscribers of the Defense Data Network (DDN).

1.2 Scope

This specification defines the interfacing requirements and communication protocols for the connection of host and terminal subscribers to the DDN. The standard methods of connection to the network may be supported in part by the DDN Network Access Component (NAC), which may be configured as a mini-Terminal Access Controller (mini-TAC), a Host Front End Processor (HFEP), or a Terminal Emulation Processor (TEP). Host subscribers may connect directly to the DDN or may utilize the HFEP or TEP configurations of the NAC. Direct connection on the unclassified segment of the network will be to a C/30 network node. Direct connection on the classified segment will be to an Internet Private Line Interface (IPLI). Terminal subscribers may connect to the DDN via a Terminal Access Controller (TAC), the mini-TAC configuration of the NAC, or through a TELNET or "native mode" implementation in a host system connected to the DDN.

For the purposes of this specification, the term "host" will include a host computer system and its native communications front end.

This specification does not include the requirements for user, program, or file system interfaces to the various services which the protocols support. Any such required interfaces and their functionality should be specified by the subscriber. Examples of such interfaces are interactive user interfaces to a terminal-to-host, file transfer, or electronic mail service; file system interfaces for file transfer and electronic mail; and program interfaces (e.g., subroutine calls) for file transfer, reliable transport (Transmission Control Protocol), datagram transport (Internet Protocol), or network access services.

1.3 Objective

The objective of this specification is to establish standard interfaces and protocols for the DDN such that data communication can take place among independently manufactured equipments with minimum effort on the part of DDN subscribers and implementors of the interfaces and protocols.

1.4 Application

This specification shall apply to the connection of host and terminal subscribers to the DDN, as well as to the development of all new standard interfaces and interface devices supporting subscriber connection to the DDN. Contracts invoking this specification should specifically identify the paragraphs or portions thereof applicable to the program being procured. The contractor shall be responsible for determining the extent to which the requirements contained herein are applicable to subcontractors, vendors, and suppliers and for the application of the requirements to subcontractors, vendors, and suppliers.

1.5 Usage note

Two types of information are included in this specification: text intended to be included in a RFP or other interface requirement document and explanatory information for subscribers. The latter information is set off by square brackets.

2. APPLICABLE DOCUMENTS

2.1 Government standards

Unless otherwise specified, the following standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

FEDERAL STANDARDS

FED-STD-1001, Telecommunications: Synchronous High Speed Data Signaling Rates Between Data Terminal Equipment and Data Communication Equipment.

FED-STD-1010, Telecommunications: Bit Sequencing of the American National Standard Code for Information Interchange in Serial-by-bit Data Transmission. (Adoption of American National Standards Institute standard X3.15-1979)

FED-STD-1011, Telecommunications: Character Structure and Character Parity Sense for Serial-by-bit Data Communication in the American National Standard Code for Information Interchange. (Adoption of American National Standards Institute standard X3.16-1979)

FED-STD-1013, Telecommunications: Synchronous Signaling Rates Between Data Terminal Equipment and Data Circuit-Terminating Equipment Utilizing 4kHz Circuits. (Adoption of American National Standards Institute standard X3.1-1979)

FED-STD-1031, Telecommunications: General Purpose 37-Position and 9-Position Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment. (Adoption of Electronic Industries Association standard RS-449)

FED-STD-1037, Glossary of Telecommunication Terms.

INT-FED-STD-1041, Telecommunications: Interface between data terminal equipment and data circuit-terminating equipment for operation with packet-switching data communication networks. (Adoption of International Telegraph and Telephone Consultative Committee Recommendation X.25)

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402 or the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.)

FEDERAL INFORMATION PROCESSING STANDARDS

FIPS PUB 1-1, Code for Information Interchange. (Adoption of American National Standards Institute standard X3.4-1977)

(Application for copies should be addressed to the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.)

MILITARY STANDARDS

MIL-STD-188C, Military Communication System Technical Standards.

MIL-STD-188-100, Common Long Haul and Tactical Communication System Technical Standards.

MIL-STD 1777, Internet Protocol Standard.

MIL-STD 1778, Transmission Control Protocol Standard.

(Application for copies should be addressed to the Naval Publications and Forms Center (NPFC), 5801 Tabor Avenue, Philadelphia, PA 19120.)

2.2 Other publications

The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI X3.1-1979, Synchronous Signaling Rates for Data Transmission.

ANSI X3.4-1977, American National Standard Code for Information Interchange.

ANSI X3.15-1979, Bit Sequencing of the American National Standard Code for Information Interchange in Serial-by-bit Data Transmission.

ANSI X3.16-1979, Character Structure and Character Parity Sense for Serial-by-bit Data Communication in the American National Standard Code for Information Interchange.

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA RS-232-C, Interface between data terminal equipment and data communication equipment employing serial binary data interchange.

EIA RS-449, General purpose 37-position and 9-position interface for data terminal equipment and data circuit-terminating equipment employing serial binary data interchange.

(Application for copies should be addressed to the Electronic Industries Association, Standards Sales, 2001 Eye Street, NW, Washington, DC 20006.)

INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE (CCITT)

Recommendation X.25: Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode on public data networks.

(Application for copies should be addressed to the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.)

NETWORK INFORMATION CENTER (NIC)

RFC 765, File Transfer Protocol, June 1980.

RFC 792, Internet Control Message Protocol, September 1981.

RFC 795, Service Mappings, September 1981.

RFC 796, Address Mappings, September 1981.

RFC 820, Assigned Numbers, January 1983.

RFC 821, Simple Mail Transfer Protocol, August 1982.

RFC 822, Standard for the Format of ARPA Internet Text Messages, August 1982.

RFC 854, TELNET Protocol Specification, May 1983.

RFC 856, TELNET Binary Transmission Option, May 1983.

RFC 857, TELNET Echo Option, May 1983.

RFC 858, TELNET Suppress Go Ahead Option, May 1983.

RFC 859, TELNET Status Option, May 1983.

RFC 860, TELNET Timing Mark Option, May 1983.

RFC 861, TELNET Extended Options List Option, May 1983.

(Application for copies should be addressed to the ARPANET Network Information Center, SRI International, Menlo Park, CA 94025.)

OTHER DOCUMENTS

Day, J.D., et al., "WWMCCS Host to Front End Protocols: Specifications Version 1.0," DTI Document 78012.C-INFE.14, Digital Technology Incorporated, November 1979. (AD A100515/6)

INTERFACE MESSAGE PROCESSOR - Specifications for the Interconnection of a Host and an IMP, BBN Report No. 1822, Bolt Beranek and Newman Inc., December 1981 Revision. (AD A002751)

(Application for copies should be addressed to the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.)

Defense Data Network Service Access Protocols, the MITRE Corporation.

IPLI Interface Specification, IPLI-83-6(U), BBN Report No. 5278, Bolt Beranek and Newman Inc., March 1983.

IPLI Site Preparation and Installation Guide, IPLI-82-27(U), BBN Report No. 5224, Bolt Beranek and Newman Inc., March 1983.

TAC Users' Guide, BBN Report No. 4780, Bolt Beranek and Newman Inc., October 1982.

(Application for copies should be addressed to the procuring activity or as directed by the contracting officer.)

2.3 Order of precedence

In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Subscriber interfaces to DDN components

3.1.1 Host connection to a C/30

3.1.1.1 General

3.1.1.1.1 Each subscriber host shall implement the data terminal equipment (DTE) side of a DTE/data circuit-terminating equipment (DCE) interface with the following physical, data link, and network level characteristics.

3.1.1.2 Physical interface

3.1.1.2.1 The physical interface shall conform to the requirements of FED-STD-1031. The provisions of Section 6.C shall apply. [This is the preferred interface. Existing equipment with RS-232-C, MIL-STD-188C, and MIL-STD-188-114 interfaces can also be accomodated. For such equipment, this paragraph should be replaced with an appropriate substitute, and the DDN Program Management Office (PMO) should be informed of the substitution so that appropriate interfaces can be supplied on the C/30.]

3.1.1.2.2 The Type SR data transmission configuration, as specified in Section 5.2 of EIA RS-449, shall apply. All interchange circuits with the exception of those designated O (optional) in Table 7 of the document entitled "IPLI Site Preparation and Installation Guide," BBN Report No. 5224, shall be implemented. The 37-position interface connector specified in Section 3.3 of EIA RS-449 shall be used. The optional 9-position interface connector is not required.

3.1.1.2.3 The interface shall be capable of transmitting and receiving binary data at one or more of the following discrete data transmission rates: 4800, 9600, 19200, 50000 and 56000 bits per second. [Subscribers should select the actual rates based on operational requirements, coordinated with the DDN PMO.]

3.1.1.3 <u>Network and data link protocols</u>

3.1.1.3.1 <u>General</u>

3.1.1.3.1.1 The interface shall support either an implementation of the ARPANET host access protocols or an implementation of the X.25 protocol. [Subscribers should select the interface based on operational requirements, coordinated with the DDN PMO. Subscribers may not implement an X.25 interface until an approved DDN X.25 specification has been issued.]

3.1.1.3.2 <u>ARPANET</u>

3.1.1.3.2.1 ARPANET implementations shall support the ARPANET High-level Data Link Control (HDLC) Distant Host (HDH) interface, as specified in Appendix J of the document entitled "INTERFACE MESSAGE PROCESSOR - Specifications for the Interconnection of a Host and an IMP," BBN Report No. 1822.

3.1.1.3.2.2 Assignment of link numbers in the "Message-ID" field of the ARPANET Host-IMP interface leader shall be in accordance with Request for Comments (RFC) 820, or its successor. Specific number assignments, when required, shall be requested from the DDN Program Management Office (PMO) Data Base and Configuration Management Branch, Code B628.

3.1.1.3.2.3 Unless otherwise specified, HDH shall be implemented to operate in the packet mode, as specified in Appendix J of BBN Report No. 1822. Alternatively, HDH shall be implemented to operate in message mode. [Subscribers should select the mode based on operational requirements, coordinated with the DDN PMO.]

3.1.1.3.2.4 The required HDLC mode of operation is LAP B, as specified in Section 4.2 of INT-FED-STD-1041.

3.1.1.3.2.5 Two way simultaneous operation shall be supported.

3.1.1.3.2.6 The HDLC system parameters shall be set as specified in Appendix J of BBN Report No. 1822. All system parameters shall be settable.

3.1.1.3.3 X.25

3.1.1.3.3.1 X.25 implementations shall conform to the requirements of the DDN X.25 Specification, to be issued in a revision to this specification.

3.1.2 Host connection to an IPLI

3.1.2.1 General

3.1.2.1.1 Each subscriber host shall implement the DTE side of a DTE/DCE interface with the following physical, data link, and network level characteristics.

3.1.2.2 Physical interface

3.1.2.2.1 The physical interface shall conform to the requirements of Section 3.2.2 of BBN Report No. 5224. The 37-position interface connector specified in Section 3.3 of EIA RS-449 shall be used. The optional 9-position interface connector is not required.

3.1.2.2.2 The interface shall be capable of transmitting and receiving binary data at one or more of the following discrete data transmission rates: 4800, 9600, 19200, 50000 and 56000 bits per second. [Subscribers should select the actual rates based on operational requirements, coordinated with the DDN PMO.]

3.1.2.3 <u>Network and data link protocols</u>

3.1.2.3.1 The interface shall implement the Host to IPLI Protocol (HIP), as specified in Section 3.2 of the document entitled "IPLI Interface Specification," BBN Report No. 5278. The HDH option shall be implemented.

3.1.2.3.2 Assignment of link numbers in the "Message-ID" field of the HIP interface leader shall be in accordance with RFC 820, or its successor. Specific number assignments, when required, shall be requested from the DDN PMO Data Base and Configuration Management Branch, Code B628.

3.1.2.3.3 Unless otherwise specified, HDH shall be implemented to operate in the packet mode, as specified in Appendix J of BBN Report No. 1822. Alternatively, HDH shall be implemented to operate in message mode. [Subscribers should select the mode of operation based on operational requirements, coordinated with the DDN PMO.]

3.1.2.3.4 The required HDLC mode of operation is LAP B, as specified in Section 4.2 of INT-FED-STD-1041.

3.1.2.3.5 Two way simultaneous operation shall be supported.

3.1.2.3.6 The HDLC system parameters shall be set as specified in Appendix J of BBN Report No. 1822. The maximum information field shall be modified in accordance with Section 3.2-7 of BBN Report No. 5278. All system parameters shall be settable.

3.1.3 <u>Host connection to a HFEP</u>

3.1.3.1 <u>General</u>

3.1.3.1.1 Each subscriber host shall implement the DTE side of a DTE/DCE interface with the following physical, data link, and network level characteristics.

3.1.3.2 Physical interface

3.1.3.2.1 The physical interface shall conform to the requirements of FED-STD-1031. The provisions of Section 6.C shall apply.

3.1.3.2.2 The Type SR data transmission configuration, as specified in Section 5.2 of EIA RS-449, shall apply. All interchange circuits with the exception of those designated O (optional) in Table 7 of BBN Report No. 5224 shall be implemented. The 37-position interface connector specified in Section 3.3 of EIA RS-449 shall be used. The optional 9-position interface connector is not required.

3.1.3.2.3 The interface shall be capable of transmitting and receiving binary data at one or more of the following discrete data transmission rates: 4800, 9600, 19200, 50000 and 56000 bits per second. [Subscribers should select the actual rates based on operational requirements, coordinated with the DDN PMO.]

3.1.3.3 Network and data link protocols

3.1.3.3.1 Host-to-HFEP communication shall conform to the requirements of the DDN Host Front-end Protocol (HFP), as specified in the document entitled "WWMCCS Host to Front End Protocols: Specifications Version 1.0."

3.1.3.3.2 Service access protocols for the DDN HFP shall conform to the requirements of the documents entitled "Defense Data Network Service Access Protocols."

3.1.3.3.3 The HFP Link Protocol shall conform to the requirements of Section 4.2 of INT-FED-STD-1041.

3.1.3.3.4 Two way simultaneous operation shall be supported.

3.1.3.3.5 The HDLC system parameters shall be set as specified in Appendix J of BBN Report No. 1822. All system parameters shall be settable.

3.1.4 Host connection to a TEP

3.1.4.1 General

3.1.4.1.1 Subscriber hosts shall interface to the TEP via their terminal ports in accordance with the following physical and functional characteristics.

3.1.4.2 Physical interface

3.1.4.2.1 The physical interface shall conform to the requirements of FED-STD-1031. For all interfaces conforming to EIA RS-232-C, the provisions of Section 6.A shall apply. For all interfaces conforming to MIL-STD-188C or MIL-STD-188-100, the provisions of Section 6.B shall apply. For all other interfaces, the provisions of Section 6.C shall apply.

3.1.4.2.2 The Type SR data transmission configuration, as specified in Section 5.2 of EIA RS-449, shall apply. All interchange circuits with the exception of those designated O (optional) in Table 7 of BBN Report No. 5224 shall be implemented. The 37-position interface connector specified in Section 3.3 of EIA RS-449 shall be used. The optional 9-position interface connector is not required.

3.1.4.2.3 The interface shall be capable of transmitting and receiving binary data at one or more of the following discrete data transmission rates: 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 4800, 9400, and 19200 bits per second. The same data rates shall be used for both transmit and receive.

3.1.4.3 Functional characteristics

3.1.4.3.1 Asynchronous

3.1.4.3.1.1 The standard transmission code set shall be the American National Standard Code for Information Interchange (ASCII), as specified in FIPS PUB 1-1. [EBCDIC and BCD code sets will also be supported.]

3.1.4.3.1.2 Serial-by-bit data transmissions shall conform to FED-STD-1010 for code sequence and FED-STD-1011 for character structure and parity sense. [Character lengths of five thru nine bits per character will be supported. One, one and one-half, and two stop bits will be supported. Odd, even, mark, and space parity options will be supported.]

3.1.4.3.1.3 Two way simultaneous and two way alternate operation shall be supported.

3.1.4.3.1.4 The use of alternate transmission code sets, code sequences, character structures, and parity sense definitions shall not be precluded. [Link level terminal flow control procedures, such as XON/XOFF, need to be supported in the host.]

3.1.4.3.2 Synchronous

3.1.4.3.2.1 To Be Determined (TBD) [Synchronous support will be added to the TEP based on subscriber requirements.]

3.1.5 Terminal connection to a TAC

3.1.5.1 Subscriber terminals shall be connected to the TAC in accordance with Appendix C of the document entitled "TAC Users' Guide," BBN Report No. 4780.

3.1.6 Terminal connection to a mini-TAC

3.1.6.1 General

3.1.6.1.1 Subscriber terminals shall connect to a mini-TAC in accordance with the following physical and functional characteristics.

3.1.6.2 <u>Physical interface</u>

3.1.6.2.1 The physical interface shall conform to the requirements of FED-STD-1031. For all terminals conforming to EIA RS-232-C, the provisions of Section 6.A shall apply. For all terminals conforming to MIL-STD-188C or MIL-STD-188-100, the provisions of Section 6.B shall apply. For all other terminals, the provisions of Section 6.C shall apply.

3.1.6.2.2 The Type SR data transmission configuration, as specified in Section 5.2 of EIA RS-449, shall apply. All interchange circuits with the exception of those designated O (optional) in Table 7 of BBN Report No. 5224 shall be implemented. The 37-position interface connector specified in Section 3.3 of EIA RS-449 shall be used. The optional 9-position interface connector is not required.

3.1.6.2.3 Standard signaling rates up to 9600 bits per second shall conform to FED-STD-1013. Signaling rates above 9600 bits per second shall conform to FED-STD-1001. The interface shall be capable of transmitting and receiving binary data at one or more of the following discrete data transmission rates: 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, and 19200 bits per second. The same data rates shall be used for both transmit and receive.

3.1.6.3 <u>Functional characteristics</u>

3.1.6.3.1 <u>Asynchronous</u>

3.1.6.3.1.1 The standard transmission code set shall be the American National Standard Code for Information Interchange, as specified in FIPS PUB 1-1. [EBCDIC and BCD code sets will also be supported.]

3.1.6.3.1.2 Serial-by-bit data transmissions shall conform to FED-STD-1010 for code sequence and FED-STD-1011 for character structure and parity sense. [Character lengths of five thru nine bits per character will be supported. One, one and one-half, and two stop bits will be supported. Odd, even, mark, and space parity options will be supported.]

3.1.6.3.1.3 Two way simultaneous and two way alternate operation shall be supported.

3.1.6.3.1.4 The use of alternate transmission code sets, code sequences, character structures, and parity sense definitions shall not be precluded.

3.1.6.3.2 Synchronous

3.1.6.3.2.1 TBD [Synchronous support will be added to the mini-TAC based on subscriber requirements.]

3.2 Host level protocols

3.2.1 Internet service

3.2.1.1 Internet service shall conform to the requirements of the DoD standard Internet Protocol (IP), as specified in MIL-STD-1777.

3.2.1.2 All IP options, as specified in Section 6.2.14 of MIL-STD-1777, shall be implemented.

3.2.1.3 The maximum IP datagram shall be 4608 bits. All IP system parameters shall be settable. [4608 bits allows a data block of 512 octets plus 64 header octets to fit in a datagram.]

3.2.1.4 Assignment of network numbers, internet version numbers, and internet protocol numbers shall be in accordance with RFC 820, or its successor. Specific number assignments, when required, shall be requested from the DDN PMO Data Base and Configuration Management Branch, Code B628.

3.2.1.5 Mapping of the IP "Type of Service" field to the actual service provided shall be in accordance with the document entitled "Service Mappings," RFC 795, or its successor. Specific service mapping for the DDN shall be requested from the DDN PMO Data Base and Configuration Management Branch, Code B628.

3.2.1.6 Mapping of the IP address fields shall be in accordance with the document entitled "Address Mappings," RFC 796, or its successor. Specific address mapping for the DDN shall be requested from the DDN PMO Data Base and Configuration Management Branch, Code B628.

3.2.1.7 Internet control messages shall conform to the requirements of the Internet Control Message Protocol (ICMP), as specified in the document entitled "Internet Control Message Protocol," RFC 792.

3.2.1.8 Implementations shall be capable of receiving all ICMP message types. As a minimum, implementations shall be capable of sending the following ICMP message types:

a. Echo Reply

b. Source Quench

c. Destination Unreachable

d. Time Exceeded

e. Parameter Problem

f. Timestamp Reply

g. Information Reply

3.2.2 <u>Transport service</u>

3.2.2.1 Transport service shall conform to the requirements of the DoD standard Transmission Control Protocol (TCP), as specified in MIL-STD-1778.

3.2.2.2 All TCP options, as specified in Section 6.2.11 of MIL-STD-1778, shall be implemented.

3.2.2.3 All TCP system parameters shall be settable.

3.2.2.4 Assignment of TCP ports shall be in accordance with RFC 820, or its successor. Specific number assignments, when required, shall be requested from the DDN PMO Data Base and Configuration Management Branch, Code B628.

3.3 Application level protocols

3.3.1 Terminal-to-host service

3.3.1.1 Terminal-to-host service shall conform to the requirements of the TELNET Protocol, as specified in the document entitled "TELNET Protocol Specification," RFC 854.

3.3.1.2 As a minimum, the following TELNET options shall be supported:

a. Binary Transmission, as specified in RFC 856,

b. Echo, as specified in RFC 857,

c. Suppress Go Ahead, as specified in RFC 858,

d. Status, as specified in RFC 859,

e. Timing Mark, as specified in RFC 860, and

f. Extended-Options-List, as specified in RFC 861.

3.3.2 File transfer service

3.3.2.1 File transfer service shall conform to the requirements of the File Transfer Protocol, as specified in the document entitled "File Transfer Protocol," RFC 765.

3.3.2.2 As a minimum, servers shall implement the following FTP commands:

a. user name (USER)

b. password (PASS)

c. logout (QUIT)

d. data port (PORT)

e. passive (PASV)

f. representation type (TYPE)

g. file structure (STRU)

h. transfer mode (MODE)

i. retrieve (RETR)

j. store (STOR)

k. noop (NOOP)

3.3.2.3 As a minimum, ASCII and Image data representations shall be accepted.

3.3.2.4 All references to mail commands including the Appendix On Mail shall not apply.

3.3.3 Electronic Mail service

3.3.3.1 Electronic Mail service shall conform to the requirements of the Simple Mail Transfer Protocol (SMTP), as specified in the document entitled "Simple Mail Transfer Protocol," RFC 821.

3.3.3.2 Specific assignments for standard names for links and protocols, as specified in Section 4.1.2 of RFC 821, shall be requested from the DDN PMO Data Base and Configuration Management Branch, Code B628.

3.3.3.3 As a minimum, receivers shall implement the SMTP commands as specified in Section 4.5.1 of RFC 821.

3.3.3.4 Mail data shall conform to the requirements of the document entitled "Standard For The Format Of ARPA Internet Text Messages," RFC 822.

4. QUALITY ASSURANCE PROVISIONS

Quality assurance of the DDN interfaces and protocols shall be subject to the policy issued by the DDN PMO Test and Evaluation Branch, Code B617.

5. PREPARATION FOR DELIVERY

This section is not applicable to this specification.

6. NOTES

6.1 Intended use

Connection of subscriber devices to the DDN is governed by the interface requirements herein (see 3.1). Direct host connection to the DDN (see 3.1.1 and 3.1.2) and the provision of network services within a subscriber host system (see 3.2 and 3.3) are the responsibilities of the subscriber. The "off-loading" of the host level protocols (see 3.2) and the terminal-to-host service (see 3.3.1) may be accomplished by using standard NAC configurations.

6.2 Terms and definitions

Terms and definitions pertaining to this specification are contained in FED-STD-1037.

6.3 Glossary

ANSI	- American National Standards Institute
ASCII	- American National Standard Code for Information Interchange
ARPANET	- Advanced Research Projects Agency Network
BBN	- Bolt Beranek and Newman Inc.
CCITT	- International Telegraph and Telephone Consultative Committee
DCE	- Data Circuit-terminating Equipment
DDN	- Defense Data Network
DoD	- Department of Defense
DoDISS	- Department of Defense Index of Specifications and Standards
DTE	- Data Terminal Equipment
DTI	- Digital Technology Incorporated
EIA	- Electronic Industries Association
FIPS	- Federal Information Processing Standards
GPO	- Government Printing Office
HDH	- HDLC Distant Host
HDLC	- High-level Data Link Control
HFEP	- Host Front End Processor
HFP	- Host Front-end Protocol
HIP	- Host to IPLI Protocol
ICMP	- Internet Control Message Protocol
IMP	- Interface Message Processor

IP	- Internet Protocol
IPLI	- Internet Private Line Interface
LAP B	- Link Access Procedures (Balanced)
mini-TAC	- mini-Terminal Access Controller
NAC	- Network Access Component
NIC	- Network Information Center
NPFC	- Naval Publications and Forms Center
NTIS	- National Technical Information Service
PMO	- Program Management Office
RFC	- Request for Comments
SMTP	- Simple Mail Transfer Protocol
TAC	- Terminal Access Controller
TBD	- To Be Determined
TCP	- Transmission Control Protocol
TEP	- Terminal Emulation Processor
WWMCCS	- Worldwide Military Command and Control System
X.25	- CCITT protocol standard

READER'S COMMENT FORM

DDN Subscriber Interface Guide

It is the intent of the Defense Data Network Program Management Office to support subscribers throughout the entire process of transitioning systems to the DDN. This Guide has been prepared to assist subscribers in one phase of that process: the selection and acquisition of interfaces for connecting their hosts and terminals to the DDN.

Comments concerning this Guide may be made in the space provided below. Comments on the following topics are especially solicited:

1. What aspects of the Guide did you find most helpful?
2. What additions, deletions, or clarifications would make this Guide more useful?
3. What site-specific problems do you have that are not adequately addressed in this Guide?

Comments:

Please fill in the requested information.

Position: ____________________

Name (Optional): ____________________

Address (Optional): ____________________

Status of your system's current or planned DDN connectivity: ____________________

____

Thank you for your cooperation.

Reader's Comment Form

Fold and tape Please Do Not Staple Fold and tape

Place Stamp Here

Defense Communications Agency

ATTN: DDN PMO, Code B610

Washington, DC 20305

Fold and tape Please Do Not Staple Fold and tape

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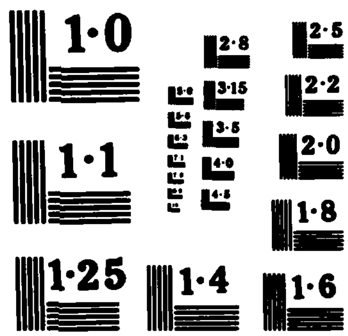
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SUPPLEMENTARY

INFORMATION

ERRATA PAGES

TO

Subscriber Interface Specification

(Appendix A of Defense Data Network Subscriber Interface Guide)

<u>Update Summary Sheet</u>

19 June 1984

1. Page A-6, line 14, and page A-8, line 1: change "X3.15-1979" to "X3.15-1976".

2. Page A-6, line 19, and page A-8, line 4: change "X3.16-1979" to "X3.16-1976".

3. Page A-6, line 23, and page A-7, line 25: change "X3.1-1979" to X3.1-1976".

4. Page A-6, lines 24 through 27: delete.

5. Page A-6, line 29: change "INT-FED-STD-1041" to "FED-STD-1041-FIPS PUB 100".

6. Page A-7: insert "MIL-STD-188-114, Electrical Characteristics of Digital Interface Circuits" after line 14.

7. Page A-7: insert "MIL-STD-1780, File Transfer Protocol", "MIL-STD-1781, Simple Mail Transfer Protocol", "MIL-STD-1782, TELNET Protocol" after line 16.

8. Page A-8: insert "EIA RS-422-A, Electrical Characteristics of Balanced Voltage Digital Interface Circuits", "EIA RS-423-A, Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits" after line 12.

9. Page A-8: insert "EIA IEB 12, Application Notes on Interconnection Between Interface Circuits Using RS-449 and RS-232-C" after line 16.

10. Page A-8, line 29: delete.

11. Page A-9, line 3 and line 4: delete.

12. Page A-9: insert "RFC 870, Assigned Numbers, October 1983" after line 6.

13. Page A-9, lines 7 through 13: delete.

14. Page A-9, lines 21 through 24: delete.

15. Page A-10, line 2: change "Corporation" to "Corporation, February 1984".

16. Page A-10: insert "Defense Data Network X.25 Host Interface Specification, Defense Communications Agency, December 1983", "Interface Message Processor - Specifications for the Interconnection of a Host and an IMP, Appendix J and Appendix K for BBN Report No. 1822, Bolt, Beranek and Newman, Inc., December 1983" after line 2.

17. Page A-11, paragraphs 3.1.1.2.1, 3.1.1.2.2: delete. Renumber 3.1.1.2.3 to 3.1.1.2.2.

18. Page A-11: insert "3.1.1.2.1 The physical interface shall conform to the requirements of Appendix J.2 of the document entitled, INTERFACE MESSAGE PROCESSOR - Specifications for the Interconnection of a Host and an IMP, BBN Report No. 1822". [Subscribers should select the interface based on operational requirements, coordinated with the DDN Program Management Office (PMO).]

19. Page A-12, lines 7 through 10, delete "Subscribers may not implement an X.25 interface until an approved DDN X.25 specification has been issued".

20. Page A-12, lines 14 through 16: change "the document entitled "INTERFACE MESSAGE PROCESSOR - Specifications for the

Interconnection of a Host and an IMP, BBN Report No. 1822" to read "BBN Report No. 1822".

21. Page A-12, line 19: change "(RFC) 820" to "(RFC) 870".

22. Page A-13, line 2: change "Section 4.2 of INT-FED-STD-1041" to "FED-STD-1041—FIPS PUB 100".

23. Page A-13, line 9: change "DDN X.25 Specification, to be issued in a revision to this specification." to "Defense Data Network X.25 Host Interface Specification".

24. Page A-14, line 5: change "RFC 820" to "RFC 870".

25. Page A-14, line 17: change "Section 4.2 of INT-FED-STD-1041" to "FED-STD-1041—FIPS PUB 100".

26. Page A-15, line 3: change "FED-STD-1031. The provisions of Section 6.C shall apply" to "EIA RS-449, Category I circuits shall implement EIA RS-422-A as prescribed in Section 6.11 of RS-449. The additional provisions of MIL-STD-188-114 shall apply".

27. Page A-15, line 5: change "those designated O (optional) in Table 7 of BBN Report No. 5224 shall be implemented" to "Test Mode (TM) and those designated "A" or "O" in Figure 5.1 of EIA RS-449 shall be implemented".

28. Page A-15, line 24: change "Section 4.2 of INT-FED-STD-1041" to "FED-STD-1041—FIPS PUB 100".

29. Page A-16, line 8: change "FED-STD-1031" to "EIA RS-449".

30. Page A-16, line 9: change "the provisions of Section 6.A shall apply." to "generators on all Category I circuits shall conform to EIA RS-423-A and the provisions described in EIA IEB 12 shall be met".

31. Page A-16, lines 10 through 12: change "the provisions of Section 6.B shall apply. For all other interfaces, the provision of Section 6.C shall apply" to "generators on all Category I circuits shall conform to EIA RS-423A (MIL-STD-188-114 unbalanced circuits) and shall have an option which will allow changing the signal sense from the negative mark to positive mark. For all other interfaces, all provisions of EIA RS-449 shall apply. Category I circuits may implement either EIA RS-422-A or EIA RS-423-A as prescribed in Section 6.11 of EIA RS-449. When EIA RS-422-A is employed for MIL-STD-188 applications, the additional provisions of MIL-STD-188-114 shall apply".

32. Page 16, lines 15-16: change "those designated O (optional) in Table 7 of BBN Report No. 5224" to "Test Mode (TM) and those designated "A" or "O" in Figure 5.1 of EIA RS-449".

33. Page 16, line 22: change "9400" to "9600".

34. Page A-18, line 3: change "FED-STD-1031" to "EIA RS-449".

35. Page A-18, line 3: change "For all terminals conforming to EIA RS-232-C, the provisions of Section 6.A shall apply. For all terminals conforming to MIL-STD-188C or MIL-STD-188-100, the provisions of Section 6.B shall apply. For all other terminals, the provisions of Section 6.C shall apply." to "For all interfaces conforming to EIA RS-232-C, generators on all Category I circuits shall conform to EIA RS-423-A and the provisions described in IEB 12 shall be met. For all interfaces conforming to MIL-STD-188C or MIL-STD-188-100, generators on all Category I circuits shall conform to EIA RS-423-A (MIL-STD-188-114 unbalanced circuits) and shall have an option that will allow changing the signal sense from the negative mark to positive mark. For all other interfaces, all provisions of EIA RS-449 shall apply. Category I circuits may implement either EIA RS-422-A or EIA RS-423-A as prescribed in Section 6.11 of EIA RS-449. When EIA RS-422A is employed for MIL-STD-188 applications, the additional provisions of MIL-STD-188-114 shall apply".

36. Page A-18, line 10: change "those designated O (optional) in Table 7 of BBN Report No. 5224" to "Test Mode (TM) and those designated "A" or "O" in Figure 5.1 of EIA RS-449".

37. Page A-19, lines 1 through 3, delete.

38. Page A-19, line 18: change "The maximum" to "The default maximum".

39. Page A-19, line 22: change "RFC 820" to "RFC 870".

40. Page A-21, line 2: change "RFC 820" to "RFC 870".

41. Page A-21, line 9: change "the document entitled "TELNET Protocol Specification, "RFC 854." to "MIL-STD-1782".

42. Page A-21, paragraph 3.3.1.2, delete.

43. Page A-21: insert "3.3.1.2 As a minimum, the DoD approved TELNET options, as specified in the appendices to MIL-STD-1782, shall be supported."

44. Page A-21, lines 21-22: change "the document entitled "File Transfer Protocol," RFC 765." to "MIL-STD-1780".

45. Page A-21, paragraph 3.3.2.2, delete.

46. Page A-21: insert "3.3.2.2 As a minimum, servers shall implement the FTP commands specified in Section 5.9.1 of MIL-STD-1780.", after line 22.

47. Page A-22, lines 17-18: change "the document entitled "Simple Mail Transfer Protocol", RFC 821." to "MIL-STD-1781".

48. Page A-22, line 20: change "Section 4.1.2 of RFC 821" to "Section 6.1.3.3 of MIL-STD-1781".

49. Page A-22, line 24: change "Section 4.5.1 of RFC 821" to "Section 6.5.1 of MIL-STD-1781".

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