Network Working Group J. Reynolds
Request for Comments: 1011 J. Postel
ISI
Obsoletes: RFCs 991, 961, 943, 924, 901, 880, 840 May 1987

OFFICIAL INTERNET PROTOCOLS

STATUS OF THIS MEMO

This memo is an official status report on the protocols used in the Internet community. Distribution of this memo is unlimited.

INTRODUCTION

This RFC identifies the documents specifying the official protocols used in the Internet. Comments indicate any revisions or changes planned.

To first order, the official protocols are those specified in the "DDN Protocol Handbook" (DPH), dated December 1985 (this is a three volume set with a total thickness of about 5 inches).

Older collections that include many of these specifications are the "Internet Protocol Transition Workbook" (IPTW), dated March 1982; the "Internet Mail Protocols", dated November 1982; and the "Internet Telnet Protocols and Options", dated June 1983. There is also a volume of protocol related information called the "Internet Protocol Implementers Guide" (IPIG) dated August 1982. An even older collection is the "ARPANET Protocol Handbook" (APH) dated January 1978. Nearly all the relevant material from these collections has been reproduced in the current DPH.

The following material is organized as a sketchy outline. The entries are protocols (e.g., Transmission Control Protocol). In each entry there are notes on status, specification, comments, other references, dependencies, and contact.

The STATUS is one of: required, recommended, elective, experimental, or none.

The SPECIFICATION identifies the protocol defining documents.

The COMMENTS describe any differences from the specification or problems with the protocol.

The OTHER REFERENCES identify documents that comment on or expand on the protocol.

The DEPENDENCIES indicate what other protocols are called upon by this protocol.

The CONTACT indicates a person who can answer questions about the protocol.

In particular, the status may be:

required

- all hosts must implement the required protocol,

recommended

- all hosts are encouraged to implement the recommended protocol,

elective

- hosts may implement or not the elective protocol,

experimental

- hosts should not implement the experimental protocol unless they are participating in the experiment and have coordinated their use of this protocol with the contact person, and

none

- this is not a protocol.

For further information about protocols in general, please contact:

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OVERVIEW

Catenet Model ----------

STATUS: None

SPECIFICATION: IEN 48 (in DPH)

COMMENTS:

Gives an overview of the organization and principles of the Internet.

Could be revised and expanded.

OTHER REFERENCES:

Leiner, B., Cole R., Postel, J., and D. Mills, "The DARPA Protocol Suite", IEEE INFOCOM 85, Washington, D.C., March 1985. Also in IEEE Communications Magazine, and as ISI/RS-85-153, March 1985.

Postel, J., "Internetwork Applications Using the DARPA Protocol Suite", IEEE INFOCOM 85, Washington, D.C., March 1985. Also in IEEE Communications Magazine, and as ISI/RS-85-151, April 1985.

Padlipsky, M.A., "The Elements of Networking Style and other Essays and Animadversions on the Art of Intercomputer Networking", Prentice-Hall, New Jersey, 1985.

RFC 871 - A Perspective on the ARPANET Reference Model

DEPENDENCIES:

CONTACT: Postel@ISI.EDU

NETWORK LEVEL

Internet Protocol ---------- (IP)

STATUS: Required

SPECIFICATION: RFC 791 (in DPH)

COMMENTS:

This is the universal protocol of the Internet. This datagram protocol provides the universal addressing of hosts in the Internet.

A few minor problems have been noted in this document.

The most serious is a bit of confusion in the route options. The route options have a pointer that indicates which octet of the route is the next to be used. The confusion is between the phrases "the pointer is relative to this option" and "the smallest legal value for the pointer is 4". If you are confused, forget about the relative part, the pointer begins at 4. The MIL-STD description of source routing is wrong in some of the details.

Another important point is the alternate reassembly procedure suggested in RFC 815.

Some changes are in the works for the security option.

Note that ICMP is defined to be an integral part of IP. You have not completed an implementation of IP if it does not include ICMP.

The subnet procedures defined in RFC 950 are now considered an essential part of the IP architecture and must be implemented by all hosts and gateways.

OTHER REFERENCES:

RFC 815 (in DPH) - IP Datagram Reassembly Algorithms

RFC 814 (in DPH) - Names, Addresses, Ports, and Routes

RFC 816 (in DPH) - Fault Isolation and Recovery

RFC 817 (in DPH) - Modularity and Efficiency in Protocol Implementation

MIL-STD-1777 (in DPH) - Military Standard Internet Protocol

RFC 963 - Some Problems with the Specification of the Military Standard Internet Protocol

DEPENDENCIES:

CONTACT: Postel@ISI.EDU

Internet Control Message Protocol ---------- (ICMP)

STATUS: Required

SPECIFICATION: RFC 792 (in DPH)

COMMENTS:

The control messages and error reports that go with the Internet Protocol.

A few minor errors in the document have been noted. Suggestions have been made for additional types of redirect message and additional destination unreachable messages.

Two additional ICMP message types are defined in RFC 950 "Internet Subnets", Address Mask Request (A1=17), and Address Mask Reply (A2=18).

Note that ICMP is defined to be an integral part of IP. You have not completed an implementation of IP if it does not include ICMP.

OTHER REFERENCES: RFC 950

DEPENDENCIES: Internet Protocol

CONTACT: Postel@ISI.EDU

Internet Group Multicast Protocol ---------- (IGMP)

STATUS: Recommended

SPECIFICATION: RFC 988

COMMENTS:

This protocol specifies the extensions required of a host implementation of the Internet Protocol (IP) to support internetwork multicasting. This specification supersedes that given in RFC 966, and constitutes a proposed protocol standard for IP multicasting in the Internet. Reference RFC 966 for a discussion of the motivation and rationale behind the multicasting extension specified here.

OTHER REFERENCES: RFC 966

DEPENDENCIES: Internet Protocol

CONTACT: Deering@PESCADERO.STANFORD.EDU

HOST LEVEL

User Datagram Protocol ---------- (UDP)

STATUS: Recommended

SPECIFICATION: RFC 768 (in DPH)

COMMENTS:

Provides a datagram service to applications. Adds port addressing to the IP services.

The only change noted for the UDP specification is a minor clarification that if in computing the checksum a padding octet is used for the computation it is not transmitted or counted in the length.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol

CONTACT: Postel@ISI.EDU

Transmission Control Protocol ---------- (TCP)

STATUS: Recommended

SPECIFICATION: RFC 793 (in DPH)

COMMENTS:

Provides reliable end-to-end data stream service.

Many comments and corrections have been received for the TCP specification document. These are primarily document bugs rather than protocol bugs.

Event Processing Section: There are many minor corrections and clarifications needed in this section.

Push: There are still some phrases in the document that give a "record mark" flavor to the push. These should be further clarified. The push is not a record mark.

Urgent: Page 17 is wrong. The urgent pointer points to the last octet of urgent data (not to the first octet of non-urgent data).

Listening Servers: Several comments have been received on difficulties with contacting listening servers. There should be some discussion of implementation issues for servers, and some notes on alternative models of system and process organization for servers.

Maximum Segment Size: The maximum segment size option should be generalized and clarified. It can be used to either increase or decrease the maximum segment size from the default. The TCP Maximum Segment Size is the IP Maximum Datagram Size minus forty. The default IP Maximum Datagram Size is 576. The default TCP Maximum Segment Size is 536. For further discussion, see RFC 879.

Idle Connections: There have been questions about automatically closing idle connections. Idle connections are ok, and should not be closed. There are several cases where idle connections arise, for example, in Telnet when a user is thinking for a long time following a message from the server computer before his next input. There is no TCP "probe" mechanism, and none is needed.

Queued Receive Data on Closing: There are several points where it is not clear from the description what to do about data received by the TCP but not yet passed to the user, particularly when the connection is being closed. In general, the data is to be kept to give to the user if he does a RECV call.

Out of Order Segments: The description says that segments that arrive out of order, that is, are not exactly the next segment to be processed, may be kept on hand. It should also point out that there is a very large performance penalty for not doing so.

User Time Out: This is the time out started on an open or send call. If this user time out occurs the user should be notified, but the connection should not be closed or the TCB deleted. The user should explicitly ABORT the connection if he wants to give up.

OTHER REFERENCES:

RFC 813 (in DPH) - Window and Acknowledgement Strategy in TCP

RFC 814 (in DPH) - Names, Addresses, Ports, and Routes

RFC 816 (in DPH) - Fault Isolation and Recovery

RFC 817 (in DPH) - Modularity and Efficiency in Protocol Implementation

RFC 879 - TCP Maximum Segment Size

RFC 889 - Internet Delay Experiments

RFC 896 - TCP/IP Congestion Control

MIL-STD-1778 (in DPH) - Military Standard Transmission Control Protocol

RFC 964 - Some Problems with the Specification of the Military Standard Transmission Control Protocol

Zhang, Lixia, "Why TCP Timers Don’t Work Well", Communications Architectures and Protocols, ACM SIGCOMM Proceedings, Computer Communications Review, V.16, N.3, August 1986.

DEPENDENCIES: Internet Protocol

CONTACT: Postel@ISI.EDU

Bulk Data Transfer Protocol ---------- (NETBLT)

STATUS: Experimental

SPECIFICATION: RFC 998

COMMENTS:

This is a revised RFC on the discussion of the Network Block Transfer (NETBLT) protocol.

NETBLT (NETwork BLock Transfer) is a transport level protocol intended for the rapid transfer of a large quantity of data between computers. It provides a transfer that is reliable and flow controlled, and is designed to provide maximum throughput over a wide variety of networks. Although NETBLT currently

runs on top of the Internet Protocol (IP), it should be able to operate on top of any datagram protocol similar in function to IP.

This document is published for discussion and comment, and does not constitute a standard. The proposal may change and certain parts of the protocol have not yet been specified; implementation of this document is therefore not advised.

OTHER REFERENCES: RFC 969

DEPENDENCIES: Transmission Control Protocol, User Datagram Protocol

CONTACT: markl@PTT.LCS.MIT.EDU

Exterior Gateway Protocol ---------- (EGP)

STATUS: Recommended for Gateways

SPECIFICATION: RFC 888, RFC 904 (in DPH), RFC 975, RFC 985

COMMENTS:

The protocol used between gateways of different administrations to exchange routing information.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: RFC 827, RFC 890

DEPENDENCIES: Internet Protocol

CONTACT: Mills@UDEL.EDU

Gateway Gateway Protocol ---------- (GGP)

STATUS: Experimental

SPECIFICATION: RFC 823 (in DPH)

COMMENTS:

The gateway protocol now used in the core gateways.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol

CONTACT: Brescia@BBN.COM

Host Monitoring Protocol ---------- (HMP)

STATUS: Elective

SPECIFICATION: RFC 869 (in DPH)

COMMENTS:

This is a good tool for debugging protocol implementations in remotely located computers.

This protocol is used to monitor Internet gateways and the TACs.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol

CONTACT: Hinden@BBN.COM

Reliable Data Protocol ---------- (RDP)

STATUS: Experimental

SPECIFICATION: RFC 908 (in DPH)

COMMENTS:

This protocol is designed to efficiently support the bulk transfer of data for such host monitoring and control applications as loading/dumping and remote debugging. The protocol is intended to be simple to implement but still be efficient in environments where there may be long transmission delays and loss or non-sequential delivery of message segments.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol

CONTACT: CWelles@BBN.COM

Internet Reliable Transaction Protocol ---------- (IRTP)

STATUS: Experimental

SPECIFICATION: RFC 938

COMMENTS:

This protocol is a transport level host to host protocol designed for an internet environment. While the issues discussed may not be directly relevant to the research problems of the Internet community, they may be interesting to a number of researchers and implementors.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol

CONTACT: Trudy@ACC.ARPA

Cross Net Debugger ---------- (XNET)

STATUS: Elective

SPECIFICATION: IEN 158 (in DPH)

COMMENTS:

A debugging protocol, allows debugger like access to remote systems.

This specification should be updated and reissued as an RFC.

OTHER REFERENCES: RFC 643

DEPENDENCIES: Internet Protocol

CONTACT: Postel@ISI.EDU

Multiplexing Protocol ---------- (MUX)

STATUS: Experimental

SPECIFICATION: IEN 90 (in DPH)

COMMENTS:

Defines a capability to combine several segments from different higher level protocols in one IP datagram.

No current experiment in progress. There is some question as to the extent to which the sharing this protocol envisions can actually take place. Also, there are some issues about the information captured in the multiplexing header being (a) insufficient, or (b) over specific.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol

CONTACT: Postel@ISI.EDU

Stream Protocol ---------- (ST)

STATUS: Experimental

SPECIFICATION: IEN 119 (in DPH)

COMMENTS:

A gateway resource allocation protocol designed for use in multihost real time applications.

The implementation of this protocol has evolved and may no longer be consistent with this specification. The document should be updated and issued as an RFC.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol

CONTACT: jwf@LL-EN.ARPA

Network Voice Protocol ---------- (NVP-II)

STATUS: Experimental

SPECIFICATION: ISI Internal Memo

COMMENTS:

Defines the procedures for real time voice conferencing.

The specification is an ISI Internal Memo which should be updated and issued as an RFC.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: RFC 741 (in DPH)

DEPENDENCIES: Internet Protocol, Stream Protocol

CONTACT: Casner@ISI.EDU

APPLICATION LEVEL

Telnet Protocol ---------- (TELNET)

STATUS: Recommended

SPECIFICATION: RFC 854 (in DPH)

COMMENTS:

The protocol for remote terminal access.

This has been revised since the IPTW. RFC 764 in IPTW is now obsolete.

OTHER REFERENCES:

MIL-STD-1782 (in DPH) - Telnet Protocol

DEPENDENCIES: Transmission Control Protocol

CONTACT: Postel@ISI.EDU

Telnet Options ---------- (TELNET-OPTIONS)

STATUS: Elective

SPECIFICATION: General description of options: RFC 855 (in DPH)

Number	Name	RFC	NIC	DPH	USE
0	Binary Transmission	856	-----	yes	yes
1	Echo	857	-----	yes	yes
2	Reconnection	...	15391	yes	no
3	Suppress Go Ahead	858	-----	yes	yes
4	Approx Message Size Negotiation	...	15393	yes	no
5	Status	859	-----	yes	yes
6	Timing Mark	860	-----	yes	yes
7	Remote Controlled Trans and Echo	726	39237	yes	no
8	Output Line Width	...	20196	yes	no
9	Output Page Size	...	20197	yes	no
10	Output Carriage-Return Disposition	652	31155	yes	no
11	Output Horizontal Tabstops	653	31156	yes	no
12	Output Horizontal Tab Disposition	654	31157	yes	no
13	Output Formfeed Disposition	655	31158	yes	no
14	Output Vertical Tabstops	656	31159	yes	no
15	Output Vertical Tab Disposition	657	31160	yes	no
16	Output Linefeed Disposition	658	31161	yes	no
17	Extended ASCII	698	32964	yes	no
18	Logout	727	40025	yes	no
19	Byte Macro	735	42083	yes	no
20	Data Entry Terminal	732	41762	yes	no
21	SUPDUP	734 736	42213	yes	no
22	SUPDUP Output	749	45449	yes	no
23	Send Location	779	-----	yes	no
24	Terminal Type	930	-----	yes	no
25	End of Record	885	-----	yes	no
26	TACACS User Identification	927	-----	yes	no
27	Output Marking	933	-----	yes	no
28	Terminal Location Number	946	-----	no	no
255	Extended-Options-List	861	-----	yes	yes

The DHP column indicates if the specification is included in the DDN Protocol Handbook. The USE column of the table above indicates which options are in general use.

COMMENTS:

The Binary Transmission, Echo, Suppress Go Ahead, Status,

Timing Mark, and Extended Options List options have been recently updated and reissued. These are the most frequently implemented options.

The remaining options should be reviewed and the useful ones should be revised and reissued. The others should be eliminated.

The following are recommended: Binary Transmission, Echo, Suppress Go Ahead, Status, Timing Mark, and Extended Options List.

OTHER REFERENCES:

DEPENDENCIES: Telnet

CONTACT: Postel@ISI.EDU

SUPDUP Protocol ---------- (SUPDUP)

STATUS: Elective

SPECIFICATION: RFC 734 (in DPH)

COMMENTS:

A special Telnet like protocol for display terminals.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol

CONTACT: Crispin@SU-SCORE.STANFORD.EDU

File Transfer Protocol ---------- (FTP)

STATUS: Recommended

SPECIFICATION: RFC 959 (in DPH)

COMMENTS:

The protocol for moving files between Internet hosts. Provides for access control and negotiation of file parameters.

The following new optional commands are included in this edition of the specification: Change to Parent Directory

(CDUP), Structure Mount (SMNT), Store Unique (STOU), Remove Directory (RMD), Make Directory (MKD), Print Directory (PWD), and System (SYST). Note that this specification is compatible with the previous edition (RFC 765).

A discrepancy has been found in the specification in the examples of Appendix II. On page 63, a response code of 200 is shown as the response to a CWD command. Under the list of Command-Reply Sequences cited on page 50, CWD is shown to only accept a 250 response code. Therefore, if one would interpret a CWD command as being excluded from the File System functional category, one may assume that the response code of 200 is correct, since CDUP as a special case of CWD does use 200.

OTHER REFERENCES:

RFC 678 (in DPH) - Document File Format Standards

MIL-STD-1780 (in DPH) - File Transfer Protocol

DEPENDENCIES: Transmission Control Protocol

CONTACT: Postel@ISI.EDU

Trivial File Transfer Protocol ---------- (TFTP)

STATUS: Elective

SPECIFICATION: RFC 783 (in IPTW)

COMMENTS:

A very simple file moving protocol, no access control is provided.

This is in use in several local networks.

Ambiguities in the interpretation of several of the transfer modes should be clarified, and additional transfer modes could be defined. Additional error codes could be defined to more clearly identify problems.

Note: The DPH contains IEN-133, which is an obsolete version of this protocol.

OTHER REFERENCES:

DEPENDENCIES: User Datagram Protocol

CONTACT: Postel@ISI.EDU

Simple File Transfer Protocol ---------- (SFTP)

STATUS: Experimental

SPECIFICATION: RFC 913 (in DPH)

COMMENTS:

SFTP is a simple file transfer protocol. It fills the need of people wanting a protocol that is more useful than TFTP but easier to implement (and less powerful) than FTP. SFTP supports user access control, file transfers, directory listing, directory changing, file renaming and deleting.

SFTP can be implemented with any reliable 8-bit byte stream oriented protocol, this document describes its TCP specification. SFTP uses only one TCP connection; whereas TFTP implements a connection over UDP, and FTP uses two TCP connections (one using the TELNET protocol).

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol

CONTACT: MKL@SRI-NIC.ARPA

Simple Mail Transfer Protocol ---------- (SMTP)

STATUS: Recommended

SPECIFICATION: RFC 821 (in DPH)

COMMENTS:

The procedure for transmitting computer mail between hosts.

This has been revised since the IPTW, it is in the "Internet Mail Protocols" volume of November 1982. RFC 788 (in IPTW) is obsolete.

There have been many misunderstandings and errors in the early implementations. Some documentation of these problems can be found in the file [C.ISI.EDU]<SMTP>MAIL.ERRORS.

Some minor differences between RFC 821 and RFC 822 should be resolved.

OTHER REFERENCES:

RFC 822 - Mail Header Format Standards

This has been revised since the IPTW, it is in the "Internet Mail Protocols" volume of November 1982. RFC 733 (in IPTW) is obsolete. Further revision of RFC 822 is needed to correct some minor errors in the details of the specification.

Note: RFC 822 is not included in the DPH (an accident, it should have been).

MIL-STD-1781 (in DPH) - Simple Mail Transfer Protocol (SMTP)

DEPENDENCIES: Transmission Control Protocol

CONTACT: Postel@ISI.EDU

Network News Transfer Protocol ---------- (NNTP)

STATUS: Experimental

SPECIFICATION: RFC 977

COMMENTS:

NNTP specifies a protocol for the distribution, inquiry, retrieval, and posting of news articles using a reliable stream-based transmission of news among the Internet community. NNTP is designed so that news articles are stored in a central database allowing a subscriber to select only those items he wishes to read. Indexing, cross-referencing, and expiration of aged messages are also provided.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol

CONTACT: Brian@SDCSVAX.UCSD.EDU

Post Office Protocol - Version 2 ---------- (POP2)

STATUS: Experimental

SPECIFICATION: RFC 937 (in DPH)

COMMENTS:

The intent of the Post Office Protocol - Version 2 (POP2) is to allow a user's workstation to access mail from a mailbox server. It is expected that mail will be posted from the workstation to the mailbox server via the Simple Mail Transfer Protocol (SMTP).

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: Obsoletes RFC 918

DEPENDENCIES: Transmission Control Protocol

CONTACT: JKReynolds@ISI.EDU

NetBIOS Services Protocol ---------- (NETBIOS)

STATUS: Recommended

SPECIFICATION: RFC 1001, 1002

COMMENTS:

These documents define a proposed standard protocol to support NetBIOS services in a TCP/IP environment. Both local network and internet operation are supported. Various node types are defined to accomodate local and internet topologies and to allow operation with or without the use of IP broadcast

RFC 1001 describes the NetBIOS-over-TCP protocols in a general manner, with emphasis on the underlying ideas and techniques. RFC 1002 gives the detailed specifications of the NetBIOS-over-TCP packets, protocols, and defined constants and variables.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol, User Datagram Protocol

CONTACT: Auerbach@CSL.SRI.COM

Bootstrap Protocol ---------- (BOOTP)

STATUS: Experimental

SPECIFICATION: RFC 951

COMMENTS:

This proposed protocol provides an IP/UDP bootstrap protocol which allows a diskless client machine to discover its own IP address, the address of a server host, and the name of a file to be loaded into memory and executed.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol, User Datagram Protocol

CONTACT: Croft@SUMEX-AIM.STANFORD.EDU

Loader Debugger Protocol ---------- (LDP)

STATUS: Experimental

SPECIFICATION: RFC 909

COMMENTS:

Specifies a protocol for loading, dumping and debugging target machines from hosts in a network environment. It is also designed to accommodate a variety of target CPU types. It provides a powerful set of debugging services, while at the same time, it is structured so that a simple subset may be implemented in applications like boot loading where efficiency and space are at a premium.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Reliable Data Protocol

CONTACT: Hinden@BBN.COM

Resource Location Protocol ---------- (RLP)

STATUS: Elective

SPECIFICATION: RFC 887 (in DPH)

COMMENTS:

A resource location protocol for use in the Internet. This protocol utilizes the User Datagram Protocol (UDP) which in turn calls on the Internet Protocol to deliver its datagrams.

OTHER REFERENCES:

DEPENDENCIES: User Datagram Protocol

CONTACT: Accetta@A.CS.CMU.EDU

Remote Job Entry ---------- (RJE)

STATUS: Elective

SPECIFICATION: RFC 407 (in DPH)

COMMENTS:

The general protocol for submitting batch jobs and retrieving the results.

Some changes needed for use with TCP.

No known active implementations.

OTHER REFERENCES:

DEPENDENCIES: File Transfer Protocol, Transmission Control Protocol

CONTACT: Postel@ISI.EDU

Remote Job Service ---------- (NETRJS)

STATUS: Elective

SPECIFICATION: RFC 740 (in DPH)

COMMENTS:

A special protocol for submitting batch jobs and retrieving the results used with the UCLA IBM OS system.

Please discuss any plans for implementation or use of this protocol with the contact.

Revision in progress.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol

CONTACT: Braden@ISI.EDU

Remote Telnet Service ---------- (RTELNET)

STATUS: Elective

SPECIFICATION: RFC 818 (in DPH)

COMMENTS:

Provides special access to user Telnet on a remote system.

OTHER REFERENCES:

DEPENDENCIES: Telnet, Transmission Control Protocol

CONTACT: Postel@ISI.EDU

Graphics Protocol ---------- (GRAPHICS)

STATUS: Elective

SPECIFICATION: NIC 24308 (in DPH)

COMMENTS:

The protocol for vector graphics.

Very minor changes needed for use with TCP.

No known active implementations.

Note: The DPH claims that this is RFC 493, but RFC 493 is actually a different earlier specification.

OTHER REFERENCES:

DEPENDENCIES: Telnet, Transmission Control Protocol

CONTACT: Postel@ISI.EDU

Echo Protocol ---------- (ECHO)

STATUS: Recommended

SPECIFICATION: RFC 862 (in DPH)

COMMENTS:

Debugging protocol, sends back whatever you send it.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol
or User Datagram Protocol

CONTACT: Postel@ISI.EDU

Discard Protocol ---------- (DISCARD)

STATUS: Elective

SPECIFICATION: RFC 863 (in DPH)

COMMENTS:

Debugging protocol, throws away whatever you send it.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol
or User Datagram Protocol

CONTACT: Postel@ISI.EDU

Character Generator Protocol ---------- (CHARGEN)

STATUS: Elective

SPECIFICATION: RFC 864 (in DPH)

COMMENTS:

Debugging protocol, sends you ASCII data.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol
or User Datagram Protocol

CONTACT: Postel@ISI.EDU

Quote of the Day Protocol ---------- (QUOTE)

STATUS: Elective

SPECIFICATION: RFC 865 (in DPH)

COMMENTS:

Debugging protocol, sends you a short ASCII message.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol
or User Datagram Protocol

CONTACT: Postel@ISI.EDU

Statistics Server ---------- (STATSRV)

STATUS: Recommended

SPECIFICATION: RFC 996

COMMENTS:

This RFC specifies a standard for the Internet community. Hosts and gateways on the Internet that choose to implement a remote statistics monitoring facility may use this protocol to send statistics data upon request to a monitoring center or debugging host.

OTHER REFERENCES:

DEPENDENCIES: Internet Protocol

CONTACT: Mills@UDEL.EDU

Active Users Protocol ---------- (USERS)

STATUS: Elective

SPECIFICATION: RFC 866 (in DPH)

COMMENTS:

Lists the currently active users.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol
or User Datagram Protocol

CONTACT: Postel@ISI.EDU

Finger Protocol ---------- (FINGER)

STATUS: Elective

SPECIFICATION: RFC 742 (in DPH)

COMMENTS:

Provides information on the current or most recent activity of a user.

Some extensions have been suggested.

Some changes are are needed for TCP.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol

CONTACT: Postel@ISI.EDU

WhoIs Protocol ---------- (NICNAME)

STATUS: Elective

SPECIFICATION: RFC 954 (in DPH)

COMMENTS:

Accesses the ARPANET Directory database. Provides a way to find out about people, their addresses, phone numbers, organizations, and mailboxes.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol

CONTACT: Feinler@SRI-NIC.ARPA

CSNET Mailbox Name Server Protocol ---------- (CSNET-NS)

STATUS: Experimental

SPECIFICATION: CS-DN-2 (in DPH)

COMMENTS:

Provides access to the CSNET data base of users to give information about users names, affiliations, and mailboxes.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol

CONTACT: Solomon@WISC.EDU

Domain Name Protocol ---------- (DOMAIN)

STATUS: Recommended

SPECIFICATION: RFC 881, RFC 882, RFC 883 (in DPH)

COMMENTS:

OTHER REFERENCES:

RFC 920 - Domain Requirements

RFC 921 - Domain Name Implementation Schedule - Revised

RFC 973 - Domain System Changes and Observations

RFC 974 - Mail Routing and the Domain System

DEPENDENCIES: Transmission Control Protocol
or User Datagram Protocol

CONTACT: Mockapetris@ISI.EDU

HOSTNAME Protocol ---------- (HOSTNAME)

STATUS: Elective

SPECIFICATION: RFC 953 (in DPH)

COMMENTS:

Accesses the Registered Internet Hosts database (HOSTS.TXT). Provides a way to find out about a host in the Internet, its Internet Address, and the protocols it implements.

OTHER REFERENCES:

RFC 952 - Host Table Specification

DEPENDENCIES: Transmission Control Protocol

CONTACT: Feinler@SRI-NIC.ARPA

Host Name Server Protocol ---------- (NAMESERVER)

STATUS: Experimental

SPECIFICATION: IEN 116 (in DPH)

COMMENTS:

Provides machine oriented procedure for translating a host name to an Internet Address.

This specification has significant problems: 1) The name syntax is out of date. 2) The protocol details are ambiguous, in particular, the length octet either does or doesn't include itself and the op code. 3) The extensions are not supported by any known implementation.

This protocol is now abandoned in favor of the DOMAIN protocol. Further implementations of this protocol are not advised.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: User Datagram Protocol

CONTACT: Postel@ISI.EDU

Daytime Protocol ---------- (DAYTIME)

STATUS: Elective

SPECIFICATION: RFC 867 (in DPH)

COMMENTS:

Provides the day and time in ASCII character string.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol
or User Datagram Protocol

CONTACT: Postel@ISI.EDU

Network Time Protocol ---------- (NTP)

STATUS: Experimental

SPECIFICATION: RFC 958

COMMENTS:

A proposed protocol for synchronizing a set of network clocks using a set of distributed clients and servers.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: RFC 778, RFC 891, RFC 956, and RFC 957.

DEPENDENCIES: User Datagram Protocol

CONTACT: Mills@UDEL.EDU

Time Server Protocol ---------- (TIME)

STATUS: Elective

SPECIFICATION: RFC 868 (in DPH)

COMMENTS:

Provides the time as the number of seconds from a specified reference time.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol
or User Datagram Protocol

CONTACT: Postel@ISI.EDU

DCNET Time Server Protocol ---------- (CLOCK)

STATUS: Experimental

SPECIFICATION: RFC 778

COMMENTS:

Provides a mechanism for keeping synchronized clocks.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Internet Control Message Protocol

CONTACT: Mills@UDEL.EDU

Authentication Service ---------- (AUTH)

STATUS: Experimental

SPECIFICATION: RFC 931

COMMENTS:

This server provides a means to determine the identity of a user of a particular TCP connection. Given a TCP port number pair, it returns a character string which identifies the owner of that connection on the server's system.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: Supercedes RFC 912

DEPENDENCIES: Transmission Control Protocol

CONTACT: StJohns@SRI-NIC.ARPA

Authentication Scheme ---------- (COOKIE-JAR)

STATUS: Experimental

SPECIFICATION: RFC 1004

COMMENTS:

This RFC focuses its discussion on authentication problems in the Internet and possible methods of solution.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES:

CONTACT: Mills@UDEL.EDU

Internet Message Protocol ---------- (MPM)

STATUS: Experimental

SPECIFICATION: RFC 759 (in DPH)

COMMENTS:

This is an experimental multimedia mail transfer protocol. The implementation is called a Message Processing Module or MPM.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

RFC 767 - Structured Document Formats

DEPENDENCIES: Transmission Control Protocol

CONTACT: Postel@ISI.EDU

Network Standard Text Editor ---------- (NETED)

STATUS: Elective

SPECIFICATION: RFC 569 (in DPH)

COMMENTS:

Describes a simple line editor which could be provided by every Internet host.

OTHER REFERENCES:

DEPENDENCIES:

CONTACT: Postel@ISI.EDU

APPENDICES

Internet Numbers ----------

STATUS: None

SPECIFICATION: RFC 997

COMMENTS:

Describes the fields of network numbers and autonomous system numbers that are assigned specific values for actual use, and lists the currently assigned values.

Issued March 1987, replaces RFC 990, RFC 790 in IPTW, and RFC 960.

OTHER REFERENCES:

CONTACT: Hostmaster@SRI-NIC.ARPA

Assigned Numbers ----------

STATUS: None

SPECIFICATION: RFC 1010

COMMENTS:

Describes the fields of various protocols that are assigned specific values for actual use, and lists the currently assigned values.

Issued May 1987, replaces RFC 990, RFC 790 in IPTW, and RFC 960.

OTHER REFERENCES:

CONTACT: JKREYNOLDS@ISI.EDU

Pre-emption ----------

STATUS: Elective

SPECIFICATION: RFC 794 (in DPH)

COMMENTS:

Describes how to do pre-emption of TCP connections.

OTHER REFERENCES:

CONTACT: Postel@ISI.EDU

Service Mappings ----------

STATUS: None

SPECIFICATION: RFC 795 (in DPH)

COMMENTS:

Describes the mapping of the IP type of service field onto the parameters of some specific networks.

Out of date, needs revision.

OTHER REFERENCES:

CONTACT: Postel@ISI.EDU

Address Mappings ----------

STATUS: None

SPECIFICATION: RFC 796 (in DPH)

COMMENTS:

Describes the mapping between Internet Addresses and the addresses of some specific networks.

Out of date, needs revision.

OTHER REFERENCES:

CONTACT: Postel@ISI.EDU

Document Formats ----------

STATUS: None

SPECIFICATION: RFC 678 (in DPH)

COMMENTS:

Describes standard format rules for several types of documents.

OTHER REFERENCES:

CONTACT: Postel@ISI.EDU

Equations Representation ----------

STATUS: None

SPECIFICATION: RFC 1003

COMMENTS:

Identifies and explores issues in defining a standard for the exchange of mathematical equations.

OTHER REFERENCES:

CONTACT: Katz@ISI.EDU

Bitmap Formats ----------

STATUS: None

SPECIFICATION: RFC 797 (in DPH)

COMMENTS:

Describes a standard format for bitmap data.

OTHER REFERENCES:

CONTACT: Postel@ISI.EDU

Facsimile Formats ----------

STATUS: None

SPECIFICATION: RFC 804

COMMENTS:

Describes a standard format for facsimile data.

OTHER REFERENCES: RFC 769 (in DPH)

CONTACT: Postel@ISI.EDU

Host-Front End Protocol ---------- (HFEP)

STATUS: Experimental

SPECIFICATION: RFC 929

COMMENTS:

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: RFC 928

DEPENDENCIES:

CONTACT: Padlipsky@ISI.EDU

Internet Protocol on ARPANET ---------- (IP-ARPA)

STATUS: Recommended

SPECIFICATION: BBN Report 1822

COMMENTS:

Describes the interface between a Host and an IMP, and by implication the transmission of IP Datagrams over the ARPANET.

OTHER REFERENCES: RFC 851, RFC 852, RFC 878 (in DPH), RFC 979, RFC 1005

CONTACT: Malis@BBN.COM

Internet Protocol on WBNET ---------- (IP-WB)

STATUS: Recommended

SPECIFICATION: RFC 907 (in DPH)

COMMENTS:

Describes a standard for the transmission of IP Datagrams over the Wideband Net.

This protocol specifies the network-access level communication between an arbitrary computer, called a host, and a packet-switched satellite network, e.g., SATNET or WBNET.

Note: Implementations of HAP should be performed in coordination with satellite network development and operations personnel.

OTHER REFERENCES:

CONTACT: Blumenthal@BBN.COM

Internet Protocol on Wideband Network ---------- (IP-WB)

STATUS: Recommended

SPECIFICATION: RFC 907 (in DPH)

COMMENTS:

Describes a standard for the transmission of IP Datagrams over the WBNET.

This protocol specifies the network-access level communication between an arbitrary computer, called a host, and a packet-switched satellite network, e.g., SATNET or WBNET.

Note: Implementations of HAP should be performed in coordination with satellite network development and operations personnel.

OTHER REFERENCES:

DEPENDENCIES:

CONTACT: Schoen@BBN.COM

Internet Protocol on X.25 Networks ---------- (IP-X25)

STATUS: Recommended

SPECIFICATION: RFC 877 (in DPH)

COMMENTS:

Describes a standard for the transmission of IP Datagrams over Public Data Networks.

OTHER REFERENCES:

CONTACT: jtk@PURDUE.EDU

Internet Protocol on DC Networks ---------- (IP-DC)

STATUS: Elective

SPECIFICATION: RFC 891 (in DPH)

COMMENTS:

OTHER REFERENCES:

RFC 778 - DCNET Internet Clock Service

CONTACT: Mills@UDEL.EDU

Internet Protocol on Ethernet Networks ---------- (IP-E)

STATUS: Recommended

SPECIFICATION: RFC 894 (in DPH)

COMMENTS:

OTHER REFERENCES: RFC 893

CONTACT: Postel@ISI.EDU

Internet Protocol on Experimental Ethernet Networks -------- (IP-EE)

STATUS: Recommended

SPECIFICATION: RFC 895 (in DPH)

COMMENTS:

OTHER REFERENCES:

CONTACT: Postel@ISI.EDU

Internet Protocol on IEEE 802 ---------- (IP-IEEE)

STATUS: Recommended

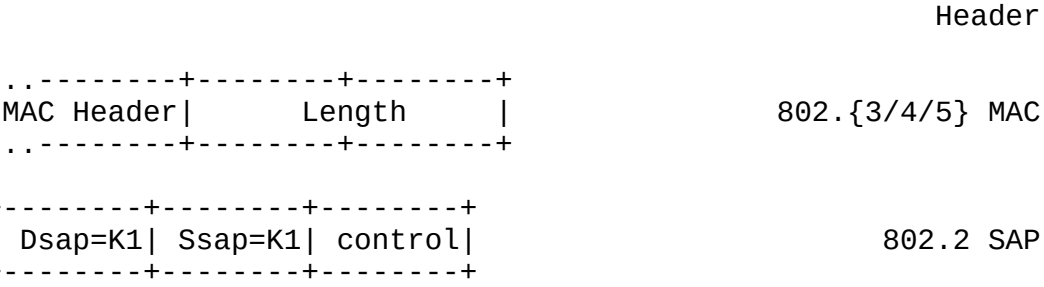
SPECIFICATION: see comments

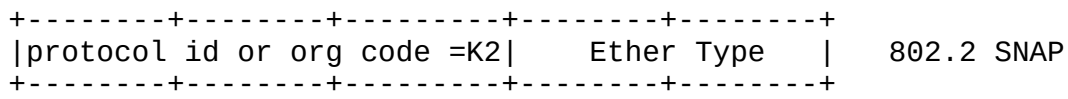
COMMENTS:

At an ad hoc special session on "IEEE 802 Networks and ARP" held during the TCP Vendors Workshop (August 1986), an approach to a consistent way to sent DOD-IP datagrams and other IP related protocols on 802 networks was developed.

Due to some evolution of the IEEE 802.2 standards and the need to provide for a standard way to do additional DOD-IP related protocols (such as Address Resolution Protocol (ARP)) on IEEE 802 networks, the following new policy is established, which will replace the current policy (see RFC-990 section on IEEE 802 Numbers of Interest, and RFC-948).

The policy is for DDN and Internet community to use IEEE 802.2 encapsulation on 802.3, 802.4, and 802.5 networks by using the SNAP with an organization code indicating that the following 16 bits specify the Ethertype code (where IP = 2048 (0800 hex), see RFC-1010 section on Ethernet Numbers of Interest).





The total length of the SAP Header and the SNAP header is 8-octets, making the 802.2 protocol overhead come out on a nice boundary.

K1 is 170. The IEEE like to talk about things in bit transmission order and specifies this value as 01010101. In big-endian order, as used in Internet specifications, this becomes 10101010 binary, or AA hex, or 170 decimal.

K2 is 0 (zero).

Note: The method described in RFC 948 (in DPH) is no longer to be used.

OTHER REFERENCES:

CONTACT: Postel@ISI.EDU

Internet Subnet Protocol ---------- (IP-SUB)

STATUS: Required

SPECIFICATION: RFC 950

COMMENTS:

This is a very important feature and must be included in all IP implementations.

Specifies procedures for the use of subnets, which are logical sub-sections of a single Internet network.

OTHER REFERENCES: RFC 940, RFC 917, RFC 925, RFC 932, RFC 936, RFC 922

DEPENDENCIES:

CONTACT: Mogul@SU-SCORE.STANFORD.EDU

Address Resolution Protocol ---------- (ARP)

STATUS: Recommended

SPECIFICATION: RFC 826 (IN DPH)

COMMENTS:

This is a procedure for finding the network hardware address corresponding to an Internet Address.

OTHER REFERENCES:

CONTACT: Postel@ISI.EDU

A Reverse Address Resolution Protocol ---------- (RARP)

STATUS: Elective

SPECIFICATION: RFC 903 (IN DPH)

COMMENTS:

This is a procedure for workstations to dynamically find their protocol address (e.g., their Internet Address), when they only only know their hardware address (e.g., their attached physical network address).

OTHER REFERENCES:

CONTACT: Mogul@SU-SCORE.STANFORD.EDU

Multi-LAN Address Resolution Protocol ---------- (MARP)

STATUS: Experimental

SPECIFICATION: RFC 925

COMMENTS:

Discussion of the various problems and potential solutions of "transparent subnets" in a multi-LAN environment.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: RFC 917, RFC 826

DEPENDENCIES:

CONTACT: Postel@ISI.EDU

Broadcasting Internet Datagrams ---------- (IP-BROAD)

STATUS: Recommended

SPECIFICATION: RFC 919

COMMENTS:

A proposed protocol of simple rules for broadcasting Internet datagrams on local networks that support broadcast, for addressing broadcasts, and for how gateways should handle them.

Recommended in the sense of "if you do broadcasting at all then do it this way".

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: RFC 922

DEPENDENCIES:

CONTACT: Mogul@SU-SCORE.STANFORD.EDU

Broadcasting Internet Datagrams with Subnets --------- (IP-SUB-BROAD)

STATUS: Recommended

SPECIFICATION: RFC 922

COMMENTS:

A proposed protocol of simple rules for broadcasting Internet datagrams on local networks that support broadcast, for addressing broadcasts, and for how gateways should handle them.

Recommended in the sense of "if you do broadcasting with subnets at all then do it this way".

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: RFC 919

DEPENDENCIES:

CONTACT: Mogul@SU-SCORE.STANFORD.EDU

Reliable Asynchronous Transfer Protocol ---------- (RATP)

STATUS: Experimental

SPECIFICATION: RFC 916

COMMENTS:

This paper specifies a protocol which allows two programs to reliably communicate over a communication link. It ensures that the data entering one end of the link if received arrives at the other end intact and unaltered. This proposed protocol is designed to operate over a full duplex point-to-point connection. It contains some features which tailor it to the RS-232 links now in current use.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES: Transmission Control Protocol

CONTACT: Finn@ISI.EDU

Thinwire Protocol ---------- (THINWIRE)

STATUS: Experimental

SPECIFICATION: RFC 914

COMMENTS:

This paper discusses a Thinwire Protocol for connecting personal computers to the Internet. It primarily focuses on the particular problems in the Internet of low speed network interconnection with personal computers, and possible methods of solution.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES:

CONTACT: Farber@UDEL.EDU

ISO and CCITT PROTOCOLS

The International Standards Organization (ISO) and the International Telegraph and Telephone Consultative Committee (CCITT) are defining a set of protocols that may be of interest to the Internet community. Some of these have been published as RFCs for information purposes. This section lists these protocols.

End System to Intermediate System Routing Exchange Protocol --------

STATUS:

SPECIFICATION: RFC 995

COMMENTS:

This protocol is one of a set of International Standards produced to facilitate the interconnection of open systems. The set of standards covers the services and protocols required to achieve such interconnection. This protocol is positioned with respect to other related standards by the layers defined in the Reference Model for Open Systems Interconnection (ISO 7498) and by the structure defined in the Internal Organization of the Network Layer (DIS 8648). In particular, it is a protocol of the Network Layer. This protocol permits End Systems and Intermediate Systems to exchange configuration and routing information to facilitate the operation of the routing and relaying functions of the Network Layer.

OTHER REFERENCES: RFC 994

DEPENDENCIES:

CONTACT: ANSI

Connectionless Mode Network Service ---------- (ISO-8473)

STATUS:

SPECIFICATION: RFC 994

COMMENTS:

This Protocol Standard is one of a set of International Standards produced to facilitate the interconnection of open systems. The set of standards covers the services and protocols required to achieve such interconnection. This

Protocol Standard is positioned with respect to other related standards by the layers defined in the Reference Model for Open Systems Interconnection (ISO 7498). In particular, it is a protocol of the Network Layer. This Protocol may be used between network-entities in end systems or in Network Layer relay systems (or both). It provides the Connectionless-mode Network Service as defined in Addendum 1 to the Network Service Definition Covering Connectionless-mode Transmission (ISO 8348/AD1).

OTHER REFERENCES: RFC 926

DEPENDENCIES:

CONTACT: ANSI

Internet-IP Addressing in ISO-IP ----------

STATUS:

SPECIFICATION: RFC 986

COMMENTS:

This RFC suggests a method to allow the existing IP addressing, including the IP protocol field, to be used for the ISO Connectionless Network Protocol (CLNP). This is a draft solution to one of the problems inherent in the use of "ISO-grams" in the DoD Internet. Related issues will be discussed in subsequent RFCs. This RFC suggests a proposed protocol for the Internet community, and requests discussion and suggestions for improvements.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES:

CONTACT: RCallon@BBN.COM

Network Layer Addressing ----------

STATUS:

SPECIFICATION: RFC 941

COMMENTS:

This Addendum to the Network Service Definition Standard, ISO 8348, defines the abstract syntax and semantics of the Network Address (Network Service Access Point Address). The Network Address defined in this Addendum is the address that appears in the primitives of the connection-mode Network Service as the calling address, called address, and responding address parameters, and in the primitives of the connectionless-mode Network Service as the source address and destination address parameters.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES:

CONTACT: ISO

Transport Protocol Specification ---------- (ISO-8073)

STATUS:

SPECIFICATION: RFC 905

COMMENTS:

This is the current specification of the ISO Transport Protocol. This document is the text of ISO/TC97/SC16/N1576 as corrected by ISO/TC97/SC16/N1695. This is the specification currently being voted on in ISO as a Draft International Standard (DIS).

OTHER REFERENCES: RFC 892

DEPENDENCIES:

CONTACT: ISO

ISO Transport Services on Top of the TCP ----------

STATUS:

SPECIFICATION: RFC 1006

COMMENTS:

This memo describes a proposed protocol standard for the Internet community. The CCITT and the ISO have defined various session, presentation, and application recommendations which have been adopted by the international community and numerous vendors. To the largest extent possible, it is desirable to offer these higher level services directly to the Internet, without disrupting existing facilities. This permits users to develop expertise with ISO and CCITT applications which previously were not available in the Internet. The intention is that hosts within the Internet that choose to implement ISO TSAP services on top of the TCP be expected to adopt and implement this standard. Suggestions for improvement are encouraged.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES: RFC 983

DEPENDENCIES:

CONTACT: DCass@NRTC.NORTHROP.COM

Mapping Between X.400 and RFC 822 ---------- (X.400)

STATUS:

SPECIFICATION: RFC 987

COMMENTS:

The X.400 series of protocols have been defined by CCITT to provide an Interpersonal Messaging Service (IPMS), making use of a store and forward Message Transfer Service. It is expected that this standard will be implemented very widely. This document describes a set of mappings which will enable interworking between systems operating the X.400 protocols and systems using RFC 822 mail protocol or protocols derived from RFC 822.

Please discuss any plans for implementation or use of this protocol with the contact.

OTHER REFERENCES:

DEPENDENCIES:

CONTACT: Kille@CS.UCL.AC.UK