

>

Network Working Group
Request for Comments: 1123

Internet Engineering Task Force
R. Braden, Editor
October 1989

Requirements for Internet Hosts -- Application and Support

Status of This Memo

This RFC is an official specification for the Internet community. It incorporates by reference, amends, corrects, and supplements the primary protocol standards documents relating to hosts. Distribution of this document is unlimited.

Summary

This RFC is one of a pair that defines and discusses the requirements for Internet host software. This RFC covers the application and support protocols; its companion RFC-1122 covers the communication protocol layers: link layer, IP layer, and transport layer.

Table of Contents

1.	INTRODUCTION	5
1.1	The Internet Architecture	6
1.2	General Considerations	6
1.2.1	Continuing Internet Evolution	6
1.2.2	Robustness Principle	7
1.2.3	Error Logging	8
1.2.4	Configuration	8
1.3	Reading this Document	10
1.3.1	Organization	10
1.3.2	Requirements	10
1.3.3	Terminology	11
1.4	Acknowledgments	12
2.	GENERAL ISSUES	13
2.1	Host Names and Numbers	13
2.2	Using Domain Name Service	13
2.3	Applications on Multihomed hosts	14
2.4	Type-of-Service	14
2.5	GENERAL APPLICATION REQUIREMENTS SUMMARY	15

3.	REMOTE LOGIN -- TELNET PROTOCOL	16
3.1	INTRODUCTION	16
3.2	PROTOCOL WALK-THROUGH	16
3.2.1	Option Negotiation	16
3.2.2	Telnet Go-Ahead Function	16
3.2.3	Control Functions	17
3.2.4	Telnet "Synch" Signal	18
3.2.5	NVT Printer and Keyboard	19
3.2.6	Telnet Command Structure	20
3.2.7	Telnet Binary Option	20
3.2.8	Telnet Terminal-Type Option	20
3.3	SPECIFIC ISSUES	21
3.3.1	Telnet End-of-Line Convention	21
3.3.2	Data Entry Terminals	23
3.3.3	Option Requirements	24
3.3.4	Option Initiation	24
3.3.5	Telnet Linemode Option	25
3.4	TELNET/USER INTERFACE	25
3.4.1	Character Set Transparency	25
3.4.2	Telnet Commands	26
3.4.3	TCP Connection Errors	26
3.4.4	Non-Default Telnet Contact Port	26
3.4.5	Flushing Output	26
3.5.	TELNET REQUIREMENTS SUMMARY	27
4.	FILE TRANSFER	29
4.1	FILE TRANSFER PROTOCOL -- FTP	29
4.1.1	INTRODUCTION	29
4.1.2.	PROTOCOL WALK-THROUGH	29
4.1.2.1	LOCAL Type	29
4.1.2.2	Telnet Format Control	30
4.1.2.3	Page Structure	30
4.1.2.4	Data Structure Transformations	30
4.1.2.5	Data Connection Management	31
4.1.2.6	PASV Command	31
4.1.2.7	LIST and NLST Commands	31
4.1.2.8	SITE Command	32
4.1.2.9	STOU Command	32
4.1.2.10	Telnet End-of-line Code	32
4.1.2.11	FTP Replies	33
4.1.2.12	Connections	34
4.1.2.13	Minimum Implementation; RFC-959 Section	34
4.1.3	SPECIFIC ISSUES	35
4.1.3.1	Non-standard Command Verbs	35
4.1.3.2	Idle Timeout	36
4.1.3.3	Concurrency of Data and Control	36
4.1.3.4	FTP Restart Mechanism	36
4.1.4	FTP/USER INTERFACE	39

4.1.4.1	Pathname Specification	39
4.1.4.2	"QUOTE" Command	40
4.1.4.3	Displaying Replies to User	40
4.1.4.4	Maintaining Synchronization	40
4.1.5	FTP REQUIREMENTS SUMMARY	41
4.2	TRIVIAL FILE TRANSFER PROTOCOL -- TFTP	44
4.2.1	INTRODUCTION	44
4.2.2	PROTOCOL WALK-THROUGH	44
4.2.2.1	Transfer Modes	44
4.2.2.2	UDP Header	44
4.2.3	SPECIFIC ISSUES	44
4.2.3.1	Sorcerer's Apprentice Syndrome	44
4.2.3.2	Timeout Algorithms	46
4.2.3.3	Extensions	46
4.2.3.4	Access Control	46
4.2.3.5	Broadcast Request	46
4.2.4	TFTP REQUIREMENTS SUMMARY	47
5.	ELECTRONIC MAIL -- SMTP and RFC-822	48
5.1	INTRODUCTION	48
5.2	PROTOCOL WALK-THROUGH	48
5.2.1	The SMTP Model	48
5.2.2	Canonicalization	49
5.2.3	VERFY and EXPN Commands	50
5.2.4	SEND, SOML, and SAML Commands	50
5.2.5	HELO Command	50
5.2.6	Mail Relay	51
5.2.7	RCPT Command	52
5.2.8	DATA Command	53
5.2.9	Command Syntax	54
5.2.10	SMTP Replies	54
5.2.11	Transparency	55
5.2.12	WKS Use in MX Processing	55
5.2.13	RFC-822 Message Specification	55
5.2.14	RFC-822 Date and Time Specification	55
5.2.15	RFC-822 Syntax Change	56
5.2.16	RFC-822 Local-part	56
5.2.17	Domain Literals	57
5.2.18	Common Address Formatting Errors	58
5.2.19	Explicit Source Routes	58
5.3	SPECIFIC ISSUES	59
5.3.1	SMTP Queueing Strategies	59
5.3.1.1	Sending Strategy	59
5.3.1.2	Receiving strategy	61
5.3.2	Timeouts in SMTP	61
5.3.3	Reliable Mail Receipt	63
5.3.4	Reliable Mail Transmission	63
5.3.5	Domain Name Support	65

5.3.6	Mailing Lists and Aliases	65
5.3.7	Mail Gatewaying	66
5.3.8	Maximum Message Size	68
5.4	SMTP REQUIREMENTS SUMMARY	69
6.	SUPPORT SERVICES	72
6.1	DOMAIN NAME TRANSLATION	72
6.1.1	INTRODUCTION	72
6.1.2	PROTOCOL WALK-THROUGH	72
6.1.2.1	Resource Records with Zero TTL	73
6.1.2.2	QCLASS Values	73
6.1.2.3	Unused Fields	73
6.1.2.4	Compression	73
6.1.2.5	Misusing Configuration Info	73
6.1.3	SPECIFIC ISSUES	74
6.1.3.1	Resolver Implementation	74
6.1.3.2	Transport Protocols	75
6.1.3.3	Efficient Resource Usage	77
6.1.3.4	Multihomed Hosts	78
6.1.3.5	Extensibility	79
6.1.3.6	Status of RR Types	79
6.1.3.7	Robustness	80
6.1.3.8	Local Host Table	80
6.1.4	DNS USER INTERFACE	81
6.1.4.1	DNS Administration	81
6.1.4.2	DNS User Interface	81
6.1.4.3	Interface Abbreviation Facilities	82
6.1.5	DOMAIN NAME SYSTEM REQUIREMENTS SUMMARY	84
6.2	HOST INITIALIZATION	87
6.2.1	INTRODUCTION	87
6.2.2	REQUIREMENTS	87
6.2.2.1	Dynamic Configuration	87
6.2.2.2	Loading Phase	89
6.3	REMOTE MANAGEMENT	90
6.3.1	INTRODUCTION	90
6.3.2	PROTOCOL WALK-THROUGH	90
6.3.3	MANAGEMENT REQUIREMENTS SUMMARY	92
7.	REFERENCES	93

1. INTRODUCTION

This document is one of a pair that defines and discusses the requirements for host system implementations of the Internet protocol suite. This RFC covers the applications layer and support protocols. Its companion RFC, "Requirements for Internet Hosts -- Communications Layers" [INTRO:1] covers the lower layer protocols: transport layer, IP layer, and link layer.

These documents are intended to provide guidance for vendors, implementors, and users of Internet communication software. They represent the consensus of a large body of technical experience and wisdom, contributed by members of the Internet research and vendor communities.

This RFC enumerates standard protocols that a host connected to the Internet must use, and it incorporates by reference the RFCs and other documents describing the current specifications for these protocols. It corrects errors in the referenced documents and adds additional discussion and guidance for an implementor.

For each protocol, this document also contains an explicit set of requirements, recommendations, and options. The reader must understand that the list of requirements in this document is incomplete by itself; the complete set of requirements for an Internet host is primarily defined in the standard protocol specification documents, with the corrections, amendments, and supplements contained in this RFC.

A good-faith implementation of the protocols that was produced after careful reading of the RFC's and with some interaction with the Internet technical community, and that followed good communications software engineering practices, should differ from the requirements of this document in only minor ways. Thus, in many cases, the "requirements" in this RFC are already stated or implied in the standard protocol documents, so that their inclusion here is, in a sense, redundant. However, they were included because some past implementation has made the wrong choice, causing problems of interoperability, performance, and/or robustness.

This document includes discussion and explanation of many of the requirements and recommendations. A simple list of requirements would be dangerous, because:

- o Some required features are more important than others, and some features are optional.
- o There may be valid reasons why particular vendor products that

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.