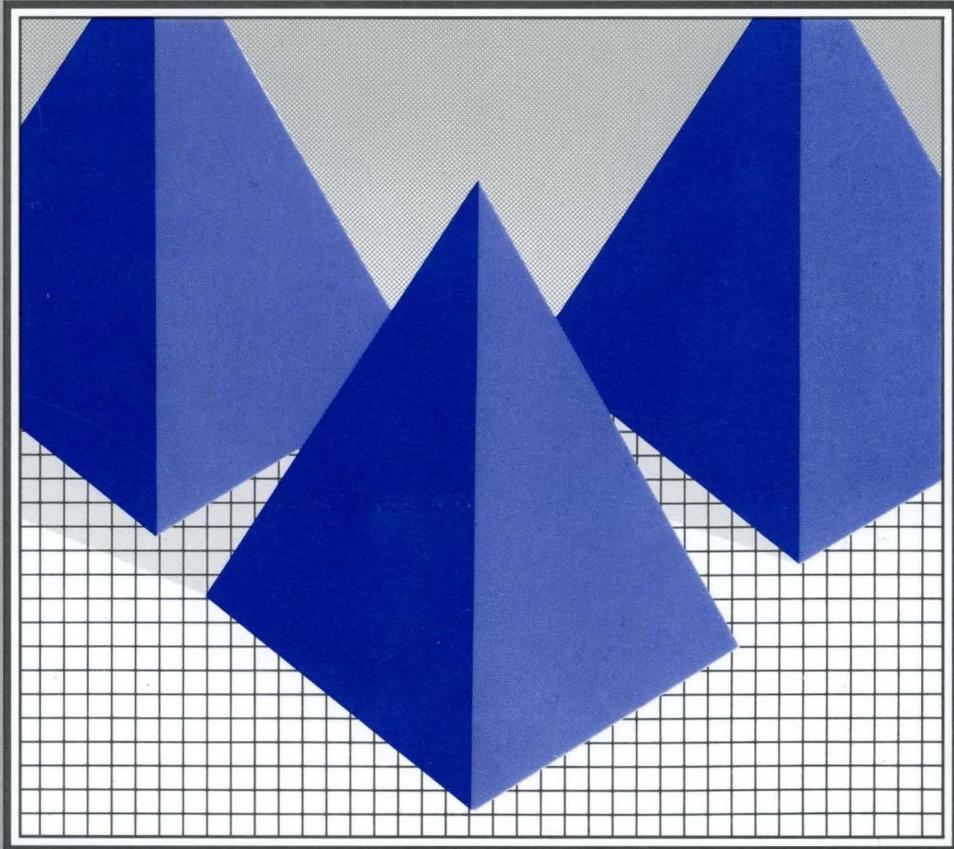


HEWLETT-PACKARD

HP 9000 Series 300 and 800 Computers

Networking Overview



HP 9000 Series 300 and 800 Computers
Networking Overview



Manual Part Number: B1012-90003
Printed in U.S.A., September 1989

Notice

Hewlett-Packard makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Hewlett-Packard shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Hewlett-Packard assumes no responsibility for the use or reliability of its software on equipment that is not furnished by Hewlett-Packard.

© Copyright 1989, Hewlett-Packard Company.

This document contains proprietary information, which is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced or translated to another language without the prior written consent of Hewlett-Packard Company. The information contained in this document is subject to change without notice.

Restricted Rights Legend

Use, duplication or disclosure by the Government is subject to restrictions as set forth in paragraph (b)(3)(B) of the Rights in Technical Data and Software clause in DAR 7-104.9(a).

© Copyright 1980, 1984, AT&T, Inc.

© Copyright 1979, 1980, 1983, The Regents of the University of California.

© Copyright, 1986, 1987, 1988 Sun Microsystems, Inc.

This software and documentation is based in part on the Fourth Berkeley Software Distribution under license from the Regents of the University of California.

DEC[®] and VAX[®] are registered trademarks of Digital Equipment Corp.

MS-DOS[®] is a trademark of Microsoft Corp.

UNIX® is a registered trademark of AT&T.

NFS is a trademark of Sun Microsystems, Inc.

Hewlett-Packard Co.
3404 E. Harmony Rd.
Fort Collins, CO 80525 U.S.A.

Printing History

First Edition September 1989

Contents

Networking Overview

Before You Begin	2
Nodes and Networks	2
Routes and Protocols	3
Network Addresses and Host or Node Names	3
Bus Networks	5
X.25 Packet Switching Networks	5
LAN-to-LAN Routers	6
Multi-homing	6
Subnetting	6
Gateways	6
Network Architecture and the OSI Model	7
Networking Software	9
Links and Services	9
LAN-Based Overview	9
X.25-Based Overview	12
The LAN Product	14
Interprocess Communication	14
NetIPC	14
Berkeley Sockets	14
Link Level Access	15
Diagnostics	15
Documentation	16
The X.25 Product	18
Interprocess Communication with Berkeley Sockets	18
Diagnostics	19
Documentation	20
The X.400 and OTS/800 Products	21
Diagnostics	23
Documentation	23
The NS Product	25
Interprocess Communication	25

Diagnostics	25
Documentation	25
The ARPA Product	27
ARPA Services	27
Berkeley Services	28
Interprocess Communication	29
Diagnostics	29
Documentation	29
The NFS Services Product	30
NFS Services	30
Diagnostics for NFS Services	31
NFS Services Documentation	31
Documentation Guide	32
Manual Descriptions	32
Documentation Map	34

Networking Overview

This booklet is for HP 9000 Series 300 and 800 computer users who have received one or more of the following products:

- LAN/9000 Link product (the LAN product)
- X.25 Link product
- X.400 product (Series 800 only)
- NS (Network Services)/9000 product (the NS product)
- ARPA Services/9000 product (the ARPA/Berkeley product)
- NFS (Network File System) Services/9000 product (the NFS product)
- OTS/800 (OSI Transport Services) product (Series 800 only)

This booklet provides an overview of these networking software products and supplies a map to their documentation.

Note The information contained in this manual applies to both the Series 300 and Series 800 HP 9000 computer systems. Any differences in installation, configuration, or operation are specifically noted.

Before You Begin

Read the following subsections if you are unfamiliar with networking concepts:

- “Nodes and Networks”
- “Routes and Protocols”
- “Network Addresses and Host or Node Names”
- “Bus Networks”
- “X.25 Packet Switching Networks”
- “LAN-to-LAN Routers”
- “Network Architecture and the OSI Model”

Nodes and Networks

A **network** is a group of computer systems connected so that they can exchange information and share resources such as disc space, printers and plotters.

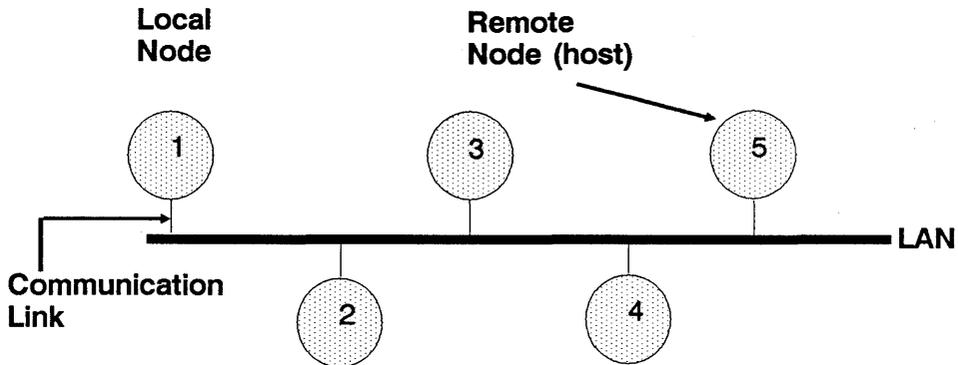
A **node** or a **host** is a computer on a network. The term **local node** refers to the node or host to which your terminal is **physically** attached. A **remote node** is a computer on the network with which your local node can communicate. A remote node does not have to be directly attached to your terminal.

Nodes or hosts on a network are connected by **communication links**. A communication link is the hardware (e.g., cables) and executable software that enable network nodes to exchange data. Typically, all network nodes are connected by the same type of link.

When computers in a network are geographically remote from each other (across cities, states or even countries), the network is called a **Wide Area Network (WAN)**.

When the geographic coverage of a network is much smaller (within a building or spread among closely spaced buildings), it is called a **Local Area Network (LAN)**.

The following figure shows a network with five nodes, each represented by a circle. Communication links, represented by lines, join the nodes to the LAN.



Example of a Bus Network with Five Nodes (hosts)

In this example, if you are a user logged into node or host 1, node 1 is your **local node**; nodes 2, 3, 4 and 5 are **remote nodes**. If you send a message from node 1 to node 2, node 1 is the **source node** and node 2 is the **destination node**.

Routes and Protocols

A **route** is the sequence of network nodes that messages travel through when sent from a source node to a destination node.

A **protocol** is a set of rules for a particular communication task. A protocol handler or protocol module is a piece of software that implements a particular protocol.

Network Addresses and Host or Node Names

Every node on a TCP/IP network must have an **internet address** for each hardware network interface it has, so that the node may recognize communications addressed to it. Every network interface must have a unique internet address. It is convenient for people to refer to nodes by names rather

than by internet addresses; therefore, each host on the network is also assigned a name.

- The ARPA/Berkeley Services and the NFS Services use the **host name** assigned with the *hostname* command. They map remote host names to internet addresses with a routine which accesses the database stored in the file */etc/hosts* or accessed via Yellow Pages (NFS) or BIND (ARPA/Berkeley). To connect with other hosts, their host names and internet addresses must be in your *hosts(4)* database; other hosts must have your host name and internet address in their *hosts(4)* database to connect to your host.
- The Network Services (NS) product uses the **node name** assigned with the *nodename(1)* command. NS also uses a different method to map names to internet addresses. It broadcasts on the network a Probe request for the internet address associated with the node name of interest. The host with that node name, or some other host responding to Probe requests by proxy, responds with the requested internet address.
- The node names assigned with the *nodename(1)* command take the form “*node.domain.organization*.” Note that this “*domain.organization*” suffix has nothing to do with internet or Yellow Pages domains. Network administration and use will be easier if the “node” parts of the node name assigned with *nodename(1)*, the host name assigned with *hostname(1)*, and the host name associated with each of your host’s internet addresses in *hosts(4)* are all the same.
- The ARPA/Berkeley Services and the NFS Services may also use internet domain-style host names instead of regular host names.

Bus Networks

The figure on page 3 is an example of a **bus network**. In a bus network, a linear run of cable connects the nodes. Every node simultaneously reads each message transmitted over the network. Typically, the nodes process only the messages that are addressed to them and ignore all other messages on the network.

Ethernet¹ and IEEE 802.3² LANs are bus networks. A major difference between these two bus LANs is how they package the information that moves across the cable. An HP 9000 computer can determine whether a remote node is using the data package format for an Ethernet LAN or an IEEE 802.3 LAN. If the remote node can communicate on both types of LANs, the HP 9000 computer communicates using whatever data package format the remote node uses. Therefore, it is possible to use the NS product, ARPA product, and NFS Services product on IEEE 802.3 or Ethernet LANs.

X.25 Packet Switching Networks

Many WANs use a technology known as packet switching. Packet switching segments messages and places the resulting pieces of data into packets for transmission across the network. Each packet contains control information that includes the identification of the virtual circuit the packet is transmitted on. The packet is routed through the network to its destination. At the destination, all the packets of a particular message are put into the correct sequence (the transmitted order), and the data information is reassembled to form the original message.

A WAN that uses packet switching is called a **Packet Switching Network (PSN)**. X.25³ is a recommendation that defines the protocol required to access a PSN. The protocol specifies the format of packets, the amount of data that

- (1) The *Ethernet* LAN is a local area network system developed by Digital Equipment Corp., Intel Corporation and Xerox Corporation. Ethernet is the de facto standard for office automation and distributed processing LANs.
- (2) The *IEEE 802.3* LAN is a networking standard similar to Ethernet that is accepted by the Institute of Electrical and Electronic Engineers.
- (3) Its full name is “CCITT (International Telegraph and Telephone Consultative Committee) Recommendation X.25,” and it is defined in *CCITT Red Book Volume VII Data Communications Networks Interfaces Recommendations X.20–X.32, 1984+*.

they can contain, and the procedures for exchanging packets at the interface between the network and the computer.

LAN-to-LAN Routers

With the LAN product, an HP 9000 computer can serve as a **LAN-to-LAN router**. As such, it can forward messages between two networks. A router physically contains more than one network interface card. This capability, called **multi-homing**, allows the computer to be connected to multiple networks at the same time. This is also true in the case of WAN (Wide Area Networks), WAN-to-LAN, and WAN-to-WAN configurations.

Multi-homing

The HP 9000 can physically contain more than one network interface card. This capability is called **multi-homing**. Multi-homing allows your computer to be connected to multiple LANs or WANS at the same time. The advantage of multi-homing is that the computer containing multiple network interface cards can have multiple internet addresses. Multiple internet addresses on one computer allows you to use the same computer to communicate with many LANs or WANS.

Subnetting

Subnetting is an internet addressing scheme that allows you to divide a logical network into several smaller physical networks. Dividing your network into smaller subnetworks, if well-planned, increases the overall efficiency of the network. This is mainly achieved by reducing the congestion on each subnetwork.

Gateways

A network **gateway** is a device used to connect two or more networks together. The gateway serves to route information among the networks to which it is connected. Sometimes a gateway with the same type of network interface cards is referred to as a router or an IP router. An X.25 to LAN gateway is also referred to as an IP router for the TCP/IP traffic.

Network Architecture and the OSI Model

A network architecture is a structured, modular design for networks. The Reference Model of Open Systems Interconnection (OSI) is a network architecture model developed by the International Standards Organization (ISO). HP has based the development of the NS, ARPA, and NFS Services products on the OSI model.

In the OSI model, communication tasks are assigned to seven logically distinct modules called **layers**. Each layer performs a specific data communication function. Interfaces between each layer allow each layer to communicate with the layers directly above it and below it. Each layer may also communicate with its peer layer on a remote computer.

The function of each layer is described in the following table.

OSI Model

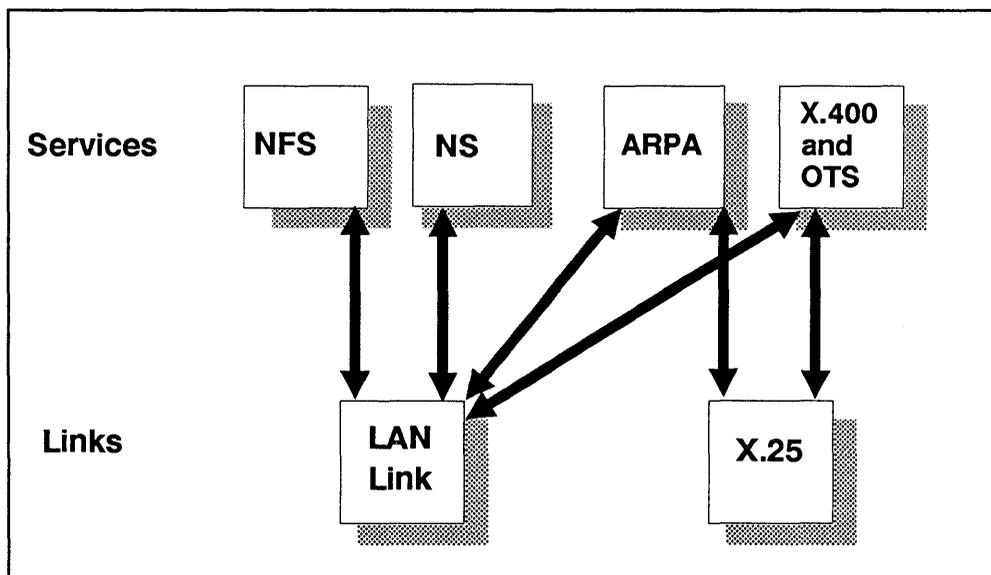
Layer	Layer Name	Layer Function
7	Application	The Application Layer provides services for the user such as file transfer and terminal access to the network.
6	Presentation	The Presentation Layer manipulates user data such as in text compression.
5	Session	The Session Layer is the user's interface into the network. Connections between users are established and managed within the Session Layer.
4	Transport	The Transport Layer is responsible for end-to-end data integrity. It ensures that data arrives at the remote node without errors. Depending on the class of transports that are supported in this layer, the transport layer provides flow control, retransmission of lost or incorrect data, and suppression of duplicated data.
3	Network	The Network Layer determines the routes messages take to get from one node to another.
2	Data Link	The Data Link Layer packs raw bits into message frames for transmission. It detects transmission errors and controls access to the media.
1	Physical	The Physical Layer defines the electronic characteristics of the transmission media.

Networking Software

Links and Services

HP 9000 Series networking products include the LAN, X.25, X.400 (Series 800 only), NS, ARPA, NFS, and OTS/800 products. The LAN and X.25 products are called link products, because they allow computers to communicate over a network by providing hardware and software for the lower OSI layers (1 to 5). The NS, ARPA, NFS, OTS/800, and X.400 products are called service products, because they provide software for the upper OSI layers (5 to 7) that allows people to perform tasks using the network.

The following figure illustrates the upper layer “services” products and the lower layer “link” products available for the HP9000 computers. The arrows show which services are supported over which links.



HP 9000 Networking Products

LAN-Based Overview

HP 9000 networking software includes the NS, ARPA, and NFS Services products. These products allow HP 9000 computers to communicate with

other computers in LAN environments. The following table illustrates the systems to which the HP 9000 can communicate when the NS, ARPA, and NFS products are installed and the services that provide the connectivity between the systems.

System Connectivity with NS, ARPA, and NFS Services

SYSTEM (Operating System)	NS	ARPA (includes Berkeley Services)	NFS (3.2)
HP1000 (RTE)	NFT, NetIPC	TELNET	
HP3000 (MPE/XL)	NFT, NetIPC		
HP9000 Series 200 (HP-UX 5.2)	NFT		
HP9000 Series 300 (HP-UX)	All*	All*	All*
HP9000 Series 800 (HP-UX)	All*	All*	All*
HP Vectra PC (MS-DOS)	NFT	FTP, TELNET, rcp, remsh	All*
DEC VAX (VMS)	NFT	All ARPA	All*
DEC VAX (BSD UNIX)		All*	
Sun Microsystems (SunOS)		All*	All*
IBM PC/AT (MS-DOS)	NFT	FTP, TELNET, rcp, remsh	All*

* = Current HP NS, ARPA, and NFS services offering.

For the most current information on environments in which the LAN, NS, ARPA, and NFS Services products can be used, contact your HP support representative.

Depending on the system, products providing LAN connectivity for non-HP 9000 systems are available from HP or other vendors.

Note On the DEC VAX the 5.0 release of the VMS operating system does not support NFT or ARPA Services.

LAN, NS, ARPA, and NFS Services

OSI Layer	NS and ARPA Services			NFS Services
	Network Services (NS)	ARPA/Berkeley Services		
		ARPA Services	Berkeley Services	
7	Network File Transfer (NFT) Remote File Access (RFA)	File Transfer Protocol (ftp) Telnet (telnet)	BIND (Berkeley Internet Name Domain Server) Remote Copy (rcp) Remote Login (rlogin) Remote Execution (rexec) Remote Shell (remsh) Remote Who (rwho) Remote Uptime (ruptime) Sendmail	Network File System (NFS) Yellow Pages (YP) Virtual Home Environment (VHE)
6		Simple Mail Transfer Protocol (SMTP)		eXternal Data Representation (XDR)
5	NetIPC		BSD IPC (Berkeley) Sockets	Remote Procedure Call (RPC)
4	Transmissions Control Protocol (TCP)	Transmissions Control Protocol (TCP)		User Datagram Protocol (UDP)
3	Internet Protocol (IP)	Internet Protocol (IP)	Internet Protocol (IP)	Internet Protocol (IP)
2	IEEE 802.3	Ethernet	Ethernet	Ethernet
1	Ethernet/IEEE 802.3	Ethernet/IEEE 802.3	Ethernet/IEEE 802.3	Ethernet/IEEE 802.3
Diagnostics for LAN, NS, ARPA, and NFS Services				
Series 300			Series 800	
Netstat			Netstat	
Ping			Ping	
Network Logging			Network Logging	
Network Tracing			Network Tracing	
Remote Loop-back Landiag (rlb-landiag)			Remote Loop-back (rlb)	
Linkloop			*LANDAD	
Note: Diagnostic services span all OSI layers				

*supplied with the HP-UX operating system

X.25-Based Overview

The X.25 product allows HP 9000 computers to communicate with other computers in WAN environments. The following table illustrates the systems to which an HP 9000 computer can communicate when the X.25, NS, and ARPA products are installed.

HP 9000 X.25 Connectivity

From HP 9000 Series 300/800	X.25 Product	ARPA Product (ARPA includes Berkeley Services)	NS Services Product
To			
HP 9000 Series 300 (HP-UX)	BSD Sockets	All except rwho and ruptime	NFT
HP 9000 Series 800 (HP-UX)	BSD Sockets	All except rwho and ruptime	NFT
Sun Microsystems (SunOS)	BSD Sockets	All except rwho and ruptime	—
HP 3000 (MPE-V)	BSD Sockets	None	NFT
HP 1000 (RTE)	BSD Sockets	None	—

The following figure outlines the specific services, programmatic interfaces and protocols that run on an X.25-based node. Each part is shown in its relative position to the OSI model (see the earlier section "Network Architecture and the OSI model.")

X.25, NS, and ARPA Services

OSI Layer		NS Services	ARPA Services/9000 Series 300/800	
7	User-Written Application	NFT	ARPA Services	Berkeley Services
			File Transfer Protocol (FTP)	Berkeley Internet Name Domain Server (BIND)
			TELNET (telnet)	Remote Copy (rcp) Remote Login (rlogin) Remote Execution (rexec) Remote Shell (remsh) Sendmail (uses SMTP)
6			Simple Mail Transfer Protocol (SMTP)	
OSI Layer	X.25 Link			
5	BSD IPC (Berkeley) Sockets			
4		Transmission Control Protocol (TCP)/User Datagram Protocol (UDP)		
3	X.25 level 3	X.25 level 3/Internet Protocol (IP)		
2	LAPB	LAPB		
1	X.21 bis	X.21 bis		
Diagnostics				
	X25check/ X25servr	X25stat	X25upload	Network Logging
		Netstat	Ping	Network Tracing
			Psidad (through Sysdiag)	
Note: The combined diagnostics span all OSI layers.				

The LAN Product

The LAN/9000 product provides link hardware and software for the Physical, Data Link, Network, Transport and Session Layers (Layers 1 through 5) of the OSI model.

Because the LAN product software and hardware provide the basis for the NS, ARPA, NFS, X.400, and OTS products, the LAN or X.25 products must be installed with the NS, ARPA and NFS products. You may also use the LAN product without the NS, ARPA and NFS products to write customized interprocess communication or application software.

Interprocess Communication

Interprocess communication allows a process to communicate with another process on the same host or on a remote host via system calls that access communication connection entities called sockets. The LAN product provides two interprocess communication (IPC) facilities: NetIPC and Berkeley Sockets (BSD IPC).

NetIPC

NetIPC enables processes running on HP 9000 nodes on the network to exchange information between other HP 9000s, HP 1000 A-Series, HP 3000 MPE-V and MPE-XL, HP Vectra PC and IBM PC nodes on the network.¹ NetIPC provides an interface between the Application Layer services and the transport protocols in the Transport Layer. A module in NetIPC, called the socket registry, translates user-defined names into machine addresses.

Berkeley Sockets

Berkeley Sockets (BSD IPC) also enable processes running on UNIX nodes on the network to exchange information. HP's implementation of sockets is

(1) If you have an HP 9000 Series 500 computer on your network, the interprocess communication facility described in the NS/9000 LAN manuals (for the HP 9000 Series 500) can only be used between Series 500 computers.

based on the IPC in the Berkeley Software Distribution of UNIX, version 4.2 (4.2 BSD).

Link Level Access

Link Level Access (LLA) allows you to implement special-purpose network protocols by directly accessing the network interface drivers. LLA may be used on HP 9000 Series 300 and 800 computers.

Diagnostics

The LAN product provides the following diagnostic utilities:

Note All of the LAN product diagnostic utilities can be used with the NS, ARPA or NFS products.

- The **network event logging** facility provides utilities that create a log of network events. The log can be sent to the system console or to a file.
- The **network tracing** facility provides utilities that record packets as they enter and exit the host through the LAN interface card.
- **Netstat** reports network and protocol statistics regarding packet traffic and network connections.
- **Ping** is a diagnostic test that verifies a connection between systems that support *ping*. Most UNIX systems support *ping*. If the test is successful, *ping* reports the round-trip time used in the local-to-remote-to-local communication.
- **Rlb** allows your host node to exchange test messages with other HP hosts on the network. *Rlb* also displays the round-trip time used in the local-to-remote-to-local communication.

Landad, a portion of the *sysdiag* diagnostic utility which is shipped with your operating system, can also be used with the networking products.

The **Landad** portion of *sysdiag* can be used to test the following portions of OSI networking layers 2 and below:

- the local LAN interface controller (LANIC) card
- the network link with an external loopback
- the network cable
- the MAU and AUI
- layer 2 remote loopback (for IEEE 802.3 nodes only).

Documentation

The standard LAN product includes the following manuals:

- *HP 9000 Series 300 and 800 Networking Overview*
- *CIO LAN Interface Controller (LANIC) Installation and Reference Manual*
- *HP Precision Bus LAN Interface Controller Installation Manual* (for use with Series 800 computers with HP Precision Bus interface).
- *ThinMAU Installation Manual*
- *Installing and Administering LAN*
- *HP 9000 Series 300 and 800 Berkeley IPC Programmer's Guide*
- *HP 9000 Series 300 and 800 LLA Programmer's Guide*
- *LAN/X.25 Reference Pages*

The StarLAN 10 Twisted-pair MAU option to the LAN product deletes the *ThinMAU Installation Manual* and includes the *Twisted-pair MAU Installation Guide*.

If you need multiple LAN cards on your system, you may order the hardware-only option. The hardware-only option to the LAN product includes only the following manuals:

- *CIO LAN Interface Controller (LANIC) Installation and Reference Manual*
- *HP Precision Bus LAN Interface Controller Installation Manual* (for use with Series 800 computers with HP Precision Bus interface).
- *ThinMAU Installation Manual*

The software-only option to the LAN product includes the following manuals:

- *HP 9000 Series 300 and 800 Networking Overview*
- *Installing and Administering LAN*
- *HP 9000 Series 300 and 800 NetIPC Programmer's Guide*
- *HP 9000 Series 300 and 800 Berkeley IPC Programmer's Guide*
- *HP 9000 Series 300 and 800 LLA Programmer's Guide*
- *LAN/X.25 Reference Pages*

A brief description of these manuals and a map to their contents is in this booklet's "Documentation Guide" section.

The X.25 Product

The X.25 product provides link software for the Physical, Data Link, Network, Transport and Session Layers (Layers 1 through 5) of the OSI model over a Wide Area Network (WAN).

The X.25 product can be used by the NS and ARPA products and can also be used without the NS and ARPA products to write customized interprocess communication or applications software. In addition, the X.25 link supports X.400 services with the OSI Transport Services (TPO.2) on the Series 800.

Interprocess Communication with Berkeley Sockets

Interprocess communication allows a process to communicate with another process on the same host or on a remote host via system calls that access communication connection entities called sockets. The X.25 product provides the Berkeley Sockets Interprocess Communication (BSD IPC) facility implemented in two ways:

- Via TCP/IP or UDP/IP at the OSI Transport Layer (Layer 4)

or

- By directly accessing the X.25 Packet Layer (X.25 Layer 3; OSI Layer 3).

Refer to the *X.25 Programmer's Guide* for details.

Diagnostics

The X.25 product provides the following diagnostic utilities:

- The **network event logging** facility provides utilities that create a log of network events. The log can be sent to the system console or to a file.
- The **network tracing** facility provides utilities that record packets as they enter and exit the host through the X.25 interface card.
- **Netstat** reports network and protocol statistics regarding packet traffic and network connections. *Netstat* reports only about the interfaces enabled with IP (Internet Protocol) addressing.
- **Ping** is a diagnostic test that verifies a connection between systems that support *ping*. If the test is successful, *ping* reports the round-trip time used in the local-to-remote-to-local communication.
- **X25stat** reports X.25 status, configuration information and virtual circuit statistics.
- **X25check** and **X25servr** are a pair of peer utilities that test connectivity up to Layer 3 (X.25 Programmatic Access, Level 3) between the local and remote hosts. *X25servr* must be running on the destination host.
- **X25upload** dumps the interface card memory contents into a file.

Documentation

The X.25 product includes the following manuals:

- *HP 9000 Series 300 and 800 Networking Overview*
- *X.25 Link Hardware Installation Manual*
- *Installing and Administering X.25*
- *X.25: The PSN Connection*
- *X.25 Programmer's Guide*
- *LAN/X.25 Reference Pages*

A brief description of these manuals and a map to their contents is in this booklet's "Documentation Guide" section.

The X.400 and OTS/800 Products

The X.400/800 product offers standards-based multivendor connectivity for the HP 9000 Series 800 system. With X.400, UNIX mail users can send and receive electronic mail messages throughout their UNIX and non-UNIX environments. This includes the ability for multiple UNIX-based machines to use an HP 9000 Series 800 system as a gateway to an X.400 environment.

Note The X.400 product is not currently available for the HP 9000 Series 300.

The X.400 product conforms to OSI specifications. This product provides format and text conversion, addressing, and other common electronic mail functions as defined by the 1984 CCITT X.400 specification.

The following figure outlines the specific services, programmatic interfaces and protocols that run on an X.400-based node. Each part is shown in its relative position to the OSI Model (see the earlier section "Network Architecture and the OSI Model").

X.25 and X.400 Services

OSI Layer	X.400	User-Written Application	ARPA Services/9000 Series 300/800	
7			ARPA Services	Berkeley Services
			File Transfer Protocol (FTP)	Berkeley Internet Name Domain Server (BIND)
			TELNET (telnet)	Remote Copy (rcp) Remote Login (rlogin) Remote Execution (rexec) Remote Shell (remsh) Sendmail (uses SMTP)
6			Simple Mail Transfer Protocol (SMTP)	
OSI Layer	OSI Transport Services/800	X.25/300 /800 Link		
5	Session	BSD (Berkeley)sockets		
4	Transport	Transmission Control Protocol (TCP)/User Datagram Protocol (UDP)		
3	X.25 level 3	X.25 level 3Internet Protocol (IP)		
2	LAPB	LAPB		
1	X.21 bis	X.21 bis		
Diagnostics				
X.25		X.400		
Network Event Logging		X4agelog		
Network Tracing		X4asview		
Netstat		X4bit		
Ping		X4eventlog		
X25stat		X4loop		
X25check/X25servr		X4msgtest		
X25upload		X4queview		
		X4rtview		
		X4stat		
		X4version		

Diagnostics

The X.400 product provides the following diagnostic utilities:

- **X4agelog** prevents X.400 log files from becoming too large by aging current log files.
- **X4asnview** views messages whose contents are X.409 (or ASN.1) encoded.
- **X4bit** tests basic interoperability between HP-UX and other vendor's X.400 implementations.
- **X4eventlog** enables or disables event logging for X.400.
- **X4loop** (loopback test) verifies the X.400 product is working properly by sending a test message down the gateway node's stack and back up.
- **X4msgtest** (quick validation test) verifies X.400 configuration by sending a test message with delivery notification turned on, to a remote X.400 node.
- **X4queview** views the contents of the queues used by the X.400.
- **X4rtview** is an interactive tool for checking the routing table created during X.400 configuration.
- **X4stat** displays current status information for X.400.
- **X4version** displays version information for X.400.

Documentation

The X.400 product includes the following manual:

- *Installing and Administering X.400*

The OTS/800 product includes the following manual:

- *Installing and Administering OSI Transport Services*

Note X.400 requires the OSI Transport Services (OTS/800) product. OTS/800 corresponds to layers 4 and 5 of the OSI model.

A brief description of these manuals and a map to their contents is in this booklet's "Documentation Guide" section.

The NS Product

NS (Network Services) is HP's networking implementation. The NS/9000 product allows your HP 9000 to communicate with other HP 9000 network nodes. Network Services can also be used between the HP 9000 and the HP 1000, HP 3000 and DEC® VAX®/VMS systems that are using NS software. To run the Network Services product, you must have installed the LAN product or the X.25 product (or both). Following are the NS product services for the HP 9000:

- **Network File Transfer (NFT)** provides the *dscopy* command to copy files between your HP 9000 and other HP computers on the network using NS software. You can also use NFT to communicate with DEC VAX/VMS computers and IBM PC/ATs that are running NS.
- **Remote File Access (RFA)** allows files that are resident on one HP 9000 to be accessed from another HP 9000 node on the network without copying the file. (The file is read directly from one computer by the other computer.)²

Interprocess Communication

NetIPC is the interprocess communication facility used with the NS product, but it is part of the LAN product. NetIPC is described in "The LAN Product" section of this booklet.

Diagnostics

When using NS, you can use all the diagnostic utilities described in "The LAN Product" section of this booklet.

(2) RFA is supported on HP-UX systems only.

Documentation

The NS product includes the following manuals:

- *Installing and Administering NS*
- *Using Network Services*
- *Network Services Reference Pages*
- *NS Cross-System NFT Reference Manual*

Another NS manual comes with the required LAN product:

- *HP 9000 Series 300 and 800 NetIPC Programmer's Guide*

A brief description of each manual and a map to their contents is in this booklet's "Documentation Guide" section.

The ARPA Product

The ARPA Services/9000 product provides the ARPA/Berkeley Services. These services originated from the Advanced Research Projects Agency (ARPA) and from the University of California at Berkeley (UCB).

The services developed for ARPA are called ARPA Services and are used to communicate in HP-UX, UNIX, and non-UNIX environments. The services developed by UCB are called Berkeley Services and are predominantly used to communicate in HP-UX or UNIX environments.

HP's implementation of the ARPA/Berkeley Services software allows you to communicate with computers from several vendors on a LAN or X.25 WAN. To run ARPA/Berkeley Services software, you must have installed the LAN product or the X.25 product (or both).

ARPA Services

The ARPA Services listed below may be used between HP 9000 computers. ARPA Services may also be used over a LAN to communicate with other vendors' equipment including Sun Microsystems, IBM-PC/AT and DEC VAX VMS and Ultrix computers that are running ARPA software from non-HP suppliers. Over an X.25 WAN, connectivity to Sun Microsystems is supported.

- **File Transfer Protocol** (*ftp*) allows you to transfer files between HP-UX, UNIX, and non-UNIX systems and perform file management operations on these systems.
- **Simple Mail Transfer Protocol** (*SMTP*) is implemented through a UNIX mail facility called *sendmail* that supports ARPA-based networks. Because the specific implementation of this ARPA service originates from UCB, it is described in the "Berkeley Services" section below. Note that the IBM PC-AT and the HP Vectra PC do not support SMTP in HP's ARPA Services implementation.
- **Telnet** (*telnet*) allows you to log into a remote HP-UX, UNIX, or non-UNIX host if you have an account on the remote host and it is running ARPA software. This service may also be used over a LAN to communicate from your HP 9000 to HP 1000 computers.

Berkeley Services

The Berkeley Services listed below may be used between HP 9000 Series 300 and 800 computers. Berkeley Services may also be used over a LAN to communicate with other vendors' equipment including Sun Microsystems and DEC VAX VMS and Ultrix computers that are running Berkeley software from non-HP suppliers. Over an X.25 WAN, connectivity to Sun Microsystems is supported.

- **Remote Copy** (*rcp*) allows data and program files and directories to be transferred between HP-UX or UNIX hosts on the network. This service also allows your HP 9000 to communicate with HP Vectra PCs and IBM PC/ATs over a LAN.
- **Remote Execution** (*rexec*) is used in programs to execute commands on a remote HP-UX or UNIX host.
- **Remote Login** (*rlogin*) allows you to log into a remote HP-UX or UNIX host if you have an account on the remote host.
- **Remote Shell** (*remsh*) allows you to execute a command on a remote HP-UX or UNIX host if you have an account on the remote host. This service also allows your HP 9000 to communicate with HP Vectra PCs and IBM PC/ATs over a LAN. *Remsh* is the same command as Berkeley's *rsh*.
- **Remote Who** (*rwho*) allows you to list the users on remote systems that are running the *rwho* daemon. This service is not supported over the X.25 link product.
- **Remote Uptime** (*ruptime*) allows you to list the status of remote systems on the network that are running the *rwho* daemon. This service is not supported over the X.25 link product.
- **Sendmail** (*sendmail*), when installed and configured, routes internetwork mail. Because this service uses ARPA's standard Simple Mail Transfer Protocol (SMTP), you can use it to route internetwork mail to remote or local HP-UX, UNIX, and non-UNIX environments that support ARPA protocols.
- **BIND** (Berkeley Internet Name Domain) name service is an optional network information lookup service which uses a hierarchical naming scheme. It allows you to retrieve host names and addresses for any node on the network. It also provides mail routing capability via a list of hosts that will accept mail for an address.

- **Gated** is a routing daemon that dynamically determines routing over internets from one node to another. It allows you to specify which networks you want to communicate with and which you do not. Gated handles the RIP, EGP, and HELLO routing protocols, and can be configured to perform all or any combination of these three protocols.

Interprocess Communication

Berkeley Sockets (BSD IPC) provide interprocess communication used with the Berkeley Services part of the ARPA product. Berkeley Sockets are part of the link products and are described in “The LAN Product” and “The X.25 Product” sections of this booklet.

Diagnostics

When using the ARPA product, you can use any of the diagnostic utilities described in “The LAN Product” or “The X.25 Product” section of this booklet.

Documentation

The ARPA product includes the following manuals:

- *Installing and Administering ARPA Services*
- *Using ARPA Services*
- *ARPA/Berkeley Services Reference Pages*

Other ARPA manuals come with the link products, either of which is required:

- *HP 9000 Series 300 and 800 Berkeley IPC Programmer's Guide* (shipped with the LAN product)
- *X.25 Programmer's Guide* (shipped with the X.25 product)

A brief description of each manual and a map to their contents is in this booklet's “Documentation Guide” section.

The NFS Services Product

The NFS Services product provides remote access to file systems over LANs. With the NFS Services product, HP and non-HP computers on a common network can share files. Once a file system is attached via NFS, most user commands (for example: *ls*, *rm*, *cp*, etc.) that are performed on the local file system will operate on the remote file system. Thus, NFS allows project teams to integrate remote data or files into local applications and to maintain consistent files among team members. Writing distributed applications is also easier with NFS's Remote Procedure Call (RPC) function and Remote Procedure Call Protocol Compiler (RPCGEN). RPC uses eXternal Data Representation (XDR), which translates data into a computer-independent data format, to help HP and non-HP computers share data and applications.

The NFS Services product also provides optional services including Yellow Pages (YP) and Virtual Home Environment (VHE). YP is a lookup facility that allows you to maintain a set of databases from one node on the network. VHE allows you to configure remote node login environments to mirror your host node environment.

NFS Services

The NFS Services product allows your HP 9000 to communicate with other HP 9000s (Series 300 and 800). The NFS Services product can also be used to communicate with computers that are running NFS software from non-HP vendors, including Sun Microsystems, DEC VAX VMS and Ultrix computers, HP Vectra PCs and IBM-PC/ATs.

- **Network File System (NFS)** provides remote file access to remote file systems for a specified group of hosts.
- **Remote Execution Facility (REX)** allows users to execute commands on a remote host.
- **Network Lock Manager** prevents processes from modifying the same file at the same time, and permits cooperating processes to synchronize access to shared files.
- **Virtual Home Environment (VHE)**, an optional service, allows users to configure login environments on remote nodes to mirror login environments on their host nodes.

- **Yellow Pages (YP)**, an optional service, is normally used to centrally administer databases on the network. No matter which computer on the network requests data, YP supplies a consistent view of the data on the network at steady state.

The NFS Services product additionally provides these capabilities.

- **Remote Procedure Call (RPC)** allows you to develop applications which access files or processes or execute routines on a remote computer on the network. RPC achieves this by using eXternal Data Representation (XDR).
- **Remote Procedure Call Protocol Compiler (RPCGEN)** assists you in writing RPC applications.
- **eXternal Data Representation (XDR)** translates machine dependent data formats to a universal data format that can be used by all the network hosts using RPC/XDR. This enables HP and non-HP nodes and operating systems to exchange information on the network.

Diagnostics for NFS Services

When using the NFS Services product, you can use any of the diagnostic utilities described in the “The LAN Product.”

NFS Services Documentation

The NFS Services product includes the following manuals:

- *Using NFS Services*
- *Installing and Administering NFS Services*
- *Programming and Protocols for NFS Services*
- *NFS Services Reference Pages*

A brief description of each manual and a map to their contents is in the “Documentation Guide” section of this booklet.

Documentation Guide

Manual Descriptions

This section provides a brief description of the manuals that are shipped with the NS, ARPA, NFS Services, X.400/800, OTS/800, and X.25 products.

- *Networking Overview* for the HP 9000 Series 300 and 800 is this booklet and is included in the LAN and X.25 products.
- *Using ARPA Services* is included in the ARPA Services product. It contains a brief overview of the ARPA Services, tutorials on learning about and using the ARPA/Berkeley Services, a brief description of the internetwork mail routing facility, detailed information on interprocess communication (Berkeley sockets), portability issues and a glossary.
- *Using Network Services* is included in the NS Services product. It contains a description of Network Services including Network File Transfer, Remote File Access and Link Level Access. It also contains error messages for NS.
- *Using NFS Services* is included in the NFS Services product. It contains an overview of the NFS Services product and descriptions of commonly used commands.
- *Installing and Administering NFS* is included in the NFS Services product. Installation, configuration, maintenance and troubleshooting for NFS, Yellow Pages (YP), and Virtual Home Environment (VHE) are described. Configuring and using the Remote Execution Facility (REX) and Network Lock Manager are also described. Appendices describe the differences between NFS and local HP-UX, migration from RFA to NFS Services and using NFS in an HP-UX cluster environment.
- *Installing and Administering NS Services* is included in the NS Services product. It contains information about the installation, configuration and maintenance of the NS Services product. Troubleshooting and diagnostics for NS Services are also described.
- *Installing and Administering ARPA Services* is included in the ARPA Services product. It contains information about the installation, configuration and maintenance of the ARPA Services product. Troubleshooting and diagnostics for ARPA Services are also described.
- *Programming and Protocols for NFS Services* is included in the NFS Services product. It contains a technical overview of the NFS Services product,

provides Remote Procedure Call (RPC) and Remote Procedure Call Protocol Compiler (RPCGEN) programming information and describes RPC, eXternal Data Representation (XDR) and Yellow Pages (YP) protocol specifications.

- *NetIPC Programmer's Guide* is included in the NS product and is for programmers who write or maintain NetIPC applications on HP 9000 systems.
- *ARPA Services Reference Pages* is included in the ARPA Services product and contains the reference manual pages that pertain to ARPA/Berkeley Services.
- *NS Services Reference Pages* is included in the NS Services product and contains the reference manual pages that pertain to Network Services.
- *NFS Services Reference Pages* is included in the NFS Services product and contains reference pages that pertain to NFS Services.
- *NS Cross-System NFT Reference Manual* is included with the NS product and contains information on using NFT between dissimilar computers.
- *X.25 Programmer's Guide* is shipped with the X.25 product and explains X.25 programmatic access (Level 3) using Berkeley Sockets (BSD IPC). This manual is for programmers writing distributed application programs.
- *Installing and Administering X.25* is shipped with the X.25 product and is for node managers of HP 9000 systems using the X.25 and ARPA products. Installation, configuration, troubleshooting, and diagnostics for the X.25 product are described.
- *LAN/X.25 Reference Pages* is shipped with the X.25 product and contains the reference pages for X.25 configuration, diagnostics, and programmatic access.
- *X.25: The PSN Connection* is shipped with the X.25 product and provides an explanation of and reference to the *CCITT's Recommendation X.25*.
- *Installing and Administering X.400*
This manual is shipped with the X.400/800 product. It contains an overview of the X.400/800 product. Chapters describe installation, configuration, maintenance, and troubleshooting for the X.400/800 product on the HP9000 Series 800.
- *Installing and Administering OSI Transport Services*
This manual is shipped with the OTS/800 product. It contains information on the installation and configuration of the OTS/800 product.

Documentation Map

The following table is a map to direct you to information contained within the NS, ARPA, NFS Services, OTS, X.400 and X.25 documentation sets. Note that the table is **not** an exhaustive listing of the manual contents for these products.

If You Are Interested In	Read This
GENERAL INFORMATION	
Description of ARPA/Berkeley Services	<i>Using ARPA Services</i>
Description of Network Services	<i>Using Network Services</i>
Description of Network File System Services	<i>Using NFS Services Installing and Administering NFS Services</i>
Description of X.25	<i>X.25: The PSN Connection</i>
Glossaries	<i>Using NS Services Installing and Administering NS Services Using ARPA Services Installing and Administering ARPA Services Using NFS Services Installing and Administering NFS Services</i>
HP-UX cluster environments	<i>HP-UX System Administrator's Manual/HP 9000 Series 800 HP-UX System Administrator's Manual/HP 9000 Series 300</i>
Information on finding MIL-STDs¹ or RFCs²	<i>Installing and Administering NS Services</i>
Portability issues for ARPA Services	<i>Using ARPA Services</i>

(1) MIL-STD is the abbreviation for the Department of Defense's *Military Standard* documents.

(2) RFC is the abbreviation for the Department of Defense's drafts of military standards called *Request For Comment* documents.

If You Are Interested In	Read This
NFS/HP-UX Local Differences	<i>Installing and Administering NFS Services</i>
Reference manual guides	<i>Installing and Administering NS Services</i> <i>Using Network Services</i> <i>Installing and Administering ARPA Services</i> <i>Using ARPA Services</i> <i>Installing and Administering NFS Services</i> <i>Using NFS Services</i>
PROGRAMMING	
Interprocess Communication Berkeley sockets NetIPC	<i>Using ARPA Services</i> <i>Berkeley IPC Programmer's Guide</i> <i>NetIPC Programmer's Guide</i> <i>X.25 Programmer's Guide</i> <i>LAN/X.25 Reference Pages</i>
RPC	<i>Programming and Protocols for NFS Services</i> <i>NFS Services Reference Pages</i>
RPCGEN	<i>Programming and Protocols for NFS Services</i> <i>NFS Services Reference Pages</i>
Link Level Access (LLA)	<i>Using Network Services</i> <i>LLA Programmer's Guide</i> <i>NS Services Reference Pages</i>
XDR	<i>Programming and Protocols for NFS Services</i> <i>NFS Services Reference Pages</i>
ACTIVITIES	
Using NFS in a cluster environment	<i>Installing and Administering NFS Services</i>

If You Are Interested In	Read This
X.400/800 Installation, configuration, and maintenance	<i>Installing and Administering X.400</i> <i>Installing and Administering OSI Transport Services</i>
SERVICES	
File Transfer Protocol (ftp)	<i>Using ARPA Services</i> <i>ARPA Services Reference Pages</i>
Internetwork mail routing General description Configuration and maintenance	<i>Using ARPA Services</i> <i>ARPA Services Reference Pages</i> <i>Installing and Administering ARPA Services</i> <i>Installing and Administering X.25</i>
Lock Manager	<i>Using NFS Services</i> <i>Installing and Administering NFS Services</i>
Network File Transfer (NFT)	<i>Using Network Services</i> <i>NS Services Reference Pages</i>
Remote copy (rcp)	<i>Using ARPA Services</i> <i>ARPA Services Reference Pages</i>
Remote execution (rexec)	<i>Using ARPA Services</i> <i>ARPA Services Reference Pages</i>
Remote Execution Facility (REX)	<i>Using NFS Services</i> <i>Installing and Administering NFS Services</i>
Remote File Access (RFA)	<i>Using Network Services</i> <i>NS Services Reference Pages</i>
Remote login (rlogin)	<i>Using ARPA Services</i> <i>ARPA Services Reference Pages</i>
Remote shell (remsh)	<i>Using ARPA Services</i> <i>ARPA Services Reference Pages</i>
Remote uptime (ruptime)	<i>Using ARPA Services</i> <i>ARPA Services Reference Pages</i>

If You Are Interested In	Read This
Remote who (rwho)	<i>Using ARPA Services ARPA Services Reference Pages</i>
Sendmail Overview Configuration and maintenance	<i>Using ARPA Services HP-UX ARPA Services Reference Pages Installing and Administering ARPA Services</i>
Telnet (telnet)	<i>Using ARPA Services HP-UX ARPA Services Reference Pages</i>
Virtual Home Environment (VHE)	<i>Using and Administering NFS Services HP-UX NFS Services Reference Pages</i>
Yellow Pages (YP)	<i>Installing and Administering NFS Services</i>
ADMINISTRATION AND CONFIGURATION	
Adding an HP 9000 computer to or deleting it from the network	<i>Installing and Administering NS Services, Installing and Administering ARPA Services</i>
ARPA/Berkeley Services configuration and maintenance	<i>Installing and Administering ARPA Services</i>
Installing NS and ARPA Services in an HP-UX cluster environment	<i>Installing and Administering NS Services Installing and Administering ARPA Services</i>
Installing, configuring, and maintaining NFS Services	<i>Installing and Administering NFS Services</i>
Migrating from RFA to NFS	<i>Installing and Administering NFS Services</i>
NS and ARPA Services configuration files	<i>Installing and Administering NS Services, Installing and Administering ARPA Services</i>

If You Are Interested In	Read This
NS and ARPA Services network daemons	<i>Installing and Administering NS Services, Installing and Administering ARPA Services</i>
NFS Services network daemons	<i>Installing and Administering NFS Services</i>
NFS Services Security	<i>HP-UX System Security A Beginner's Guide to Using Shells</i>
NS Services security	<i>HP-UX System Security A Beginner's Guide to Using Shells</i>
ARPA Services security	<i>HP-UX System Security A Beginner's Guide to Using Shells</i>
Virtual Home Environment (VHE) configuration	<i>Installing and Administering NFS Services</i>
X.25 configuration	<i>Installing and Administering X.25</i>
Yellow Pages (YP) configuration	<i>Installing and Administering NFS Services</i>
X.400/800 Configuration	<i>Installing and Administering X.400</i>
DIAGNOSTICS	
LAN interface statistics	<i>Installing and Administering LAN</i>
Linkloop	<i>Installing and Administering LAN</i>
Network event logging	<i>Installing and Administering LAN LAN Reference Pages Installing and Administering X.25</i>
Network tracing	<i>Installing and Administering LAN LAN/X.25 Reference Pages Installing and Administering X.25</i>
Network error messages	<i>Installing and Administering LAN</i>
Netstat	<i>Installing and Administering LAN LAN/X.25 Reference Pages</i>
Ping	<i>Installing and Administering LAN LAN/X.25 Reference Pages Installing and Administering X.25</i>
Remote Loopback (rlb)	<i>Installing and Administering LAN LAN/X.25 Reference Pages</i>

If You Are Interested In	Read This
Self-test completion codes	<i>Installing and Administering LAN</i>
x4agelog	<i>Installing and Administering X.400</i>
x4asnview	<i>Installing and Administering X.400</i>
x4bit	<i>Installing and Administering X.400</i>
x4eventlog	<i>Installing and Administering X.400</i>
x4loop	<i>Installing and Administering X.400</i>
x4msgtest	<i>Installing and Administering X.400</i>
x4queview	<i>Installing and Administering X.400</i>
x4rtview	<i>Installing and Administering X.400</i>
x4stat	<i>Installing and Administering X.400</i>
x4version	<i>Installing and Administering X.400</i>
SECURITY	
C2 Security	<i>HP-UX System Security Manual HP-UX Beginner's Guide A Beginner's Guide to Using Shells</i>
TROUBLESHOOTING	
Troubleshooting NS Services	<i>Installing and Administering NS Services</i>
Troubleshooting ARPA Services	<i>Installing and Administering ARPA Services</i>
Troubleshooting NFS, YP, VHE, and REX	<i>Installing and Administering NFS Services</i>
Troubleshooting X.25	<i>Installing and Administering X.25</i>
Troubleshooting X.400/800 Product	<i>Installing and Administering X.400</i>



HP Part Number
B1012-90003
Printed in U.S.A

E0989



B1012-90003