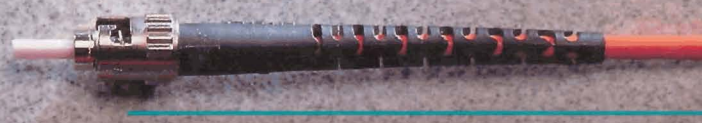
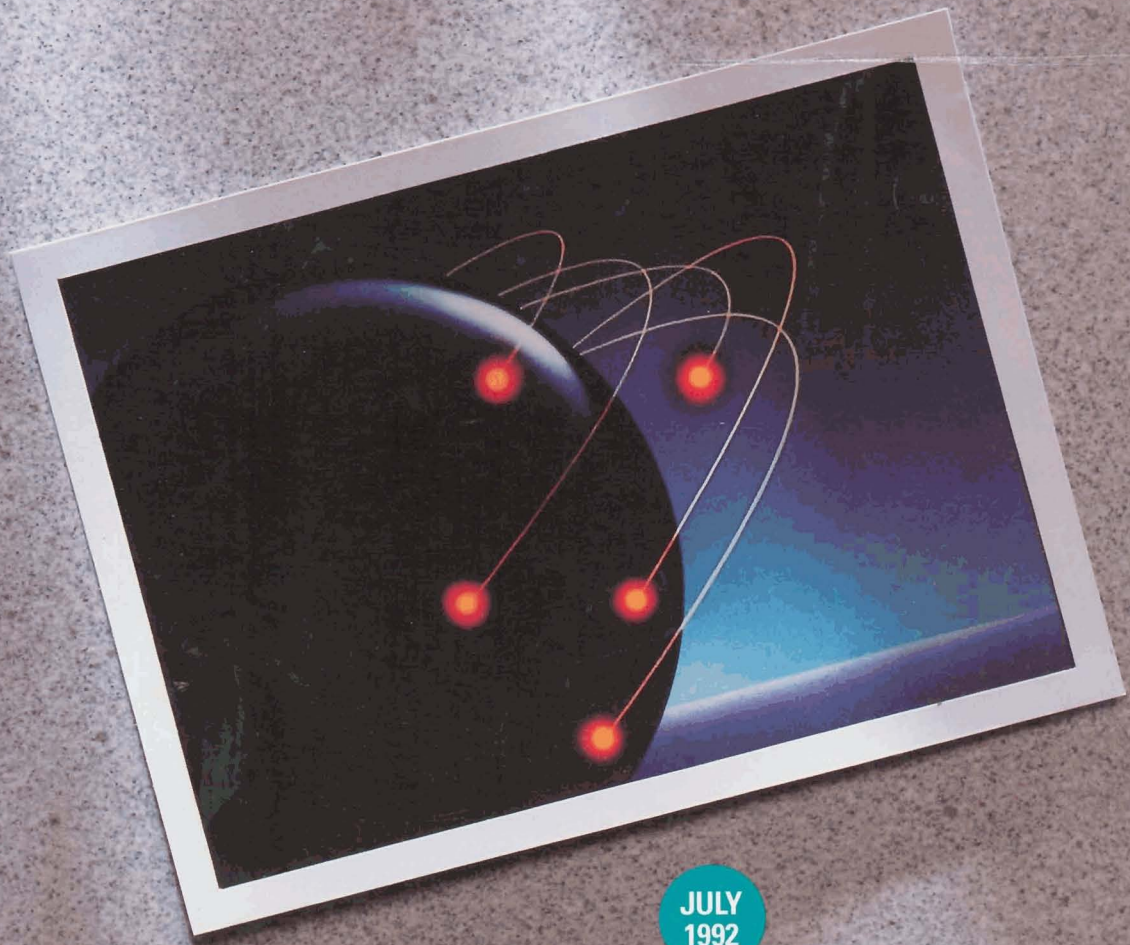
HEWLETT PACKARD

HP EtherTwist Technical Reference Guide



Technical Guide to Using HP Networking Products



JULY 1992

HP Computer Museum
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Technical Reference Guide

HP EtherTwist Family of Products

- **Introduction**
- **Table of Contents**

What Is in This Guide

This technical reference guide is organized into five major sections:

Section 1: Workgroup LANs

Section 2: Site LANs

Section 3: Multisite LANs

Section 4: Network Management

Section 5: Advanced Topics

The placement and organization of the various HP EtherTwist network products discussed in this reference guide is not rigid. The presentation of an HP EtherTwist network product in one of the above sections does not limit the product to be used in a specific network solution. Rather, the organization is designed so that information may be located in an orderly fashion. For example, although HP routers are discussed in the Multisite LAN section, routers may be used to interconnect multi-protocol networks within a site LAN. That is, you don't always have to use WAN links and WAN link terminating equipment in order to use HP routers. HP routers can be used to administratively divide a large site LAN and to help optimize overall network performance. Even though HP routers are presented in the Multisite LAN section of this document, routers can be used in site LANs as well.

Likewise, although HP ThinLAN hubs are discussed in the workgroup LAN section of this document, ThinLAN hubs can also be used in site LANs. HP transceivers (such as the EtherTwist, ThinLAN, and fiber-optic transceivers) can be used with all HP EtherTwist network products in workgroup, site, and multisite LAN environments. In this document, information on HP transceivers is presented in the workgroup LAN section.

The information in this guide is as follows:

Section 1: Workgroup LANs

This section provides technical information on HP EtherTwist network products used in workgroup LANs. This section describes:

- HP EtherTwist LAN Adapters and associated drivers
  - questions and answers
  - installation steps
- HP Transceivers
  - questions and answers
  - installation steps
- HP EtherTwist Hubs
  - questions and answers
  - installation steps
- HP ThinLAN Hub Plus
  - questions and answers
  - installation steps
- Workgroup LAN Design
- Workgroup LAN Cabling
- HP Wire Test Instrument

Section 2: Site LANs

This section provides technical information on HP EtherTwist network products used in site LANs. This section describes:

- HP Fiber-Optic Hub Plus
  - questions and answers
  - installation steps
- HP 10:10 LAN Bridges
  - questions and answers
  - installation steps
- Site LAN Design
- Site LAN Cabling

Section 3: Multisite LANs

This section provides technical information on HP EtherTwist network products used in multisite LANs. This section describes:

- HP Remote Bridge RB
  - questions and answers
  - installation steps
- HP Router ER and HP Router TR
  - questions and answers
  - installation steps
- Multisite LAN Design
- Multisite LAN and WAN Connections

Section 4: Network Management

This section provides technical information on the HP EtherTwist network management products for HP OpenView/DOS.

- HP OpenView Interconnect Manager/DOS
- HP OpenView Hub Manager/DOS
- HP OpenView Resource Manager/DOS
- HP OpenView Network Management questions and answers

Section 5: Advanced Topics

This section provides additional technical information on a variety of topics that apply to one or more of the HP EtherTwist network products.

Glossary

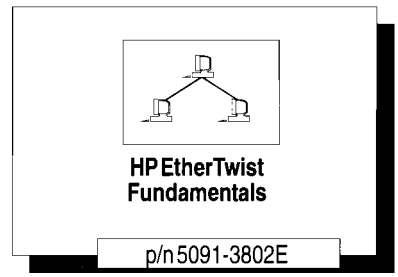
The glossary provides brief definitions of terms found in this document.

Index

This *HP EtherTwist Technical Reference Guide* is part of the family of HP EtherTwist reference materials and technical training courses described below.

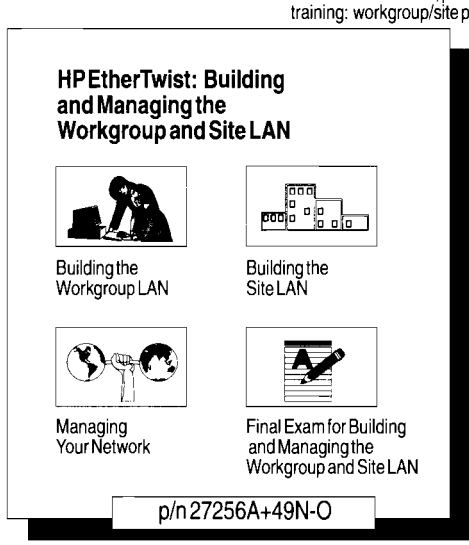
HP EtherTwist Technical Training

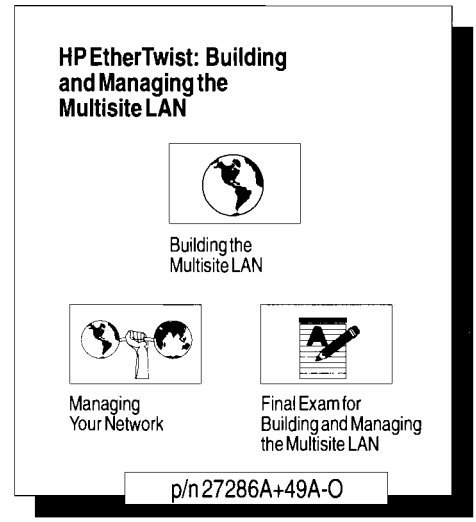
Prerequisite Training



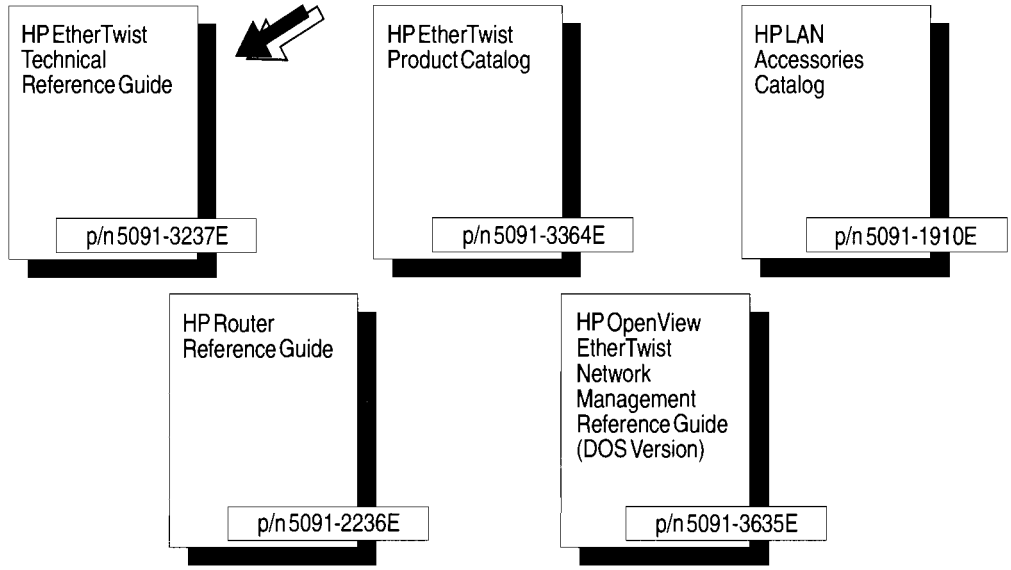
Basic-Level Training

For NP authorization, pass ONE final exam from the basic-level training: workgroup/site products OR multisite products.





Reference Documents



Prerequisite Training

Fundamental Training (p/n 5091-3802E): This video introduces you to the HP EtherTwist family of LAN products.

Basic-Level Training

HP EtherTwist: Building and Managing the Workgroup and Site LAN (p/n 27256A+49N-0*): This is component-level installation and configuration training covering HP workgroup and site LAN hardware and network management products. Fundamental training is a prerequisite to this course. The kit includes the following, to be completed in order:

1. *HP EtherTwist: Building the Workgroup LAN* covers twisted-pair PC adapter cards, hubs, and transceivers. It contains:
   - student workbook
   - 30-minute video
2. *HP EtherTwist: Building the Site LAN* covers HP fiber-optic products and 10:10 LAN bridges. It contains:
   - student workbook
   - computer-based training (CBT) disks
3. *HP EtherTwist Network Management* covers network management principles and HP OpenView network management products. It contains:
   - student workbook
   - computer-based training (CBT) floppy disks
   - principles guide
   - emulator software for practice tasks
4. A *Final Exam* covers workgroup and site LAN products, including management of these products.

---

* HP Service Personnel: Please use the following course numbers:

NEN2-10BASETB	*HP EtherTwist: Building the Workgroup LAN*
NEN-2868XA	*HP EtherTwist: Building the Site LAN*
NEN2-DEVMGRB	*HP EtherTwist Network Management*

HP EtherTwist: Building and Managing the Multisite LAN (p/n 27286A+49A-0*): This is component-level installation, configuration, and verification training covering HP multisite LAN hardware and network management products. Fundamental training is a prerequisite to this course. The kit includes the following, to be completed in order:

1. *HP EtherTwist: Building the Multisite LAN* covers the HP remote bridge and HP routers. It contains:
   - computer-based training (CBT) floppy disks
   - student workbook
   - router reference document
2. *HP EtherTwist Network Management* covers network management principles and HP OpenView network management products. (This is the same as the network management component in the previous kit.) It contains:
   - student workbook
   - computer-based training (CBT) floppy disks
   - principles guide
   - emulator software for practice tasks
3. A *Final Exam* covers multisite products and management of those products.

Reference Documents:

- *HP EtherTwist Technical Reference Guide* (p/n 5091-3237E, this guide) provides technical information on all HP EtherTwist products.
- *HP EtherTwist Product Catalog* (p/n 5091-3364E) lists and describes available HP EtherTwist network products.
- *HP LAN Accessories Catalog* (p/n 5091-1910E) lists and describes basic hardware components necessary for connecting multiple HP EtherTwist networking products.
- *HP Router Reference Guide* (p/n 5091-2236E) provides detailed technical information on the HP 27285A Router ER and the HP 27286A Router TR.
- *HP OpenView EtherTwist Network Management Reference Guide (DOS Version)* (p/n 5091-3635E) provides detailed technical information on the HP 28686D OpenView Hub Manager/DOS, HP 27256D Interconnect Manager/DOS, and HP 27257D Resource Manager/DOS products.

* HP Service Personnel: Please use the following course numbers:

NEN2-272XXA	*HP EtherTwist: Building the Multisite LAN*
NEN2-DEVMGRB	*HP EtherTwist Network Management*

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HP EtherTwist

Technical Reference Guide

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Workgroup LANs

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- **HP EtherTwist LAN Adapters**
- **HP Transceivers**
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- **Workgroup LAN Design**
- **Workgroup LAN Cabling**
- **HP Wire Test Instrument**

LAN Products

Introduction

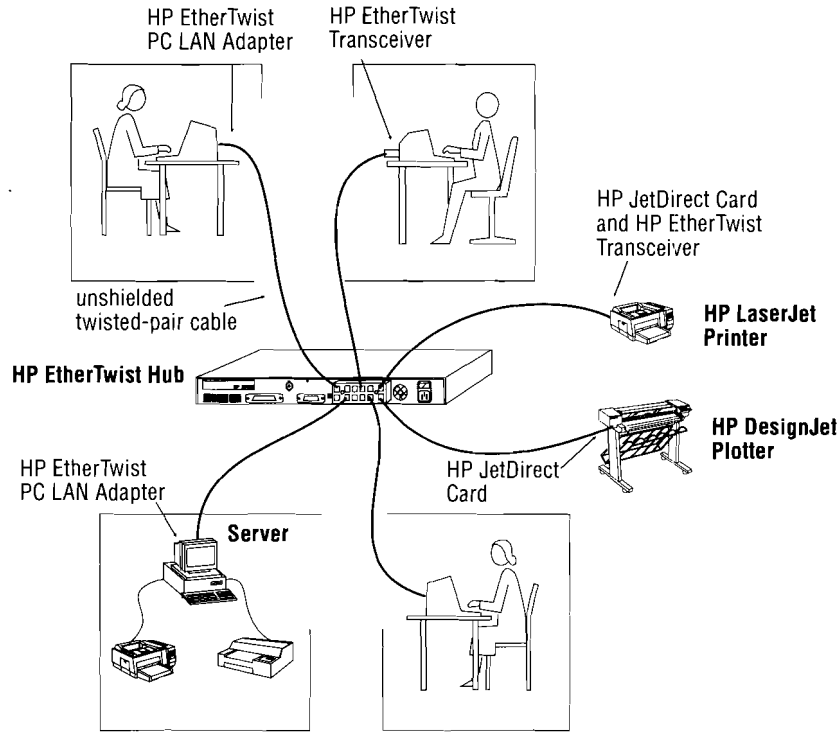
Workgroup LANs

A workgroup is a family of users who have common projects and share similar objectives. They usually use common software, and have identical, localized security needs.

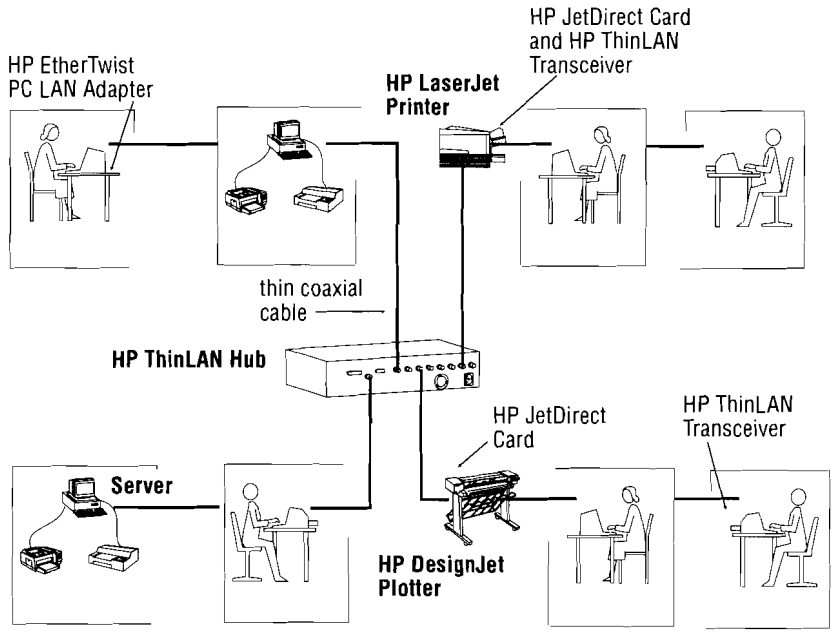
A workgroup LAN connects members of a workgroup to each other and to shared peripherals. A workgroup LAN may be a small LAN on its own and consist of a server and several clients. Or, a workgroup LAN may be a large LAN that includes many servers, as well as PCs, workstations, and minicomputers as clients.

The HP EtherTwist family of network products offers a complete set of IEEE 802.3 Type 10Base-T and Type 10Base2-compatible products to implement any size client/server workgroup LAN. The Type 10Base-T products use unshielded twisted-pair (UTP) cabling and the Type 10Base2 products use thin coaxial cabling.

Workgroup LAN using unshielded twisted-pair cable.



Workgroup LAN using thin coaxial cable.



The HP EtherTwist products covered in the Workgroup LAN section are:

PC LAN adapters. PC LAN adapters provide the interfaces that let personal computers connect to a network cable such as unshielded twisted-pair (UTP) or thin coaxial cabling.

Transceivers. Transceivers adapt AUI ports on adapters cards, or devices such as hubs, bridges, and routers—for connection to a network cable. HP offers three different transceivers—HP EtherTwist Transceiver, HP ThinLAN Transceiver, and HP Fiber-Optic Transceiver. By attaching any one of these transceivers to an AUI port, you can make a connection to twisted-pair, thin coaxial, and fiber-optic cabling respectively. Even though transceivers are discussed in this section, they are used in site and multisite LANs as well.

Hubs. Hubs form the network by providing the physical connections for all nodes (such as computers, peripherals, other hubs, and bridges) connected on the LAN. The two types of hubs discussed in the Workgroup LAN section are the HP EtherTwist hubs, and the HP ThinLAN hub.

The organization and placement of HP EtherTwist network products discussed in this reference guide is not rigid. For instance, if you have a workgroup that exists in a noisy environment, you can use fiber-optic cabling, transceivers, and hubs for that workgroup rather than UTP or thin coaxial cabling. Even though the HP Fiber-Optic Hub is presented in the Site LAN section of this document, fiber-optic products can be used in workgroup or in multisite network environments as well.

HP EtherTwist LAN Adapters

Technical Data

HP 27248A EISA LAN Adapter/32 TP
☆ **HP 27247B PC LAN Adapter/16 TP Plus**
☆ **HP 27269B PC LAN Adapter/16 TP Plus 6-Pack**
☆ **HP 27252A PC LAN Adapter/16 TL Plus**
HP 27246A MC LAN Adapter/16 TP
HP 27245A PC LAN Adapter/8 TP
HP 27267A PC LAN Adapter/8 TP 6-Pack

☆ ***new products***

The HP EtherTwist family of LAN Adapters offers leading price-performance across client and server applications, and for different PC backplanes including 8-bit ISA, 16-bit ISA, 16-bit Micro Channel, and 32-bit EISA. A new 10Base2 card, the HP 27252A PC LAN Adapter/16 TL Plus, provides direct connections to 10-Mbit/s thin coaxial LANs.

There are two new additions to the HP EtherTwist LAN Adapter Card family. They are the HP 27247B, an ISA 16-bit 10Base-T card, and the HP 27252A, an ISA 16-bit 10Base2 (thin coax) card. Both of these cards offer market-leading performance and an assortment of new features. For example, they provide boot ROM support for diskless PC applications, LEDs for indicating status, and an AUI port for attachment to other media such as optical fiber. These new cards are 100 percent software configurable through HPLANSet, an easy-to-use configuration and diagnostic program. The HP 27247B and HP 27269B (6-pack) are replacements for the HP 27247A and HP 27269A, respectively. The HP 27252A is a new high-performance IEEE 802.3/Ethernet card for thin coaxial networks.

Highlights

☆ **High Performance**
HP EtherTwist LAN Adapters are designed for optimal network performance via high throughput and low CPU utilization. The adapters have plenty of on-board memory (32 or 64 Kbytes) for packet buffering; most competing products have only a 16-Kbyte buffer memory. The HP 27247B and 27252A 16-bit ISA adapters are the highest performing 16-bit cards in the industry. Their performance rivals that of most 32-bit EISA cards.

☆ **Reliability**
The HP EtherTwist LAN Adapters give you long-term trouble-free operation. These cards use the latest in application-specific integrated circuit (ASIC) chips and surface mount technology (SMT) packaging. This results in fewer components than more complicated competing cards. The mean-time-between-failure (MTBF) of these adapters is greater than 300 years (350 years for HP 27245A). All HP EtherTwist LAN Adapters are backed by a lifetime limited warranty.

☆ **Extensive Driver Support**
The HP EtherTwist LAN Adapters come with drivers for a wide variety of network operating systems (NOSs). This gives you the flexibility to run the network applications best suited for your business. HP provides driver support for Novell's NetWare Lite, NetWare 286 and 386, Microsoft's LAN Manager 2.1, SCO UNIX v3.2.x, FTP Inc.'s PC/TCP, and NCSA TCP/IP v2.3. See the "Driver Compatibility" Product Note for more details.

HP EtherTwist LAN Adapter Selection Guide

Client	Server	PC Bus Type	Connection Type
27245A		ISA 8-bit	10Base-T
27246A	27246A	MC 16-bit	10Base-T
27247B	27247B	ISA 16-bit	10Base-T, AUI
27252A	27252A	ISA 16-bit	Thin Coax, AUI
	27248A	EISA 32-bit	10Base-T, AUI

Features

HP 27248A EISA LAN Adapter/32 TP

- High throughput and low CPU utilization
- 32-bit EISA backplane connection
- Burst DMA data transfer (33-Mbyte/s transfer rate)
- 64 Kbytes of on-board static RAM for packet buffering
- 8-pin modular (RJ-45) jack for 10Base-T connection
- AUI port for connection to coaxial or fiber-optic cabling
- LED indications for transmit and receive signals

HP 27247B PC LAN Adapter/16 TP Plus and HP 27269B PC LAN Adapter/16 TP Plus 6-Pack

- Remote boot support for Novell NetWare 286 & 386 (ROM product number HP 27260A)
- Fully software configurable; no jumpers, no switches
- Easy-to-use configuration and diagnostic program (HPLANSet)
- Dual-mode operation: shared memory or Rep I/O
- RJ-45 (8-pin) modular jack for 10Base-T connection
- AUI (15-pin) port for transceiver connection to fiber-optic cabling (HP 28683A Fiber-Optic Transceiver)
- LED indicators: Transmit, Receive, Link Beat Status, Port Selected
- Wide selection of interrupts (IRQs: 3, 4, 5, 6, 7, 9, 10, 11, 12, 15)
- Large packet buffer memory (32 Kbytes)

HP 27252A PC LAN Adapter/16 TL Plus

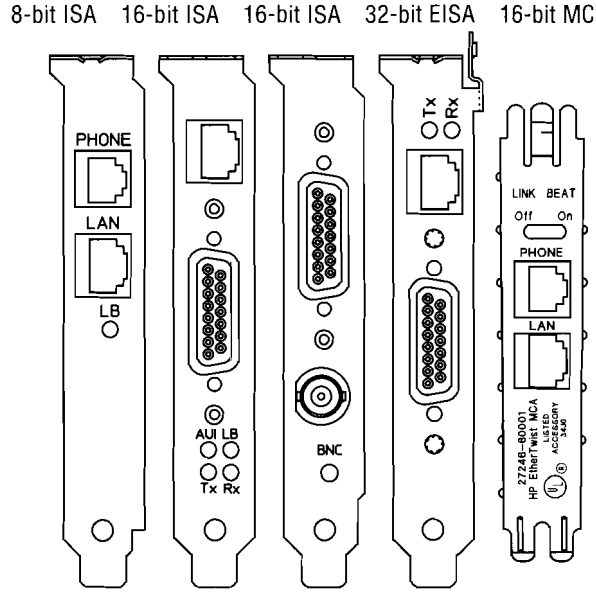
- Remote boot support for Novell NetWare 286 & 386 (ROM product number HP 27260A)
- Fully software configurable; no jumpers, no switches
- Easy-to-use configuration and diagnostic program (HPLANSet)
- Dual-mode operation: shared memory or Rep I/O
- BNC connector for standard Ethernet thin coax connection
- AUI (15-pin) port for transceiver connection to fiber-optic cabling (HP 28683A Fiber-Optic Transceiver)
- LED indicator for Port Selected
- Wide selection of interrupts (IRQs: 3, 4, 5, 6, 7, 9, 10, 11, 12, 15)
- Large packet buffer memory (32 Kbytes)

HP 27246A MC LAN Adapter/16 TP

- 16-bit Micro Channel backplane connection
- 64 Kbytes of on-board static RAM for packet buffering
- 8-pin modular (RJ-45) jack for 10Base-T connection
- 6-pin modular (RJ-11) jack for integration with phone cabling

HP 27245A PC LAN Adapter/8 TP and HP 27267A PC LAN Adapter/8 TP 6-Pack

- 8-bit ISA (AT) backplane connection
- 32 Kbytes of on-board static RAM for packet buffering
- 8-pin modular (RJ-45) jack for 10Base-T connection
- 6-pin modular (RJ-11) jack for integration with phone cabling
- LED indicator for 10Base-T link beat signal



Specifications

Environmental Characteristics

Operating Temperature: 0°C to 55°C (+32°F to +131°F)

Relative Humidity: 15% to 95% @40°C noncondensing

Electrical Characteristics

HP 27248A:	0.90 A @ 5 V typical; 2.00 A @ 5 V maximum
HP 27247B & HP 27269B:	0.75 A @ 5 V typical; 0.90 A @ 5 V maximum
HP 27252A:	0.75 A @ 5 V typical; 0.90 A @ 5 V maximum
HP 27246A:	1.20 A @ 5 V typical; 1.40 A @ 5 V maximum
HP 27245A & HP 27267A:	0.65 A @ 5 V typical; 0.70 A @ 5 V maximum

Physical Characteristics

HP 27248A	Dimensions:	22.9 cm by 12.1 cm (9.00 in. by 7.75 in.)
	Weight:	147 g (5.2 oz)
HP 27247B & HP 27269B	Dimensions:	15.9 cm by 8.9 cm (6.25 in. by 3.5 in.)
	Weight:	85 g (3.0 oz)
HP 27252A	Dimensions:	15.9 cm by 8.9 cm (6.25 in. by 3.5 in.)
	Weight:	85 g (3.0 oz)
HP 27246A	Dimensions:	10.5 cm by 8.6 cm (4.13 in. by 3.4 in.)
	Weight:	116 g (4.1 oz)
HP 27245A & HP 27267A	Dimensions:	10.5 cm by 8.6 cm (4.13 in. by 3.4 in.)
	Weight:	71 g (2.5 oz)

Standards

Communications:

HP 27248A, 27247B, 27252A, 27246A, & 27245A:	IEEE 802.3 Type 10Base-T
HP 27252A:	IEEE 802.3 Type 10Base2

Safety:	UL 1950 CSA 220 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class A* EN 55022 (1988) Class A* VCCI Class 1 * 27246A, 27247A, & 27248A are Class B
Immunity:	
ESD	IEC 801-2: 1991 3 kV CD, 8 kV AD prEN 55101-2: 1990
Radiated Emissions:	IEC 801-3: 1984 3 V/m prEN 55024-3: 1991

Warranty

All HP EtherTwist LAN Adapters have a lifetime limited warranty.

HP EtherTwist LAN Adapters

Product Note

Driver Compatibility

New drivers are continually being written and different network operating systems (NOSs) tested with HP EtherTwist network products. Check CompuServe, HPNN, your authorized HP dealer, or your local HP support representative for the latest software compatibility list. CompuServe and HPNN provide the latest software updates to drivers. Files on HPNN are available to HP authorized dealers. Files on CompuServe are available to CompuServe subscribers.

What's New

(as of Spring 1992)

- Drivers for the new HP 27247B PC LAN Adapter/16 TP Plus.
- Drivers for the new HP 27252A PC LAN Adapter/16 TL Plus.
- Novell NetWare Lite drivers for all adapters.
- Additional interrupt levels 6, 9, 10, 11, 12, and 15 supported on the HP 27247B PC LAN Adapter/16 TP Plus and the HP 27252A PC LAN Adapter/16 TL Plus.
- Streams driver for the HP EISA LAN Adapter/32 TP for SCO UNIX 3.2.x support.

Driver Compatibility Reference Table

Network Operating System (NOS)	HP EtherTwist Adapter Card			
	32-bit EISA HP 27248A	16-bit ISA HP 27252A, HP 27247B/27269B	16-bit MC HP 27246A	8-bit ISA HP 27245A/ 27267A
Novell NetWare 286 v2.15, v2.2	C-IPX	C-IPX S-IPX S-ATALK1 S-ATALK2	C-IPX S-IPX S-ATALK S-ATALK2	C-IPX S-IPX S-ATALK S-ATALK2
Novell NetWare 386 v3.0, v3.1x	S-ODI C-IPX	S-ODI C-ODI C-IPX	S-ODI C-ODI C-IPX	S-ODI C-ODI C-IPX
HP LAN Manager (DOS, OS/2 v1.x)[a]	NDIS 2.0	NDIS 2.0	NDIS 2.0	NDIS 2.0
Microsoft LAN Manager v2.0, v2.1[a]	NDIS 2.0	NDIS 2.0	NDIS 2.0	NDIS 2.0
IBM/Microsoft OS/2 v1.x[a] LAN Manager v2.0, v2.1	NDIS 2.0	NDIS 2.0	NDIS 2.0	NDIS 2.0
HP LM/X Support[b]	NDIS 2.0 *client only*[b]	NDIS 2.0 *client only*[b]	NDIS 2.0 *client only*[b]	NDIS 2.0 *client only*[b]
3Com 3+Open v1.1 (XNS)[a]	NDIS 2.0	NDIS 2.0	NDIS 2.0	NDIS 2.0
DEC Pathworks v4.0[a]	NDIS 2.0	NDIS 2.0	NDIS 2.0	NDIS 2.0
SCO UNIX v3.2.X	Streams[e]	Streams[d,e]	Streams[f]	Streams[e]
Banyan Vines (c)	NDIS 2.0 *client only*	NDIS 2.0 *client only*	NDIS 2.0 *client only*	NDIS 2.0 *client only*
FTP Inc. PC/TCP Plus[a]	NDIS 2.0	NDIS 2.0 Packet Driver[d]	NDIS 2.0 Packet Driver	NDIS 2.0 Packet Driver
FTP Inc. PC/TCP	—	Packet Driver[d]	Packet Driver	Packet Driver
HP OfficeShare III	—	—	OSD	OSD
NCSA TCP/IP Services v2.3	—	Packet Driver[d]	Packet Driver	Packet Driver
Hughes ProLink[a]	NDIS 2.0	NDIS 2.0	NDIS 2.0	NDIS 2.0

LEGEND:

—	Presently not available.
S-IPX	NetWare 2.2 Server
C-IPX	NetWare DOS IPX Client
S-ODI	NetWare 386 v3.11 Open Data-link Interface (ODI) Server
C-ODI	NetWare DOS ODI Client
S-ATALK	NetWare v2.2 Server with AppleTalk Phase 1 functionality
S-ATALK2	NetWare v2.2 Server with AppleTalk Phase 2 functionality
OSD	HP OfficeShare Driver

NOTES:

(a) NDIS 2.0 driver supports both server and client unless otherwise noted.

(b) HP LM/X Support: NDIS 2.0 clients running under LAN Manager 1.0 or 1.1 on the PC can communicate with HP 9000 LM/X servers.

(c) Requires Banyan Vines version 4.00 (2) with patch release 2NNN, or later versions.

(d) Supported only on the HP 27247A adapter. Currently not available for the HP 27247B PC LAN Adapter/16 TP Plus and HP 27252A PC LAN Adapter/16 TL Plus cards.

(e) Available from SCO on the LLI Drivers Disk v3.x Extended Feature Supplement.

(f) Does not presently support SCO UNIX 3.2v4.

HP EtherTwist LAN Adapters

Product Note

Support Disk for HP EtherTwist LAN Adapters

A support disk is included with each HP EtherTwist LAN Adapter. The support disk contains drivers (unique to that adapter) for operation in many popular network operating systems. In addition to drivers, the support disk has a test program that can initiate self-test on the adapter and also send 802.2 test packets (at the data link layer) to other devices on the network.

Revision History

D.01.00 (Spring '92)

- Added drivers for HP 27252A PC LAN Adapter/16 TL Plus.
- Added drivers for HP 27247B PC LAN Adapter/16 TP Plus.
- Added SCO UNIX 3.2.x support for the HP EISA LAN Adapter/32 TP.
- Added HPLANSet (HP LAN Adapter Setup and Diagnostics) for the HP PC LAN Adapter/16 TL Plus and the HP PC LAN Adapter/16 TP Plus.

C.02.00

- Added Novell DOS ODI server and client drivers for NetWare 3.11. Support for multiple protocols.
- Added NDIS 2.0 support.
- Updated TEST program (string comparison).
- Added new configuration files for EISA environment.

C.01.01

- Added new AppleTalk Phase I and Phase II drivers for NetWare 2.x servers.
- Updated TEST program.
- Changed packet driver.

C.00.00

- Added SCO UNIX drivers.
- Added Clarkson University Packet driver.
- Added Novell NetWare drivers for HP EISA Adapter card (HP 27248A).
- Updated TEST program.

Support Disk Directory Contents

Since each HP EtherTwist LAN Adapter comes with its own (unique) support disk, the contents and organization will vary. Refer to the README file found on the root directory of each support disk.

You can also access CompuServe and HPNN for copies of the latest drivers for HP EtherTwist LAN adapters. Files on HPNN are available to HP authorized dealers. Files on CompuServe are available to CompuServe subscribers. Refer to the "Software Update Access" Product Note in the Advanced Topics section of this document for more information.

HP EtherTwist LAN Adapters

Product Note

Third-Party Compatibility List—Personal Computers

HP LAN adapters are designed to operate with industry-standard hardware and software products. Based on limited testing, HP believes the following products achieve compatibility with HP EtherTwist and ThinLAN cards.

HP relies in part upon information from the suppliers of the products and makes no warranty, expressed or implied, with respect to the following products' operation or compliance with worldwide regulatory requirements. HP advises customer to conduct independent examination to determine suitable levels of compatibility for the customer's individual needs.

HP Adapter Card	**Personal Computers** *(compatible)*
HP 27245A	HP Vectra PC family IBM PC/XT/AT Compaq Portable Compaq Deskpro (286e, 486/33) Compaq Systempro 386/33 Epson (386/20) Compuadd 325 (386/25) Olivetti M300 (386/16) ACER 1100/25 (386/25) AST 386/33, Bravo 386SX/30, Premier 386/33T Toshiba T8500 model (386/25) Hyundai 286C NEC Businessmate 386/33T ALR VEISA 101, 486/33i Everex 386/25 Everex 486/33e Mitsubishi 386/16 AGI 3000L 386/33 Data Master 386/23 DELL 425E Leading Edge 386/33 Standard Technologies 386/25 Wyse 3016SX, 386/25 Zenith Z-386/33e
HP 27246A	IBM PS/2 models: 30/286, 50, 60, 70, 80, 90/95

HP Adapter Card	Personal Computers *(compatible)*
HP 27247A/B, HP 27252A	HP Vectra PC family IBM PC /XT/AT Compaq Portable Compaq Deskpro (286, 486/33) Compaq Systempro 386/33 Epson (386/20) Compuadd 325 (386/25) Olivetti M300 (386/16) ACER 1100/25 (386/25) AST 386/33, Bravo 386SX/20, Premier 386/33T Toshiba T8500 model (386/25) Hyundai 286C NEC Businessmate 386/33T ALR VEISA 101, 486/33i Everex 386/25 Everex 486/33e Mitsubishi 386/16 AGI 3000L 386/33 Data Master 386/23 DELL 425E Leading Edge 386/33 Standard Technologies 386/25 Wyse 3016SX, 386/25 Zenith Z-386/33e 3Com 3S/40x Tandy 3000 and 4000 Honeywell 286, 386
HP 27248A	HP Vectra EISA family Compaq Deskpro 486/33 ALR VEISA 486/33i Everex 486/33e Dell 425E

Check with HP for the latest list of personal computers that have been tested with the HP EtherTwist family of LAN adapters.

HP EtherTwist LAN Adapters

Product Note

Questions and Answers

HP EtherTwist LAN Adapters

Q. What is the difference between the HP 27247A Adapter Card/16 and the HP 27247B PC LAN Adapter/16 TP Plus?

A. Many new enhancements have been added to the "B" version adapter. They include:

- a built-in socket for remote client boot ROM code
- a software configuration utility; no jumpers or switches
- improved CPU utilization performance
- dual-mode operation: shared memory or Rep I/O
- a built-in AUI (15-pin) port for transceiver connection
- LED indicators: Transmit, Receive, Link Beat Status, Port Selected (RJ-45 or AUI)
- a wide selection of interrupts (IRQs: 3, 4, 5, 6, 7, 9, 10, 11, 12, 15)
- a large packet buffer memory (32 Kbytes)

Q. What boot ROM capabilities does the HP 27247B PC LAN Adapter/16 TP Plus have?

A. HP 27260A provides a boot ROM with Novell NetWare 286 and 386 client code. The boot ROM is ordered separately.

Q. When should I disable link beat on an HP EtherTwist LAN Adapter?

A. Disable link beat on an adapter when it is connected to an HP 28633A StarLAN 10 Hub or any other device that is not Type 10Base-T compliant.

Q. If a LAN adapter has link beat enabled and does not detect any link beat pulses, what happens?

A. The adapter will stop transmitting until it detects link beat from the attached hub.

Q. What are the major factors that influence the performance of a PC server?

A. The speed of the disk and I/O sub-system is *the* major factor that influences the PC server performance. Very high speed CPU, adapters, etc., generally have little noticeable effect if the PC's disk sub-system is slow and inefficient.

Once the PC server is equipped with an efficient disk caching sub-system, the performance of the LAN adapter used in the server will make a difference in the overall server performance.

Q. What is a bus master adapter?

A. A bus master adapter is one that is capable of becoming the bus master on the system backplane and performing the desired transactions. In general, such adapters directly arbitrate for the bus, *quickly* initiate the transaction when the bus is granted, and *quickly* relinquish the bus when the transaction completes.

Q. What are the advantages of a bus master design?

A. In a carefully designed bus master adapter, the CPU utilization to "gather" during outbound data transfer is minimal. The performance increase will become more noticeable on servers with high-performance disk systems. In other words, gathering is the process of forming contiguous LAN packets from fragmented pieces of information (such as, protocol headers, data, etc.) for transmission over the network.

Q. What is a bus slave DMA adapter?

A. A slave DMA adapter requests the services of the system DMA to transfer data between the adapter and the system memory. The DMA transfer is initiated when the host system "acknowledges" the DMA request.

Q. What are the disadvantages of a bus master adapter?

A. Special bus master circuits are required to optimize the design. Hence, the cost relative to slave DMA designs could be several hundred dollars higher.

Q. What are the disadvantages of a slave DMA adapter?

A. Generally, with slave DMA adapters, the CPU utilization to "gather" during outbound data transfer is slightly higher than that in a bus master adapter.

Q. When should one select a bus master adapter?

A.

1. When CPU utilization is of grave concern, for example in heavily used servers that have fast disk sub-systems. This is mainly due to the efficient "gather" operation.
2. When cost is not a major factor.
3. When the driver is capable of taking advantage of the PC's fast disk sub-system capabilities.

Q. When should one select a slave DMA adapter?

A.

1. In servers when low cost and high throughput are the primary concerns. Even though CPU utilization is important, it is not the overriding factor.

   For example, the HP 27248A EISA LAN Adapter/32 TP is several hundred dollars cheaper than bus master designs, and offers a higher throughput at a slightly increased CPU utilization.

2. For client applications.

Q. Is the HP 27248A EISA LAN Adapter/32 TP a bus master adapter?

A. No. The HP EISA LAN adapter uses burst DMA data transfer, which in turn uses the DMA subsystem on the PC's motherboard. This DMA subsystem provides bus mastering so the performance of the HP EISA LAN adapter is equivalent to that of a bus master card at a lower cost.

Q. Does the EISA LAN adapter run in standard mode or only in enhanced mode?

A. Microsoft Windows 3.0's Enhanced Mode Kernel DMA services does not fully implement all EISA DMA modes. However, the NDIS 2.0 DOS driver for the HP EISA LAN Adapter/32 TP will work in Windows 3.0 real and standard modes and with all DOS releases.

The restriction is that the driver should only be loaded in DOS base 640K memory.

Note:

1. All other HP NDIS drivers can be loaded above base memory.
2. Preliminary analysis shows that Windows 3.1 may allow the NDIS 2.0 DOS driver for the HP EISA LAN Adapter/32 TP to operate in enhanced mode.

Q. What is the difference between Rep I/O mode and memory mapped mode?

A. Repetitive I/O mode (or Rep I/O mode) means that data transfer between a PC adapter and the PC processor backplane uses I/O transactions. Rep I/O mode requires minimum configuration on the PC to use the LAN adapters. With the exception of the HP 27248A EISA LAN Adapter/32 TP, the HP 27252A PC LAN Adapter/16 TL Plus, and the HP 27247B PC LAN Adapter/16 TP Plus, the HP EtherTwist LAN adapters use repetitive I/O (or Rep I/O). The EISA LAN adapter card uses DMA (direct memory access) to the PC processor. The TP Plus and the TL Plus adapters can use either Rep I/O or memory mapped mode.

Memory mapped mode means that you can allocate a block of system memory to be used by the LAN adapter. This generally results in higher performance and requires significant additional knowledge of PC system (memory manager, cache, etc.) and memory configurations on the part of the network administrator.

Q. What does multi-protocol support mean with Novell NetWare 3.11?

A. Multi-protocol support means that the NetWare 3.11 network operating system (NOS) supports both IPX and TCP/IP communication protocols on a network.

Q. Do the HP EtherTwist LAN adapters support SNMP-based network management?

A. No. When an EtherTwist adapter card is connected to an EtherTwist Hub Plus, you can get status on link beat, counters, and activity for the port on the hub that the adapter is connected to. The NOS vendor may supply SNMP agents that will manage adapters directly. See your NOS vendor for more information.

Q. Why would someone choose the EISA LAN adapter over the 16-bit LAN adapter? Isn't it all 10 Mbit/s anyway?

A. The EISA LAN adapter has twice the memory (64 Kbytes versus 32 Kbytes) and is a faster adapter. 10 Mbit/s is the network's bandwidth, not necessarily the adapter's throughput. In heavy network traffic, an adapter card could become a bottleneck. Thus, a faster adapter (with additional memory) can accommodate heavy traffic loads. The percentage of CPU utilization represents the portion of the CPU's bandwidth that is taken up by a LAN adapter to complete a data transfer. In servers, it is important to have LAN adapters with low CPU utilization, particularly if the server is heavily loaded or has more than one LAN adapter. For example, if the CPU utilization of an adapter is 60%, then having more than one LAN adapter in the server may "starve" the LAN to which the adapter is connected. That is, the LAN may have to wait for its turn for LAN data to be processed by the CPU.

HP ThinLAN Card

Q. When should I use the HP 27252A PC LAN Adapter/16 TL Plus?

A. Use the HP 27252A when you need to attach PCs to a thin coaxial segment.

Q. What connectors are available on the HP 27252A?

A. The HP 27252A has a ThinLAN (BNC) port and an AUI port . For example, use the AUI port for fiber-optic transceiver connection to a fiber-optic network.

Q. What features are available on the HP 27252A PC LAN Adapter/16 TL Plus?

A. The HP 27252A (ThinLAN) adapter is very similar to the HP 27247B PC LAN Adapter/16 TP (twisted-pair) Plus adapter. It includes:

- a built-in socket for remote client boot ROM code
- a software configuration utility; no jumpers or switches
- improved CPU utilization performance
- dual-mode operation: shared memory or Rep I/O
- a built-in AUI (15-pin) port for transceiver connection
- LED indicators: Transmit, Receive, Link Beat Status, Port Selected (RJ-45 or AUI)
- a wide selection of interrupts (IRQs: 3, 4, 5, 6, 7, 9, 10, 11, 12, 15)
- a large packet buffer memory (32 Kbytes)

Q. What boot ROM capabilities does the HP 27252A PC LAN Adapter/16 TL Plus have?

A. HP 27260A provides a boot ROM with Novell NetWare 286 and 386 client code. The boot ROM is ordered separately.

Drivers

Q. How can I get drivers for my HP LAN adapters?

A. Each HP LAN adapter comes with a support disk that contains drivers (unique to that adapter) for operation in many popular network operating systems.

You can also access CompuServe and HPNN for copies of the latest drivers for HP EtherTwist LAN Adapters. Files on HPNN are available to HP authorized dealers. Files on CompuServe are available to CompuServe subscribers. Refer also to the "Software Update Access" Product Note in the Advanced Topics section for more information.

Q. Will Banyan Vines work with HP EtherTwist LAN adapters? Who supplies the driver?

A. Yes, Banyan Vines works with HP EtherTwist LAN adapters for Banyan clients only. Use the NDIS 2.0 driver provided in the support disk that ships with each adapter.

Note that the NDIS 2.0 driver is used for Banyan clients ONLY, not servers. A proprietary driver is required for Banyan servers and HP does not provide this driver.

Q. What is the difference between the NDIS 2.0 drivers provided in the support disk subdirectories "NDIS", "MSLANMAN.DOS", and "MSLANMAN.OS2?

A. The NDIS 2.0 driver provided in the "NDIS" subdirectory is used for LAN Manager 1.x installations. The NDIS 2.0 drivers provided in the "MSLANMAN.DOS" and "MSLANMAN.OS2" subdirectories are used for LAN Manager 2.x installations.

Q. On the support disk, which NDIS directory structure do you use for FTP's TCP/IP, Banyan, DECnet, or other NDIS compatible network software?

A. You should use the drivers supplied in the NDIS subdirectory of the support disk. The NDIS subdirectory contains NDIS 2.0 drivers for those network operating systems.

Q. Is there a driver that supports Novell NetWare Lite v1.0?

A. Yes, you can use the Novell DOS ODI driver for NetWare 3.11.

Q. Does the HP EISA LAN Adapter/32 TP support Novell NetWare for the Apple Macintosh (for example, SNAP protocol)?

A. Yes. The Novell DOS ODI driver for NetWare 3.11 supports the SNAP protocol. However there is no driver for SNAP support for NetWare 2.2.

Q. How can I get the Streams driver for SCO UNIX?

A. The Streams driver can be found in the SCO_UNIX subdirectory of the support disk. This driver provides support for SCO UNIX 3.2 v0, 3.2 v1, 3.2 v2, and ODT 1.x *only*. These drivers currently do not work on SCO UNIX 3.2 v4, and ODT 2.0.

HP recommends using the drivers distributed on SCO's LL1 3.0 or later driver disk for the latest Streams driver support.

HP EtherTwist LAN Adapters

Installation Steps

HP 27245A PC LAN Adapter/8 TP

The HP 27245A PC LAN Adapter/8 TP connects a personal computer to a twisted-pair cable. It is compatible with Type 10Base-T networks.

Check the basics.

Systems

This adapter is compatible with certain personal computers that have IBM PC, XT, or AT architecture. The computer must have MS-DOS version 3.3 or later, or OS/2 version 1.1 or later.

Network Software Driver Preparation

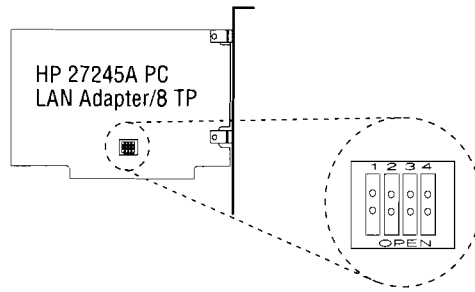
Each LAN adapter comes with a unique support disk that contains a set of network software drivers. Do not use drivers from a support disk of a different LAN adapter, the drivers may not always be the same. Each driver on the support disk has a README file for that driver. The README file contains information on how to prepare and install the driver for your PC.

Antistatic Handling

Work in static-free area if possible. Use an antistatic wrist strap if possible. Handle the adapter by its edges and do not touch components. Touch the computer chassis frequently to equalize static charge.

Set the I/O base address.

Make sure the I/O address range does not conflict with another card in the computer. To set the base address, use switches 1 through 3. (Address range includes the base address and the next 31 addresses.)



I/O Base Address	Switch Settings
200h	1 2 3 4 open
240h	1 2 3 4 open
280h	1 2 3 4 open
2C0h	1 2 3 4 open
300h factory default	1 2 3 4 open
320h do not use on HP Vectra CS	1 2 3 4 open
340h	1 2 3 4 open

Note: Normally, switch 4 (the link beat switch) will remain at the factory setting (CLOSED). If you are connecting to a device that is not compatible with Type 10Base-T networks (such as HP StarLAN 10 Networks), disable link beat by moving switch 4 to the OPEN position. For more details, see the adapter's installation guide.

Install and test.

Install adapter. Install the adapter in any 8-bit slot in your PC. For more detail, see "Installing the Card" in chapter 2 of the *HP EtherTwist PC Link Installation Guide* .

Test adapter. Make sure the ANSI.SYS driver is installed in your CONFIG.SYS file. Boot the DOS operating system. Insert the Support Disk in drive A. Enter A:TEST and follow the prompts.

Attach cable. Attach 4-pair twisted-pair cable to the LAN port of adapter.

For more information about interrupt channels, see the adapter's installation guide.

HP EtherTwist LAN Adapters

Installation Steps

HP 27247B PC LAN Adapter/16 TP Plus and HP 27252A PC LAN Adapter/16 TL Plus

The HP 27247B PC LAN Adapter/16 TP Plus connects a personal computer to a twisted-pair cable. It is compatible with IEEE 10Base-T 802.3 networks.

The HP 27252A PC LAN Adapter/16 TL Plus connects a personal computer to a thin coaxial cable. It is compatible with IEEE 802.3 Type 10Base2 networks.

Both adapters have an AUI connector for connection to any AUI-compatible transceiver such as the HP 28685B EtherTwist Transceiver, the HP 28683A Fiber-Optic Transceiver, or the HP 28641B ThinLAN Transceiver. For example, you can connect a PC to a fiber-optic network by attaching a fiber-optic transceiver to the adapter's AUI connector. Both adapters fit in 16-bit ISA slots.

Each LAN adapter comes with a unique support disk that contains a set of network software drivers. Do not use drivers from a support disk of a different LAN adapter, the drivers may not always be the same. Each driver on the support disk has a README file for that driver. The README file contains information on how to prepare and install the driver for your PC.

Installation for these adapters is very similar to the installation of the HP 27245A PC LAN Adapter/8 TP. The only difference is that the HP 27247B and HP 27252A are shipped with a configuration utility—HPLANSet (an HP PC LAN adapter setup and diagnostics utility). For the HP 27247B and HP 27252A adapters, you don't use switches on the adapter to set the I/O base address or to enable or disable link beat. HPLANSet allows you to configure the adapters via software.

HPLANSet

Once you have installed your adapter in the PC, you can run HPLANSet to set up your adapter. Execute the HPLANSet command from the same drive and directory that contains the file HPLANSET.EXE. For example, if HPLANSET.EXE is on a floppy disk in drive A, the following command would be executed from the A prompt:

```
A: \hplanset
```

Note that the HPLANSET command is not case sensitive. Follow the instructions given in the HPLANSet utility.

To test the adapter, run the test program by following the instructions provided in the HPLANSet utility.

HP EtherTwist LAN Adapters

Installation Steps

HP 27246A MC LAN Adapter/16 TP

This adapter connects a personal computer with Micro Channel architecture to twisted-pair cable. It is compatible with Type 10Base-T networks.

Check the basics.

Systems

This card is compatible with personal computers that have Micro Channel architecture. The computer must have MS-DOS version 3.3 or later, or OS/2 version 1.1 or later.

Network Software Driver Preparation

Each LAN adapter comes with a unique support disk that contains a set of network software drivers. Do not use drivers from a support disk of a different LAN adapter, the drivers may not always be the same. Each driver on the support disk has a README file for that driver. The README file contains information on how to prepare and install the driver for your PC.

Antistatic Handling

Work in static-free area if possible. Use an antistatic wrist strap, if available. Handle the card by its edges and do not touch components. Touch the computer chassis frequently to equalize static charge.

Add the .ADF file.

Add the adapter description file (.ADF) to your Reference Diskette:

1. Insert the work copy of your computer's Reference Diskette into drive A. Start the computer.
2. Follow prompts to the main menu. Choose "Copy an option diskette" from the menu. When prompted for the option diskette, use the Support Disk shipped with this adapter.

Install and test.

Note: If you are connecting to a device that is not compatible with Type 10Base-T networks, disable link beat by moving switch 1 on the card to the OPEN position. For more details, see the *HP EtherTwist Micro Channel Link Installation Guide* (27246-90001).

Install adapter. See the *HP EtherTwist Micro Channel Link Installation Guide* for detailed instructions.

Set options. Start your computer's Reference Diskette. Follow the prompts. Answer "yes" to the "Automatically configure the system" question.

Test adapter. Make sure the ANSI.SYS driver is installed in your CONFIG.SYS file. Start the computer. With DOS running, insert the Support Disk in drive A. Enter A:TEST and follow the prompts.

Attach cable. Attach 4-pair twisted-pair cable to the LAN port of card.

For more information about interrupt channels, see the *HP EtherTwist Micro Channel Link Installation Guide*, part number 27246-90001.

HP EtherTwist LAN Adapters

Installation Steps

HP 27248A EISA LAN Adapter/32 TP

This adapter connects a personal computer to an IEEE 802.3 or Ethernet network. The adapter has two LAN connectors:

- an 8-pin modular (RJ-45) connector for attaching twisted-pair cable (compatible with Type 10Base-T).
- an AUI connector for attaching an AUI cable or transceiver.

Check.

Systems

This adapter is compatible with personal computers that have an Extended Industry Standard Architecture (EISA) backplane.

Network Software Drivers

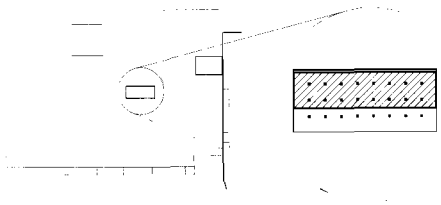
Each LAN adapter comes with a unique support disk that contains a set of network software drivers. Do not use drivers from a support disk of a different LAN adapter, the drivers may not always be the same. Each driver on the support disk has a README file for that driver. The README file contains information on how to prepare and install the driver for your PC.

Antistatic Handling

Work in static-free area if possible. Use an antistatic wrist strap, if available. Handle the adapter by its edges and do not touch components. Touch the computer chassis frequently to equalize static charge.

Set the LAN port selection jumper.

There is a jumper on the HP 27248A for selecting which LAN port (twisted-pair or AUI) will be used to connect the adapter to the network. The default jumper position enables the twisted-pair port. To enable the AUI port, change the jumper position to the bottom two



rows of pins (labeled AUI). For more details, see the *HP EtherTwist EISA Adapter Card/32 Installation Guide* (p/n 27248-90001).

Install and configure.

Install adapter. See your computer's installation manual for instructions.

Copy the EISA configuration file. Start the computer. With DOS running, copy the adapter's configuration file (!HWP1840.CFG) from the Support Disk to the disk and directory containing your system's EISA configuration utility files.

Run the EISA configuration utility. From your system's DOS prompt, change directories to the EISA configuration utility directory and enter cf to run the EISA configuration utility. On the "System Configuration Overview" screen you should see that the adapter labeled "HP EtherTwist EISA LAN Adapter/32" has been "Auto-Added".

View the adapter's configuration. Use the cursor-control keys to highlight the "HP EtherTwist EISA LAN Adapter/32" label and then press ENTER. The resulting "System Configuration Detailed View" screen will show the adapter's configuration. The configurable parameters are:

- interrupt level
- DMA channel
- link beat setting

To keep the configuration shown, press Ctrl-X and then press S to save the configuration and exit from the configuration utility. When you exit from the configuration utility, your system will automatically be rebooted.

If you want to change the adapter's configuration, see "Changing the Card's Configuration" in chapter 2, "Installation" of the adapter's installation guide.

Verify the adapter.

You can verify that the adapter is properly installed by checking the LEDs on the adapter and by using the test program from the support disk.

LEDs. If the adapter is properly installed, and if the default settings for the LAN port selection jumper (twisted-pair port enabled) and link beat (enabled) are used, the LED pattern is:

Tx - ON
Rx - ON

The LED patterns for other configurations are described in chapter 2, "Installation" of the adapter's installation guide.

Test program. To test the adapter more thoroughly, use the test program from the Support Disk. Insert the Support Disk in drive A. Enter A:TEST and follow the prompts. (Note: to run this test, the ANSI.SYS driver must be installed in your CONFIG.SYS file.)

Attach the network cable.

Attach a 4-pair twisted-pair cable to the twisted-pair port, or attach a transceiver or AUI cable to the AUI port on the adapter. (Make sure you are using the port that matches the setting of the LAN port selection jumper.) If you use the AUI port, make sure you secure the transceiver or cable with the AUI retainer that came with the adapter.

HP Transceivers

Technical Data

HP 28685B, HP 28683A, and HP 28661B

- ☆ **HP 28685B EtherTwist Transceiver**
- ☆ **HP 28683A Fiber-Optic Transceiver**
- ☆ **HP 28641B ThinLAN Transceiver**

The HP transceivers allow quick and easy connection between your LAN cabling and the AUI port of your system or network device. They send and receive data, detect collisions on the network, and protect the network's reliability by monitoring malfunctions between the AUI and the transceiver. For maximum flexibility, the transceivers all support both IEEE 802.3 and Ethernet protocols and are transparent to network operating systems. LEDs provide a quick visual assessment of the status of your network.

Highlights

- ☆ **Compact Size:**
  HP transceivers are about the size of a 1-inch stack of business cards. This space-saving design allows them to be attached directly to the device's AUI port, saving you money on cables and eliminating an additional source of potential failure in your cabling scheme.
- ☆ **Cabling Versatility:**
  HP transceivers let you easily attach devices with AUI ports to twisted-pair, fiber-optic, or thin coaxial cable.
- ☆ **Industry-Standard Compatibility:**
  HP transceivers support IEEE 802.3 and Ethernet version 1.0 and 2.0 devices. They are compatible with IEEE 802.3 Type 10Base-T, FOIRL, and Type 10Base2 networks.

Features

HP 28685B EtherTwist Transceiver

- Provides compatibility with IEEE 802.3 Type 10Base-T networks, as well as with HP StarLAN 10 networks.
- Connects to twisted-pair cable via 8-pin modular (RJ-45) jack.
- Supports 22, 24, or 26 AWG unshielded twisted-pair cable. Shielded cable can also be used with proper adapter.
- Supports 100 meters of twisted-pair cable to any AUI-compatible device. Using low-loss cable between two HP 28685B transceivers with the long-cable switch on, enables cabling distances of up to 225 meters.
- Provides user-selectable switches for link beat and SQE test, loopback test, and long cable function.
- Provides six LEDs for quick indication of power, collision detection, polarity, transmission activity, receive activity, and link status.

HP 28683A Fiber-Optic Transceiver

- Provides compatibility with IEEE 802.3 FOIRL standard.
- Connects to fiber-optic cable via two ST connectors (Tx and Rx).
- Supports both 62.5/125-µm and 50/125-µm fiber-optic cable.
- Supports up to 2 km of fiber-optic cable distance (with 10-dB cable attenuation).
- Can be used in both point-to-point configurations and in star configurations with the HP 28682A Fiber-Optic Hub Plus.
- Provides user-selectable switches for loopback test and SQE test.
- Provides LEDs for quick visual indication of power, transmission activity, collision detection, and light status.

HP 28641B ThinLAN Transceiver

- Provides compatibility with IEEE 802.3 Type 10Base2 networks.
- Connects to thin coaxial cable via ThinLAN (BNC) port.
- Provides user-selectable SQE test switch.
- Provides LED power indicator for quick notification that the transceiver is functioning.

Specifications

Characteristics

	HP 28685B EtherTwist	HP 28683A Fiber-Optic	HP 28641B ThinLAN
Environmental:			
Operating Temperature	←	0°C to +55°C (+32°F to +131°F)	→
Relative Humidity	←	15% to 95% @ 40°C (104°F) noncondensing)	→
Electrical:			
Voltage Requirements	9.0–15.75 V	10.5–15.75 V	10.2–15.75 V
Power Consumption	1.0 W typical, 2.6 W maximum	1.8 W typical, 2.4 W maximum	2.0 W typical, 2.6 W maximum
Physical:			
Connectors	- Standard IEEE 802.3 AUI 15-pin - Modular 8-pin (RJ-45)	- Standard IEEE 802.3 AUI 15-pin - ST fiber-optic (Tx/Rx)	- Standard IEEE 802.3 AUI 15-pin - BNC
Switches *Enable/Disable*	- SQE Test - Loopback Test - Link Beat - Long Cable	- SQE Test - Loopback Test	- SQE Test
LEDs	Pwr, Tx, Rx, Col, Polarity, Linkbeat	Pwr, Light status, Collision, Activity	Power
Dimensions	6.85 cm by 4.3 cm by 2.41 cm (2.7 in. by 1.7 in. by 0.95 in.)	←	9.52 cm by 4.34 cm by 2.41 cm) (3.75 in. by 1.71 in. by 0.95 in.) →
Weight	57 g (2.0 oz)	75 g (2.6 oz)	85 g (3.0 oz)

Optical Characteristics for HP 28683A Fiber-Optic Transceiver

	62.5/125-µm fiber	50/125-µm fiber
Optical Receiver	-30 dBm typical, -27 dBm min	-30 dBm typical, -27 dBm min
Optical Transmitter	-12 dBm typical, -17 dBm min	-12 dBm typical, -17 dBm min
Optical Budget	10 dB	6 dB
Wavelength	820 nm	820 nm

Hardware Compatibility

The HP 28685B EtherTwist Transceiver, the HP 28683A Fiber-Optic Transceiver, and the HP 28641B ThinLAN Transceiver each provide an AUI connection for LAN devices that are compatible with the IEEE 802.3 or Ethernet version 1.0 or 2.0 standards.

Software Compatibility

The HP transceivers are transparent to network operating systems.

Standards

Communications	
HP 28685B:	IEEE 802.3 Type 10Base-T
HP 28683A:	IEEE 802.3 FOIRL
HP 28641B:	IEEE 802.3 Type 10Base2
Safety:	*Complies with:* UL 1950 CSA 220 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class B EN 55022 (1988) Class B VCCI Class 2 FTZ 1046/84 (VDE Level B)
Immunity:	
ESD	IEC 801-2: 1991 3 kV CD, 8 kV AD prEN 55101-2: 1990
Radiated Emissions:	IEC 801-3: 1984 3 V/m prEN 55024-3: 1991

Warranty

The HP 28685B, HP 28683A, and HP 28641B transceivers are warranted for one year against defects.

HP Transceivers

Product Note

Questions and Answers

General

Q. To what can the HP transceiver's AUI port connect?

A. Any AUI port that complies with the IEEE 802.3 AUI standard and supports 802.3 or Ethernet protocols can be connected to the HP transceiver's AUI port.

Q. When should I disable the SQE test switch on HP transceivers?

A. Disable the SQE test switch when you connect an HP transceiver to the AUI port of an HP hub or a repeater. Note that HP transceivers are set by default with SQE test enabled. This chart shows the SQE test configuration when using the HP transceivers with the following HP network products.

HP 28699A EtherTwist Hub Plus/48	disable
HP 28684A EtherTwist Hub	disable
HP 28688A/B EtherTwist Hub Plus	disable
HP 28682A Fiber-Optic Hub Plus	disable
HP 28692A ThinLAN Hub Plus	disable
HP 28681A 10:10 LAN Bridge LB	don't care
HP 28673A 10:10 LAN Bridge MB	don't care
HP 28674A/B Remote Bridge RB	don't care
HP 27285A Router ER	don't care
HP 27286A Router TR	don't care
HP 27270A Router CR	don't care
HP LaserJet IIISi Printer with HP JetDirect Card	enable*
HP DesignJet Plotter with HP JetDirect Card	enable
System LAN cards with AUI Port	enable

* A transceiver is not required with HP LaserJet II, IID, III, IIID Printers with HP JetDirect cards.

Q. Do I need to use an AUI cable with a transceiver?

A. Since the HP transceivers are compact, they can attach directly to the AUI port on any network device. If this is not possible, an AUI cable can be used.

Q. What is the maximum distance of AUI cable I can use?

A. If you are using a thin AUI cable, the maximum distance is 15 meters (47 feet). With a thick AUI cable, the maximum distance is 50 meters (155 feet).

Q. Are HP transceivers "hot-swappable"? Do I need to power down the hub to add or replace a transceiver?

A. Yes, the transceivers are hot-swappable. You don't need to bring down the hub to add or replace a transceiver on the hub's AUI port. This also applies to PC LAN adapters and HP JetDirect cards with AUI connectors.

HP EtherTwist Transceiver

Q. What is the difference between the HP 28685A and 28685B EtherTwist transceivers?

A. The "B" EtherTwist transceiver is smaller in size than the "A" version transceiver. The HP 28685B also has six LEDs indicating power, receive and transmit activity, polarity of the unshielded twisted-pair (UTP) "receive" pair of wires, link status, and collision conditions. The "B" version has a loopback test mode switch and a long cable mode switch. The "B" version can also automatically detect and correct for reversed polarity on the UTP "receive" pair of wires.

Q. What is the long cable switch used for on the HP 28685B EtherTwist transceiver?

A. When the long cable switch is disabled, the transceiver operates at standard 10Base-T signal levels. A maximum of 100 meters of unshielded twisted-pair (UTP) cable can be used.

When you wish to use the long cable option (enabled), two requirements must be met:

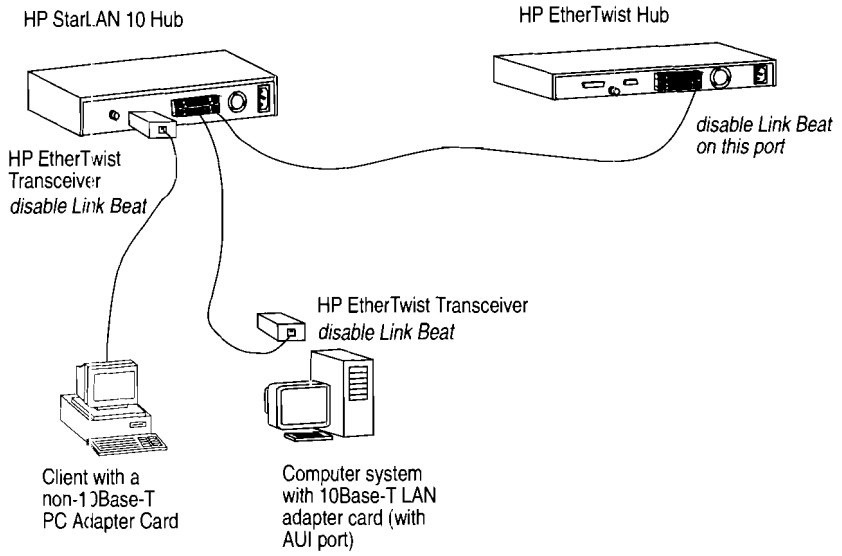
1. The device on the other end of the UTP cable must have the long cable capability (for example, another HP 28685B EtherTwist transceiver, not the "A" version).
2. The UTP cable must have near-end crosstalk attenuation greater than 25 dB. Four-pair Level 3 UTP cable that is used for 10Base-T cabling will normally meet this requirement.

When the long cable switch is enabled, you can use UTP cable lengths greater than 100 meters. With the switch in this position, you can use cable lengths of up to 150 meters of standard 10Base-T UTP cable (level 3), or cable lengths of up to 225 meters of high-grade UTP cable (level 4). The maximum cable length will vary depending on the specifications of the cable used.

For more information, refer to the Product Note: "Long Cable Option on the HP 28685B EtherTwist Transceiver" located in the Advanced Topics section of this document.

Q. When should I disable the link beat switch on HP 28685A/B EtherTwist transceivers?

A. Link beat (also called link test pulse) is required by the Type 10Base-T standard. If the transceiver is attached via UTP (unshielded twisted-pair) cable to another device that doesn't support link beat, then link beat should be disabled on the transceiver. For example, when attaching the HP EtherTwist transceiver (via UTP) to the HP 28663A StarLAN 10 Hub (which is not Type 10Base-T compliant), disable link beat on the transceiver.



Q. If the EtherTwist transceiver has link beat enabled, what happens when it does not receive a link beat pulse from the connected device?

A. The transceiver will stop transmitting until it receives a link beat pulse. Depending on the type of device connected and the network software running on it, an error message may appear on the device indicating a "loss of carrier" hardware error.

Q. If I suspect that the EtherTwist transceiver is defective, what should be done?

A. Enable both the loopback test switch and the SQE test switch. Attach a twisted-pair loopback connector to the RJ-45 port. Run a loopback test from the attached network device—such as a hub, bridge, or computer—through its AUI port (where the transceiver is attached). If the test fails the transceiver may be faulty. You should also verify that the error is not caused by faulty operation of the attached network device. One way to do this is to try the test again with a known good transceiver. If this test fails, then the original transceiver may be good; the network device may be faulty. Remember to disable the transceiver's loopback switch (and SQE test switch if connected to an HP hub) before resuming your network connection.

HP ThinLAN Transceiver

Q. Is there a Long Cable switch on the HP 28641B ThinLAN Transceiver?

A. No. The long cable option is a function that applies to twisted-pair communications only.

Q. What is the difference between the HP 28641A and HP 28641B ThinLAN transceivers?

A. The "B" ThinLAN transceiver is smaller in size and uses a different package than the "A" ThinLAN transceiver. The "B" ThinLAN transceiver also has an SQE test mode switch so that you may enable or disable SQE test. The "B" ThinLAN transceiver is set by default with SQE test enabled. The "A" ThinLAN transceiver does not have an SQE test switch and is set with SQE test enabled. The "A" transceiver must not be used with hubs that comply with the IEEE 802.3 repeater management standard. That is, do not use the "A" transceiver with HP EtherTwist hubs.

Q. If I suspect that the ThinLAN transceiver is defective, what should be done?

A. Attach a BNC "T" connector terminated with two 50-ohm terminators to the ThinLAN (BNC) port. Run a loopback test from the attached network device—such as a hub, bridge, or computer—through its AUI port (where the transceiver is attached). If the test fails the transceiver may be faulty. You should also verify that the error is not caused by faulty operation of the attached network device. One way to do this is to try the test again with a known good transceiver. If this test fails, then the original transceiver may be good; the network device may be faulty.

HP Fiber-Optic Transceiver

Q. What is the low-light LED used for?

A. The low-light LED will turn on when light is being received by the fiber-optic transceiver. The LED is off if there is no connection (no light), or if there is a problem with the fiber-optic cable or fiber-optic port.

Q. If I suspect that the fiber-optic transceiver is defective, what should be done?

A. Enable the loopback test switch and attach a fiber-optic loopback connector to the Tx and Rx ports. Run a loopback test from the attached network device—such as a hub, bridge, or computer—through its AUI port (where the transceiver is attached). If the test fails the transceiver may be faulty. You should also verify that the error is not caused by faulty operation of the attached network device. One way to do this is to try the test again with a known good transceiver. If this test fails, then the original transceiver may be good; the network device may be faulty. Remember to disable the transceiver's loopback switch before resuming your network connection.

Q. What happens if I accidentally switched the position of the two fibers connected to the fiber-optic transceiver?

A. No damage will occur. However, the low-light LED will be off. This indicates that no communication is occurring on the transceiver.

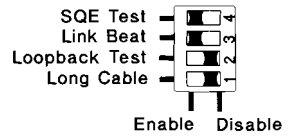
HP Transceivers

Installation Steps

HP 28685B EtherTwist Transceiver

Set the Switches

The HP EtherTwist Transceiver has four switches so it can be configured for use in a wide variety of twisted-pair network environments.



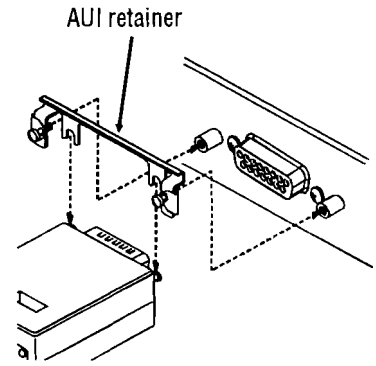
SQE Test	Enables or disables the signal quality error (SQE) test signal. The factory setting is ENABLE. • Keep at ENABLE if attaching the transceiver to a LAN card in a computer, or to another device that expects the SQE test signals. Also set to ENABLE if running a loopback test. • Set to DISABLE if attaching the transceiver to a hub's or repeater's AUI port.
Link Beat	Enables or disables the link beat signal. The factory setting is ENABLE. • Keep at ENABLE if the transceiver is used in a 10Base-T network. • Set to DISABLE if the transceiver is used in a network that is not compatible with the 10Base-T standard (for example HP StarLAN 10).
Loopback Test	Enables or disables a loopback test mode for troubleshooting the transceiver. The factory setting is DISABLE. • Set to ENABLE *only* for troubleshooting with a loopback test.
Long Cable	Allows the transceiver to be used with twisted-pair cable lengths of over 100 meters. The factory setting is DISABLE. • Keep at DISABLE for standard 10Base-T operation for UTP cable lengths up to 100 meters. • Set to ENABLE when you use standard 10Base-T (level 3) UTP cable lengths up to 150 meters, or when you use high-grade (level 4) UTP cable for lengths up to 225 meters. You must connect to another HP EtherTwist transceiver that also has long cable enabled.

Install the Transceiver

Secure the transceiver to the AUI port:

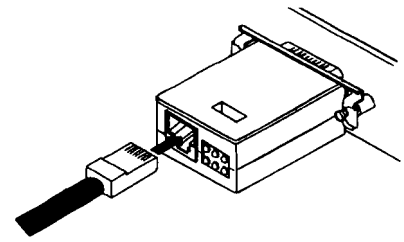
1. The power may be on or off on the network device when attaching the transceiver to its AUI port.
2. If the port has a slide latch, slide it so the mounting posts on the transceiver are captured and the connection is secure.

   If the port does not have a slide latch (as on an HP EtherTwist hub, for example), use the AUI retainer included with the transceiver, as shown in the illustration.



Attach the twisted-pair cable:

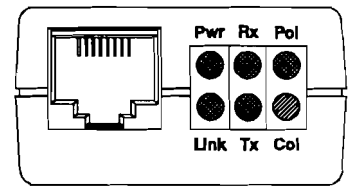
Push the twisted-pair cable's 8-pin plug into the transceiver's jack until it clicks into place.



Check the LEDs on the End of the Transceiver

Switch the network device's power back on and look at the LEDs on the end of the transceiver. When the transceiver is used in a 10Base-T network, and the devices at both ends of the UTP cable are operating correctly:

- Pwr, Link, and Pol should go ON, and
- Rx and Tx should begin Flashing when network traffic is received and transmitted by the device on the AUI port.



If you see this pattern, the network segment is ready to use. See "LED Meanings" on the next page for more information.

LED Meanings

The descriptions in this table assume that the network device supplying power to the transceiver is powered on and is functioning properly.

LED	State	Meaning
Pwr Power (green)	**ON**	Power is being received from the network device.
	OFF	Power is not being received.
Link Link Beat (green)	**ON**	If in a 10Base-T network (the Link Beat switch is set to ENABLE), a good link has been established with a functioning 10Base-T device over the twisted pair cable. If in a non-10Base-T network (the Link Beat switch is set to DISABLE), this LED is always ON.
	OFF	The Link Beat switch is set to ENABLE and for some reason the link beat signal is not being received.
Rx Receive (green)	**FLASH**	Data is being received on the twisted-pair port. Under many normal LAN traffic loads, this LED may appear ON continuously.
	OFF	No data is being received.
Tx Transmit (green)	**FLASH**	Data is being transmitted on the twisted-pair port. In heavy traffic, this LED may appear ON continuously.
	OFF	No data is being transmitted.
Pol Polarity (green)	**ON**	The UTP cable is wired correctly with respect to the polarity of the "receive" pair of wires.
	OFF	The polarity of the "receive" pair of wires is reversed from normal. The LED indicates this wiring error, but the transceiver automatically corrects for the error.
Col Collision (yellow)	**FLASH**	A collision has been detected on the twisted-pair port. (A collision occurs when two or more devices try to transmit on the twisted-pair network at the same time.) If the collisions are infrequent (which is normal), this LED will blink very faintly with each collision. If it appears ON continuously, there may be a problem with the twisted-pair cable segment attached to the transceiver.
	OFF	No collisions are being detected.

HP Transceivers

Installation Steps

HP 28683A Fiber-Optic Transceiver

The HP Fiber-Optic Transceiver connects an IEEE 802.3 or Ethernet device to a fiber-optic network. It is designed to attach directly to an AUI port. It is compatible with the IEEE 802.3 Fiber-Optic Inter-Repeater Link (FOIRL) standard.

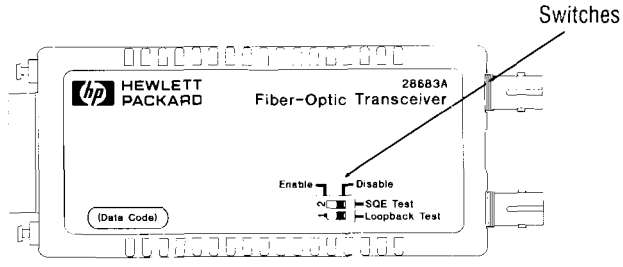
Attach the transceiver to an AUI port.

Check SQE Test switch: Factory setting is disabled. Enable it if connecting to:

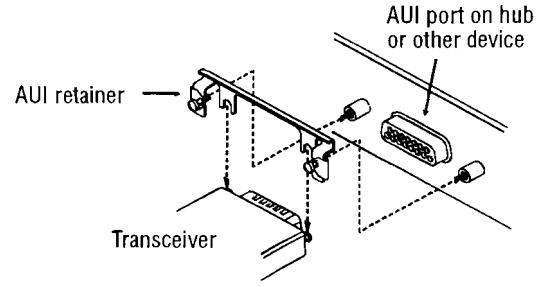
- AUI port on a LAN card in a computer or PC
- another device expecting SQE test (heartbeat) signals

Disable it if connecting to a hub's or repeater's AUI port.

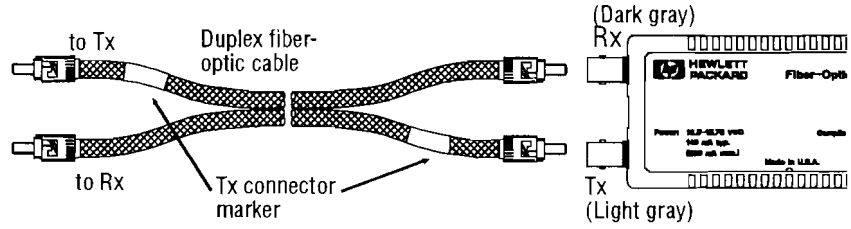
Check Loopback Test switch: Factory setting is disabled. Enable it only for troubleshooting with a loopback test.



Secure to the AUI port: The power may be on or off on the network device when attaching the transceiver to its AUI port. If the port does not have a slide latch (for example, an HP EtherTwist hub), then use the AUI retainer (included) as shown here.



Attach fiber-optic cable.

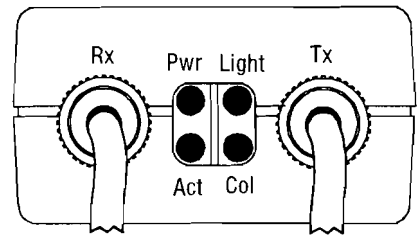


The two fibers may be labeled "Tx" and "Rx" at both ends. If there is a blank label on just one of the two fibers, as shown here, attach it to "Tx". Use this rule at both ends of the cable.

Check the LEDs on the end of the transceiver.

Pwr should go ON when the transceiver is connected to the AUI port of a network device supplying power.

Light should go ON when a cable transmitting light is connected to the transceiver's Rx port. If not, you may have connected the wrong fiber. (You must connect the fiber attached to the Tx port of the device at the other end.) Try switching the fibers.



HP Transceivers

Installation Steps

HP 28641B ThinLAN Transceiver

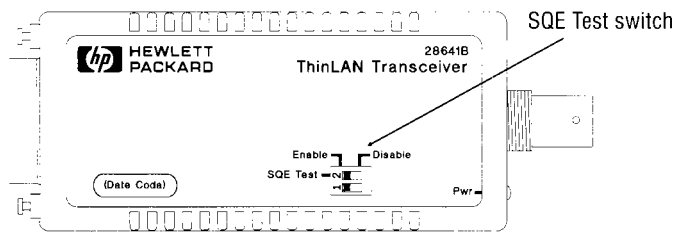
The HP ThinLAN Transceiver is used to connect an IEEE 802.3 or Ethernet network device to a ThinLAN coaxial network. It is designed to attach directly to an AUI port. It is compatible with the IEEE 802.3 Type 10Base2 standard.

Set the SQE Test switch (if required).

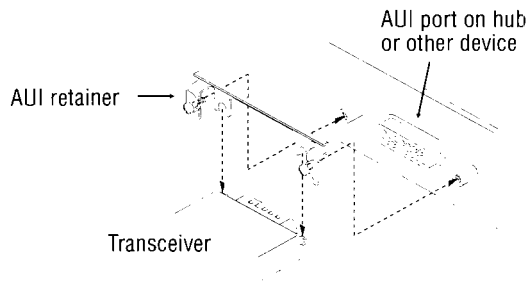
Check SQE Test switch: The factory setting is enabled. Keep SQE Test enabled if attaching to:

- an AUI port on a LAN card in a computer or PC
- another device expecting SQE test (heartbeat) signals

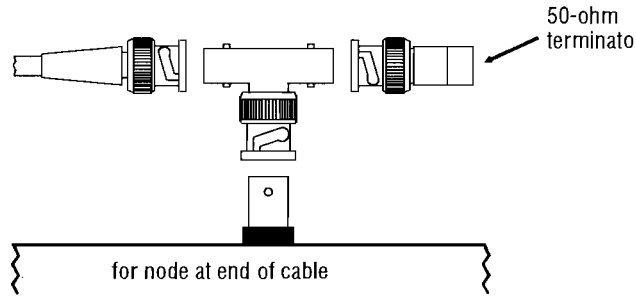
Disable SQE Test if attaching to a hub's or repeater's AUI port.

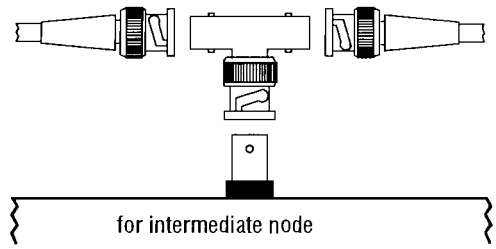


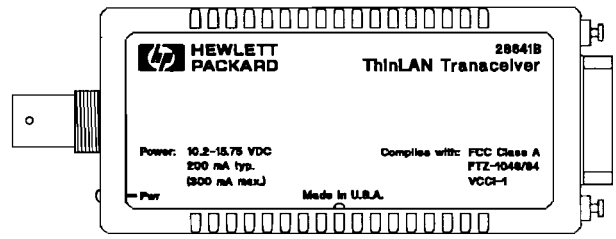
Secure to the AUI port: The power may be on or off on the network device when attaching the transceiver to its AUI port. If the port does not have a slide latch (for example, an HP EtherTwist Hub), then use the AUI retainer as shown here.



Attach coaxial cable.







Check the transceiver LED.

The Pwr LED should go ON when the transceiver is connected to the AUI port of a network device and the device is powered on.

At any time, if the Pwr LED is OFF when it should be ON, make sure that:

- the network device is powered on
- the transceiver is firmly attached to the device

If the LED is still OFF, the transceiver may be faulty.

HP EtherTwist Hub/8

Technical Data

Product Number
HP 28691A

The HP 28691A EtherTwist Hub/8 is a low-cost 10Base-T multiport repeater that includes eight twisted-pair ports and one thin coaxial (BNC) port. The Hub/8 is used to interconnect network devices such as PCs, computers, and network peripherals with twisted-pair cabling. The Hub/8 repeats and retimes signals, handles collision management, and monitors individual link status. In addition, the hub automatically segments individual ports experiencing network communication problems. This improves network integrity and aids in fault isolation. Segmented ports automatically resume operation when the problems are corrected. This simple and compact hub does not include support for SNMP network management (such as HP OpenView Interconnect Manager/DOS or HP OpenView Hub Manager/DOS).

Highlights

☆ **Low Cost LAN Infrastructure**
The HP EtherTwist Hub/8 gives you a low connection cost that used to be possible only with ArcNet and thin coax, while delivering the speed and reliability of 10Base-T (Ethernet on twisted-pair cabling).

☆ **Simple Plug-and-Play Operation**
The Hub/8 is designed to simplify the installation and startup of your LAN. Twisted-pair cable plugs directly into the RJ-45 ports, and thin coaxial backbone cable can be connected to the integrated BNC port. No configuration or special setup is required, which allows you to start up your LAN in minutes.

☆ **Topology Flexibility**
A Hub/8 can be used as a standalone device to support up to eight users, or multiple hubs can be combined to support larger networks in various configurations. Hubs can be connected using the BNC port with thin coaxial backbone cable, or cascaded with twisted-pair cable. Either way gives you growth paths for the future.

Features

- Provides eight twisted-pair ports using 8-pin modular (RJ-45) plugs and one thin coaxial (BNC) port.
- Supports up to 100 meters of unshielded twisted-pair (UTP) cable (typically) between hub and twisted-pair transceiver or PC adapter card. Greater distances are possible with low-loss UTP cable.

- Includes LEDs for Port Status, Collisions, Activity, Fault, and Power, providing quick hub status checks and troubleshooting.
- Executes a self-test for fault identification when it powers on.
- Can be wall mounted or stacked on a table top.
- Operates transparently to network operating system software.
- Supports both IEEE 802.3 and Ethernet networks.
- Provides auto-segmentation of ports for fault isolation and improved network integrity.
- Detects wiring polarity faults on the twisted-pair cable and automatically switches polarity to compensate for the wiring error.
- Supports multi-hub configurations using either a thin coaxial backbone between BNC ports or twisted-pair between twisted-pair ports.
- Supports voice and data signals in the same cable bundle.
- Installs in minutes.

Specifications

Environmental Characteristics

Operating Temperature:
5°C to 40°C (41°F to 104°F)

Relative Humidity:
15% to 95% @ 40°C (104°F) noncondensing

Physical Characteristics
Dimensions: 21.3 cm by 15.1 cm by 4.6 cm (8.4 in. by 5.9 in. by 1.8 in.)
Weight: 1.0 kg (2.2 lbs)

Electrical Characteristics

Voltage:	100-120 V ac	200-240 V ac
Current:	0.2 A max	0.1 A max
Frequency:	50/60 Hz	50/60 Hz

The HP EtherTwist Hub/8 automatically adjusts to any voltage between 90 and 240 volts.

Standards

Communications:	IEEE 802.3 Type 10Base-T IEEE 802.3 Type 10Base2
Safety:	UL 1950 CSA 220 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class A EN 55022 (1988) Class A VCCI Class 1
Immunity:	
ESD	IEC 801-2: 1991 3 kV CD, 8kV AD prEN 55101-2: 1990
Radiated Emissions:	IEC 801-3: 1984 3 V/m prEN 55024-3: 1991

Warranty

The HP 28691A EtherTwist Hub/8 is warranted for two years against defects.

HP EtherTwist Hub Plus and Hub Plus/48

Technical Data

Product Numbers
HP 28688B & HP 28699A

The HP 28688B EtherTwist Hub Plus and HP 28699A EtherTwist Hub Plus/48 are 10Base-T multiport repeaters that include 12 or 48 twisted-pair ports, 1 ThinLAN port and 1 AUI port. The EtherTwist Hubs can be used to interconnect network devices such as PCs, computers, and network peripherals with twisted-pair cabling. The Hub Pluses repeat and retime signals, handle collision management, and monitor individual link status. In addition, the hubs automatically segment individual ports experiencing network communication problems. This improves network integrity and aids in fault isolation. Segmented ports automatically resume operation when the problems are corrected.

Hub Pluses include agent firmware that supports SNMP/IP- and SNMP/IPX-based network management and a console (RS-232) port for out-of-band network management. In addition, the agent firmware incorporates HP EASE (Embedded Advanced Sampling Environment), an embedded instrument technology that allows the hubs to perform trend analysis functions. When used with HP OpenView Resource Manager/DOS (HP 27257D), the Hub Plus and Hub Plus/48 can identify top talkers, heavy users, error sources, and communication pairs on your network.

Highlights

☆ **Topology Flexibility**
Hub Pluses are designed to be easily combined to support large LANs in various configurations. Bridges, routers, and hubs can be combined using the BNC port and thin coaxial "virtual backplane" to make a "cardcage solution" of any size. Since the AUI and BNC ports are both active, the AUI port on the hub can be used to connect the "cardcage" to a fiber-optic or thick coaxial backbone.

☆ **Full Management Control**
Configure, monitor, and control your HP hubs over the LAN with the graphical, full-featured HP OpenView Hub Manager/DOS (HP 28686D) or HP OpenView Interconnect Manager/DOS (HP 27256D). With their SNMP/IP and SNMP/IPX agent firmware, the HP hubs can be controlled from a single DOS management station on the network or remotely controlled via out-of-band network management.

☆ **Low Cost with Full Features**
The EtherTwist modular solution gives all the features of a cardcage solution without the overhead of a chassis, network management card, and repeater card. You achieve full economies of scale with each 12- or 48-port module. Each hub is complete with network management capability, power, repeater, and backbone connection. You buy only what you need when you need it: pay as you grow.

☆ **Backup Links for Fault Tolerance**
HP Hub Pluses, including the HP 28688A/B EtherTwist Hub Plus, HP 28699A EtherTwist Hub Plus/48, HP 28692A ThinLAN Hub Plus, and the HP 28682A Fiber-Optic Hub Plus, can support a single backup link between any two hubs. This provides network fault tolerance at the hardware level. A backup link is a separate cable installed between two hubs. Using the hub's console port, simply configure the primary link and backup link to a single hub. The backup link automatically becomes enabled when the primary connection between the two hubs fails. See the "Backup Link on HP Hubs for Fault Tolerance" Product Note (located in the Advanced Topics section) for more information.

Features

- Provides 12 or 48 twisted-pair ports using 50-pin (female) connectors, 1 AUI port, and 1 thin coaxial port (BNC). A 50-pin-plug to modular-plug (RJ-45) adapter is available separately (product number HP 28638A). One modular-plug adapter is included with the HP 28688B EtherTwist Hub Plus.
- Supports up to 100 meters of unshielded twisted-pair (UTP) cable (typically) between hub and twisted-pair transceiver or PC adapter card. Greater distances are possible with low-loss UTP cable.
- Supports one redundant link per hub to provide backup connections.
- Includes an RS-232 console port for maintenance and configuration that allows users to configure ports and look at statistics in the hub. Connection is made using a terminal or terminal emulator connected to the hub directly or via a modem.
- Supports SNMP/IP- and SNMP/IPX-based network management such as HP OpenView Hub Manager/DOS and HP Interconnect Manager/DOS.
- Includes LEDs for Port Status, Collisions, Activity, Fault, and Power, providing quick hub status checks and troubleshooting.
- Executes a self-test for fault identification when it powers on.
- Operates transparently to network operating system software.
- Supports both IEEE 802.3 and Ethernet networks.
- Provides auto-segmentation of ports for fault isolation and improved network integrity.
- Detects wiring polarity faults on the twisted-pair cable and automatically switches polarity to compensate for the wiring error.
- Supports flexible backbone configurations with direct thin coaxial connections to the integrated BNC port, fiber-optic or thick coaxial connections to the AUI port, or twisted-pair cascading. All ports are active, so both AUI and BNC ports can be connected along with the twisted-pair ports.
- Supports voice and data signals in the same cable bundle.

- Is fully compatible with existing HP StarLAN 10 networks.
- Mounts in a standard 19-inch rack (with cables facing front or back), on a wall (flat or on end), or on any horizontal surface like a shelf or table. The Hub Plus uses only 1.75 inches (one rack space) vertically, and the Hub Plus/48 uses only 3.5 inches (two rack spaces)—very little space in any mounting configuration.
- Installs in minutes.

Specifications

Environmental Characteristics

Operating Temperature:
0°C to 55°C (32°F to 131°F)

Relative Humidity:
15% to 95% @ 40°C (104°F) noncondensing

Physical Characteristics

Hub Plus:
Dimensions: 42.6 cm by 23.5 cm by 4.4 cm (16.8 in. by 9.3 in. by 1.7 in.)
Weight: 2.7 kg (6.0 lbs)

Hub Plus/48:
Dimensions: 42.6 cm by 23.5 cm by 8.9 cm (16.8 in. by 9.3 in. by 3.5 in.)
Weight: 3.8 kg (8.3 lbs)

Electrical Characteristics

Voltage:		100-120 V ac	200-240 V ac
Current:	*Hub Plus*:	0.5 A max	0.25 A max
	Hub Plus/48:	0.6 A max	0.5 A max
Frequency:		50/60 Hz	50/60 Hz

The EtherTwist Hub Plus and Hub Plus/48 automatically adjust to any voltage between 90 and 240 volts.

Standards

Communications:	IEEE 802.3 Type 10Base-T IEEE 802.3 Type 10Base2
Safety:	UL 1950 CSA 220 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class A EN 55022 (1988) Class A VCCI Class 1 VDE-0871 Level A
Immunity:	
ESD	IEC 801-2: 1991 3 kV CD, 8 kV AD prEN 55101-2: 1990
Radiated Emissions:	IEC 801-3: 1984 3 V/m prEN 55024-3: 1991

Warranty

The HP 28688B EtherTwist Hub Plus and HP 28699A EtherTwist Hub Plus/48 are warranted for one year against defects.

HP ThinLAN Hub Plus

Technical Data

Product Number
HP 28692A

Using the same form factor as the HP EtherTwist Hub Plus/48, the HP 28692A ThinLAN Hub Plus adds even more functionality to the HP modular, "rack-and-stack" family. The HP ThinLAN Hub Plus is a manageable, multiport, thin-coaxial repeater for use in Ethernet and IEEE 802.3 Type 10Base2 local area networks. With nine thin coaxial (BNC) ports and one AUI port, this SNMP-based hub provides a scalable, manageable, and flexible solution for 10-Mbit/s LANs using thin coaxial cable.

The HP ThinLAN Hub Plus includes agent firmware that supports SNMP/IP- and SNMP/IPX-based network management and a console (RS-232) port for out-of-band network management. In addition, the agent firmware incorporates HP EASE (Embedded Advanced Sampling Environment), an embedded instrument technology that allows the hub to perform trend analysis functions. When used with HP OpenView Resource Manager/DOS (HP 27257D), the HP ThinLAN Hub Plus can identify top talkers, heavy users, error sources, and communication pairs on your network.

Highlights

☆ **Full Management Control**
Configure, monitor and control your HP hubs over the LAN with the graphical, full-featured HP OpenView Hub Manager/DOS (HP 28686D) or HP OpenView Interconnect Manager/DOS (HP 27256D). With its SNMP/IP and SNMP/IPX agent firmware, the hub can be controlled from a single DOS management station on the network or remotely controlled via out-of-band network management.

☆ **Topology Flexibility**
Hub Pluses are designed to be easily combined to support large LANs in various configurations. Bridges, routers, and hubs can be combined using the BNC port and thin coaxial "virtual backplane" to make a "cardcage solution" of any size and configuration.

☆ **Maximum Reliability Through Diagnostics and Fault Isolation**
To ensure your network integrity for critical backbone applications, the HP ThinLAN Hub Plus automatically identifies any segment disturbing the network and disconnects it from the rest of the network. When the problem is resolved, the hub automatically reconnects the segment. Status LEDs help you troubleshoot your network.

☆ **Backup Links for Fault Tolerance:**
HP Hub Pluses, including the HP 28688A/B EtherTwist Hub Plus, HP 28699A EtherTwist Hub Plus/48, HP 28692A ThinLAN Hub Plus, and the HP 28682A Fiber-Optic Hub Plus, can support a single backup link between any two hubs. This provides network fault tolerance at the hardware level. A backup link is a separate cable installed between two hubs. Using the hub's console port, simply configure the primary link and backup link to a single hub. The backup link automatically becomes enabled when the primary connection between the two hubs fails. See the "Backup Link on HP Hubs for Fault Tolerance" Product Note (located in the Advanced Topics section) for more information.

Features

- Provides nine ThinLAN coaxial ports using BNC connectors and one AUI port. The AUI port allows simultaneous connection to thin or thick coaxial, fiber-optic, or twisted-pair cable via transceiver.
- Supports one redundant link per hub to provide backup connections.
- Is compatible with the IEEE 802.3 Type 10Base2 standard.
- Supports 10-Mbit/s link speed.
- Supports both IEEE 802.3 and Ethernet networks.
- Provides cable fault detection.
- Isolates network faults by automatically segmenting ports disturbing the network.
- Includes LEDs for a quick visual check of port status, collisions, activity, and power.
- Provides console (RS-232) port, which allows users to read network statistics and configure ports in the hub. This port connects to a terminal or terminal emulator either directly or via a modem.
- Includes diagnostics for checking port functionality and loopback test for troubleshooting cable problems.
- Is transparent to network operating system software.
- Supports SNMP/IP- and SNMP/IPX-based network management. Specifically, the hub can be managed from a central network management station using HP OpenView Hub Manager/DOS (HP 28686D) or HP OpenView Interconnect Manager/DOS (HP 27256D).
- Mounts in a standard 19-inch rack (with cables facing front or back), on a wall (flat or on end), or on any horizontal surface like a shelf or table. Since the hub is only $3\frac{1}{2}$ inches high (two rack spaces), it takes up very little space in any mounting configuration.

Specifications

Environmental Characteristics

Operating Temperature:
0°C to 55°C (32°F to 131°F)

Relative Humidity:
15% to 95% @ 40°C (104°F) noncondensing

Physical Characteristics

Dimensions: 42.6 cm by 23.5 cm by 8.9 cm (16.8 in by 9.3 in by 3.5 in)
Weight: 4.0 kg (8.8 lbs)

Electrical Characteristics

Voltage	100-120 V ac	200-240 V ac
Current (max)	0.8 A max.	0.6 A max.
Frequency:	50/60 Hz	50/60 Hz

The ThinLAN Hub Plus automatically adjusts to any voltage between 90 and 240 volts.

Standards

Communications:	IEEE 802.3 Type 10Base2
Safety:	UL 1950 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class B EN 55022 (1988) Class B VCCI Class 2
Immunity:	
ESD	IEC 801-2: 1991 3 kV CD, 8 kB AD prEN 55101-2: 1990
Radiated Emissions:	IEC 801-3: 1984 3 V/m prEN 55024-3: 1991

Warranty

The HP 28692A ThinLAN Hub Plus is warranted for one year against defects.

HP EtherTwist Hubs

Product Note

Questions and Answers

General

Q. When should I use the Hub/8, the Hub Plus, or the Hub Plus/48?

A. The HP 28691A EtherTwist Hub/8 is perfect for small networks that need low-cost connectivity and do not require network management.

Use the HP 28688B EtherTwist Hub Plus for small-to-medium networks that will grow and may need network management features.

Use the HP 28699A EtherTwist Hub Plus/48 for medium-to-large networks that will grow and may need network management features.

All hubs can be used in any combination for optimum port counts in your wiring infrastructure.

Q. What is the main difference between the HP 28691A EtherTwist Hub/8 and the HP 28688B and HP 28699A EtherTwist hubs?

A. The main difference is that the HP 28688B and HP 28699A hubs can be managed by HP OpenView network management. That is, they support the SNMP network management protocol. They also have an RS-232 console port for out-of-band management. The EtherTwist Hub/8 does not have a console port, nor can it be managed by HP OpenView network management.

Q. What are the advantages/disadvantages of using four EtherTwist Hub Pluses versus one EtherTwist Hub Plus/48?

A. One EtherTwist Hub Plus/48 is less expensive than four EtherTwist Hub Pluses and takes much less room in a rack or wiring closet. With four Hub Pluses, you can spread out your hubs in different locations. Also, if one hub's power supply fails, the whole network is not affected.

Q. Is the HP 28688A EtherTwist Hub Plus fully compatible with the HP 28688B and what are the differences between them (if any)?

A. Yes, the HP 28688A and the HP 28688B hubs are fully compatible. The "B" hub supports all parameters for backup link configuration, it provides a ping test command in the console port interface, and port LEDs flash if there is a fault on that port.

The "B" hub (with agent firmware version D.01.xx) includes network management software for both the IP and IPX communication protocol stacks, and has enough memory to handle IP and IPX communications simultaneously. The "A" hub (upgraded with agent firmware D.01.xx) has enough memory to accommodate only one communication protocol; with the "A" hub you must specify which protocol (IP or IPX) you will use.

Q. Do I need modular adapters for the 12-port and 48-port hubs? The Hub/8?

A. The twisted-pair ports of the HP 28688B EtherTwist Hub Plus and HP 28699A EtherTwist Hub Plus/48 are 50-pin connectors. You can use the 50-pin connectors to wire directly to cross-connect blocks via 25-pair cables using standard 50-pin connectors. The HP 28688B EtherTwist Hub Plus includes one modular adapter. This adapter attaches to a 50-pin connector and allows you to plug in twelve twisted-pair cables using 8-pin modular (RJ-45) plugs. You may purchase modular adapters (HP 28638A) for each 50-pin connector on the HP 28699A EtherTwist Hub/48.

The HP 28691A Hub/8 has 8 built-in RJ-45 plugs. You don't need to purchase a modular adapter for it.

Q. Does the EtherTwist Hub/8 have an AUI connector?

A. No. The EtherTwist Hub/8 has eight RJ-45 jacks and one ThinLAN (BNC) connector.

Q. What happens when someone unplugs a PC from an EtherTwist hub? Does it take down the hub?

A. No. When someone powers down a PC or unplugs a PC from a hub, the other hub ports continue operating. You will see the LED go out for the port used by that PC.

Q. How does the hub store configuration data?

A. With the exception of the HP 28691A Hub/8, all EtherTwist hub's configuration data is stored in EEPROM. The agent code (software) for network management is stored in flash EEPROM. The Hub/8's configuration is not alterable. Its configuration is stored in EEPROM.

Q. Do HP hubs interoperate with SynOptics' Lattisnet?

A. No. HP hubs do not interoperate with SynOptics' non-10Base-T products.

Q. Can I connect HP EtherTwist hubs to a DECnet?

A. Yes, if the DECnet supports Ethernet version 2 or IEEE 802.3.

Q. I plan to use SCO UNIX on my network. Do the HP EtherTwist hubs and bridges care that they are "carrying" TCP/IP and not IPX protocol packets?

A. No, HP EtherTwist hubs and bridges operate at the data link layer (layer 2 of the OSI model for networks). They are independent of upper layer protocols. Therefore, you may run Novell NetWare, SCO UNIX, EtherTalk, LAN Manager, or any network operating system (NOS) that runs on Ethernet or IEEE 802.3 networks.

With regard to network management, HP OpenView network management products use either the IP or IPX protocol for communication to HP hubs and bridges. Therefore, HP hubs and bridges support both the IP and IPX protocol for network management communication purposes only.

Console Port Configuration

Q. What is Thinwatch for and when should I use it?

A. The HP 28688B and HP 28699A EtherTwist hubs have a ThinLAN (BNC) port and a Thinwatch function associated with this port. Thinwatch causes the Fault LEDs and port LED to flash when the hub's ThinLAN port become segmented.

If the ThinLAN port is to be unused, you should disable the Thinwatch function so that the Fault LED does not blink. The hubs are shipped (from the factory) with Thinwatch disabled. Thinwatch has no effect on the AUI port or the twisted-pair ports of the hub.

Q. Do I need to set the IP configuration parameters on my HP EtherTwist Hub Plus or EtherTwist Hub Plus/48 if I am using Novell NetWare software?

A. No. If you plan to use HP OpenView network management to manage your hubs and you are using Novell NetWare, it is not necessary for you to set the IP configuration parameters on your hubs. The HP OpenView Interconnect Manager/DOS (HP 27256D), HP OpenView Hub Manager/DOS (HP 28686D), and the hubs (except the Hub/8) support IPX communications.

If you are not using Novell NetWare software, you must set the IP configuration parameters on your hubs if you wish to manage your hubs with HP OpenView network management using IP communications.

Q. How do I set the IP configuration parameters on my Hub Plus?

A. To set the IP configuration parameters on your Hub Plus, you must attach a terminal or terminal emulator to the hub's console port. Once a console port session is established, then use the IP command to set the parameters for your hub. Note that there is no console port on the HP 28691A Hub/8, nor can it be managed by network management products.

Hub Ports

Q. Do I have to disable hub ports that are not in use?

A. No. You can leave unused twisted-pair ports enabled. Link beat should also remain enabled for these ports. When a connection is made, the ports automatically become active with no need to use network management or the console port commands to enable them. However, if you are concerned with security and do not want anyone to attach a PC to your hubs, you may want to disable unused twisted-pair ports.

Q. Can I plug Apple Macintoshes with AppleTalk Ethernet cards into the EtherTwist hubs?

A. Yes, if the AppleTalk Ethernet cards are IEEE 802.3 Type 10Base-T cards. If the Ethernet card does not have an RJ-45 jack, but has an AUI connector, then use an EtherTwist transceiver (HP 28685B) to connect the Macintosh with unshielded twisted-pair (UTP) cable to the hubs.

Q. Is the AUI port compatible with AUI slide-latch connectors?

A. All HP hubs include an AUI retainer (part number 5062-3351) instead of an AUI slide-latch connector. The retainer replaces the slide-latch connector and is used to securely fasten any transceiver to the hub's AUI port.

Link Beat and Auto-Segmentation

Q. When should I enable link beat on a hub's twisted-pair port?

A. Link beat is an IEEE 802.3 Type 10Base-T requirement and is also known as link test pulse. Link beat improves the reliability of your network by monitoring link integrity on the twisted-pair port, so you should use it whenever possible. Disable link beat when the hub's port is attached to a device that does not support link beat (for example, an HP StarLAN 10 hub).

Q. Is link beat a packet on the network? If so, does it affect the performance of the network?

A. Link beat is a periodic 100-nanosecond pulse that occurs every 16 milliseconds and does not contribute to network traffic. Link beat is sent when the network is idle.

Q. Which ports will auto-segment?

A. All of the hub's ports (excluding the RS-232 console port) could be auto-segmented. This includes all twisted-pair ports, the AUI port, and the ThinLAN (BNC) port.

Q. What causes the hub to auto-segment a twisted-pair port?

A. When the hub detects excessive collisions (greater than 30 consecutive collisions), the hub will auto-segment the port. The corresponding port LED and Fault LEDs will flash when this happens.

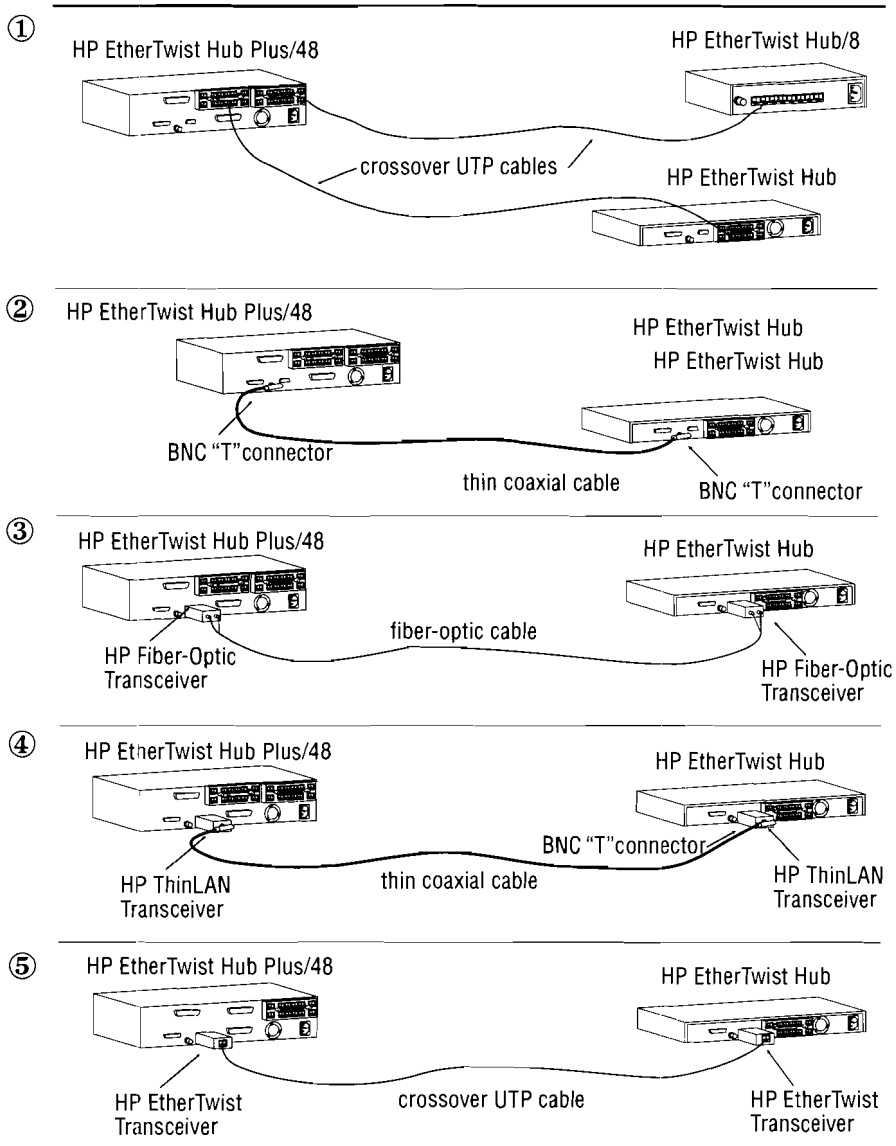
Q. What causes the hub to auto-segment the AUI or ThinLAN (BNC) port?

A. Auto-segmentation of these ports is caused by excessive collisions (greater than 30 consecutive collisions). Auto-segmentation can be caused by improper termination of the thin coaxial cabling, or will occur if nothing is attached to the ThinLAN port and the port and Thinwatch are enabled.

Connecting Hubs in the Network

Q. How can I connect (or cascade) EtherTwist hubs together?

A.



1. Use an unshielded twisted-pair (UTP) crossover cable between any twisted- pair ports.
2. Connect two or more hubs to the same thin coaxial backbone using the BNC port on each hub. Use at least 0.5 meter of coaxial cable between adjacent hubs.
3. Connect fiber-optic cabling between two hubs, via a fiber-optic transceiver (HP 28683A) attached to the AUI port on each hub.
4. Connect thin coaxial cabling between two hubs, via a ThinLAN transceiver (HP 28641B) attached to the AUI port on each hub.
5. Connect UTP crossover cabling between two hubs, via an EtherTwist transceiver (HP 28685B) attached to the AUI port on each hub.

Q. When should I use a "straight-through" twisted-pair cable?

A. Use a straight-through twisted-pair cable when connecting between a PC (with EtherTwist LAN adapter) and an EtherTwist hub, or between an EtherTwist transceiver and an EtherTwist hub. Refer to the "Twisted-Pair Cabling Tips" Product Note for a description of a straight-through cable.

Q. When should I use a "crossover" twisted-pair cable?

A. Use a cross-over cable when connecting two EtherTwist hubs or two EtherTwist transceivers via twisted-pair cable. An available HP crossover cable is HP 92214W. Refer to the "Twisted-Pair Cabling Tips" Product Note for a description of a crossover cable.

Backup Link

Q. When should I use the hub's backup link feature?

A. In some network configurations, a critical link exists. For example, two workgroups that regularly share or exchange data over the network cannot afford to have their network link down. The backup link feature helps to maintain the integrity of such a critical link.

Q. What is a backup link?

A. A backup link is a separate cable run between two hubs that is automatically enabled if the connection designated as the primary link fails. The primary link and the backup link cabling should be run over different paths (through different conduits, for example) to reduce the possibility that damage will occur to both cables simultaneously.

Q. Can I have more than one backup link on an EtherTwist hub?

A. Each hub can monitor a single backup link (only one backup link can be configured on each hub). But, the hub may be at the remote end of one backup link and at the monitoring end of a backup link to a different hub. For more information on how backup links works, refer to the "Backup Link on HP Hubs for Fault Tolerance" Product Note (located in the Advanced Topics section).

Q. Can I mix backup links between different types of hubs?

A. Yes. You can have a backup link between any HP hubs that support the backup link feature. If you have older hubs (that were purchased before April, 1992), make sure that their firmware is upgraded to version D.01.xx. Note that the HP 28691A EtherTwist Hub/8 does not support the backup link feature.

Any combination of media types (twisted-pair, thin coaxial, and fiber-optic cabling) can be used as a backup link.

Q. Can I have a backup link between an EtherTwist hub and an HP ThinLAN hub?

A. Yes. For example, you can have a primary link connection between an EtherTwist hub and a ThinLAN hub by using their ThinLAN (BNC) ports and thin coaxial cabling. You can use a twisted-pair cable between an EtherTwist hub and an EtherTwist transceiver attached to the ThinLAN hub's AUI port as your backup link.

Q. Can I have a backup link between an EtherTwist hub and an HP Fiber-Optic hub?

A. Yes. For example, you can have a primary link between an EtherTwist hub and a fiber-optic hub by using their ThinLAN (BNC) ports and thin coaxial cabling. The backup link could be a fiber-optic cable between the fiber-optic hub and a fiber-optic transceiver (HP 28683A) attached to the EtherTwist hub's AUI port.

Q. Can I use HP OpenView network management to configure backup links on my hubs?

A. No. To configure a backup link, you must use the hub console Backup command. Once you have configured your backup link via the console (RS-232) port, HP OpenView network management can automatically discover and lay out your primary and backup links. The backup link will appear as a dotted line on the network map.

Q. How can I tell that the backup link has been activated?

A. When the primary link fails, the backup link is automatically enabled. The effect of this change is displayed on the monitoring hub's LEDs and console interface. (The monitoring hub is the hub that you configured for the primary and backup links.)

On the hub's LEDs, the primary port's LED goes off, and the backup port's LED goes on.

On the hub console's Status command screen, the status of the primary port changes from ON to OFF, and the backup port changes from OFF to ON.

Q. If the backup link is currently being used and I have fixed the primary link, will the primary link automatically reactivate itself and resume operation again?

A. No. When the primary link is repaired, use the hub console Port command to turn the primary port back on (PO n ON, where n is the port number of the primary link). When this is accomplished, the backup port is automatically turned off. If for some reason you do not have access to the hub's console interface (for example, because the hub is in a wiring closet and a console is not available), you can also reactivate the primary port by cycling power on the hub. The primary port can also be enabled from an HP network management station.

Q. How does the hub store configuration data?

A. The ThinLAN hub's configuration data is stored in EEPROM. The network management agent code (software) is stored in flash EEPROM.

Console Port Configuration

Q. What is Thinwatch for and when should I use it?

A. The purpose of Thinwatch is to monitor the ThinLAN (BNC) port connection. Thinwatch causes the Fault LEDs and port LED to flash

Q. What does "lost carrier" mean on the ThinLAN hub?

A. The ThinLAN hub can detect when it has lost the carrier signal on any of its ports. Lost carrier usually indicates that:

- a LAN cable has become shorted or damaged, or
- a ThinLAN port has failed,or
- a transceiver has become disconnected from the AUI port, or no device is attached to the AUI port and that port is enabled

When a port experiences a lost carrier, and Thinwatch is enabled on the hub, the port's LED and Fault LED both FLASH. Additionally, on the console interface, the Status command display shows NO CARRIER for the port.

Most of the time, the lost carrier condition can be corrected by replacing a faulty cable or reconnecting a transceiver that has become disconnected from the hub's AUI port. The hub automatically recovers when the corrective action is taken.

Auto-Segmentation

Q. Which ports will auto-segment?

A. All of the hub's ports (excluding the RS-232 console port) could be auto-segmented. This includes all the ThinLAN (BNC) ports, and the AUI port.

Q. What causes the hub to auto-segment the AUI or ThinLAN (BNC) port?

A. The ThinLAN Hub will automatically disable (auto-segment) a port if the port experiences excessive collisions (greater than 30 consecutive collisions). The port will automatically return to operation if the excessive collision condition goes away and normal traffic reappears. For the ThinLAN ports, some particular causes of auto-segmentation are:

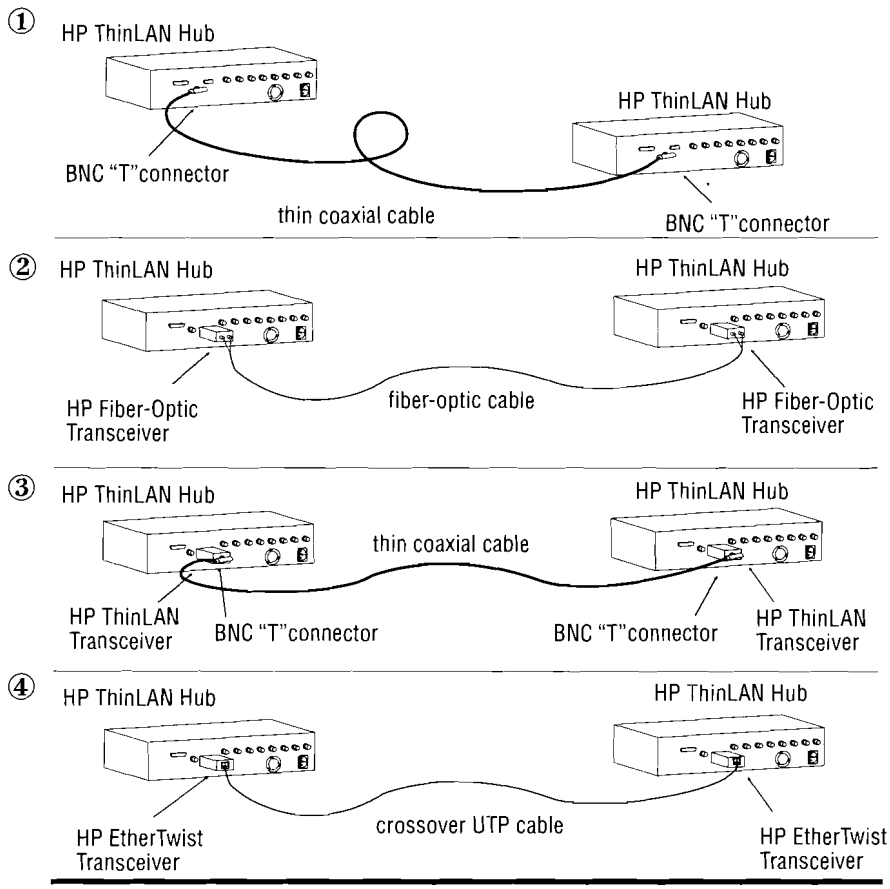
- the thin coaxial cable attached to the port is not properly terminated
- the port is ON (enabled), but no cable is attached to the port, and there is some activity on the hub (traffic is being repeated, or the hub has just been reset or power cycled)

If a port is auto-segmented, its port LED and the Fault LEDs will flash. Note that a segmented ThinLAN port will not cause the Fault LED to flash unless Thinwatch has been explicitly set ON (enabled) with the Thinwatch console port command. For the AUI port, auto-segmentation will always cause its port LED and Fault LED to flash.

Hub Connections

Q. How can I connect ThinLAN hubs together?

A.



1. Connect two or more hubs to the same thin coaxial backbone using the BNC port on each hub. Use at least 0.5 meter of coaxial cable between adjacent hubs.
2. Connect fiber-optic cabling between two hubs, via a fiber-optic transceiver (HP 28683A) attached to the AUI port on each hub.
3. Connect thin coaxial cabling between two hubs, via a ThinLAN transceiver (HP 28641B) attached to the AUI port on each hub.
4. Connect UTP crossover cabling between two hubs, via an EtherTwist transceiver (HP 28685B) attached to the AUI port on each hub.

HP EtherTwist Hubs

Installation Steps

HP 28688B Hub Plus and HP 28699A Hub Plus/48

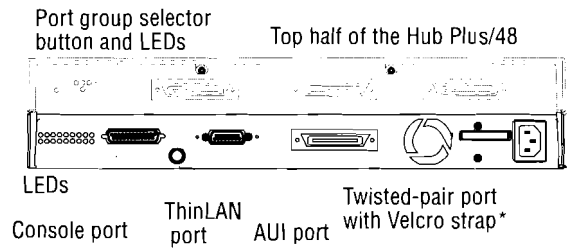
The HP 28688B Hub Plus and HP 28699A Hub Plus/48 are twisted-pair hubs that connect computers over twisted-pair cable. They are be compatible with Type 10Base-T networks.

Mount and plug in.

1. Make sure the hub's power cord is correct for your country's ac power receptacle.
2. Mount the hub on wall or table, or in a rack.
3. Attach the power cord to the hub. Plug into an electrical outlet.
4. Check these LEDs on the back:
   - All the LEDs should go ON momentarily.
   - **Power** should be ON.
   - **Fault** should go OFF.
   - Disregard the other LEDs for now.

If LEDs are different, the hub may be faulty.

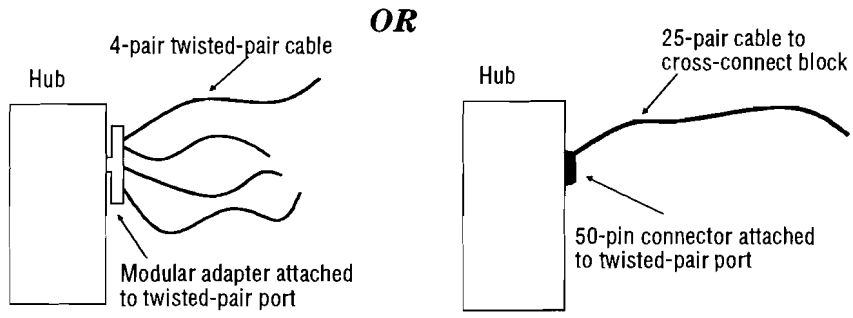
For more installation details, see the hub's installation and reference manual.



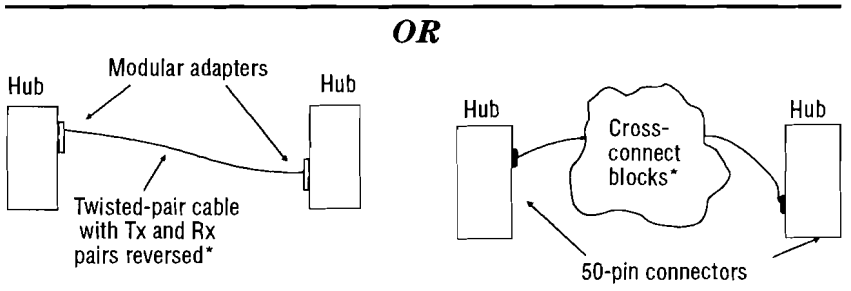
Back of the Hub Plus or Hub Plus/48

*Use the Velcro strap to secure a 50-pin connector. For a modular adapter, remove the Velcro strap holder.

Connect computers.

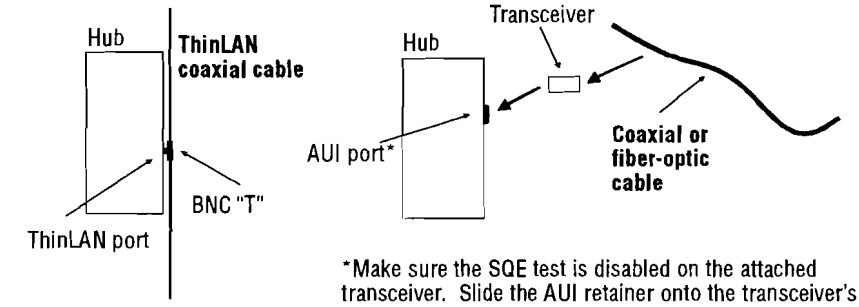


Connect hubs if required.



*Between hubs, Tx and Rx pairs must be reversed. For a wiring diagram, see the "Workgroup LAN Cabling" section in this technical reference guide.

Connect to a backbone if required.



*Make sure the SQE test is disabled on the attached transceiver. Slide the AUI retainer onto the transceiver's connector. Attach to the hub's AUI port with screws.

Notes.

If any twisted-pair port connects to a device that is not compatible with Type 10Base-T operation, disable the link beat on that port.

LEDs on the Back of the Hub:

Power (green) is ON if the hub is receiving power.

Activity (green) is ON when data is being transmitted.

Fault (yellow) is ON if the hub is faulty, flashing if a port has been auto-segmented.

Collision (yellow) is ON when collisions occur on any of the attached cable segments.

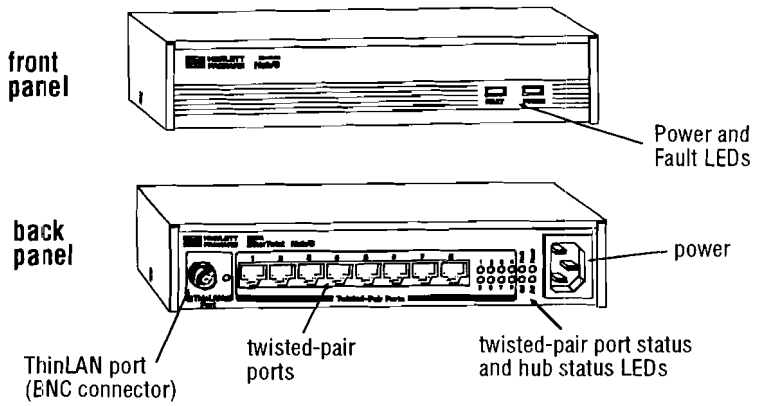
Each port LED (green) is ON when the port is enabled and functioning normally, Flashing if the port has been auto-segmented. (The LED for an enabled AUI port is ON when nothing is connected to it.)

HP EtherTwist Hubs

Installation Steps

HP 28691A Hub/8

These installation steps describe how to set up the HP 28691A EtherTwist Hub/8. Installation details and a complete description of the HP Hub/8 are provided in the *HP EtherTwist Hub/8 User's Guide* (28691-90001).

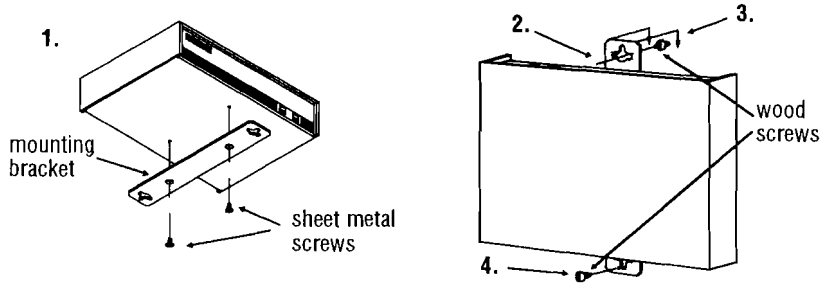


Position the hub.

Place the hub on a surface near a power source, or, as described in the following steps, mount the hub on a surface.

1. Attach the mounting bracket to the bottom of the hub with the two sheet metal screws provided. *(Do not overtighten these screws.)*
2. Screw a wood screw into the wall leaving approximately 1/4 inch of the screw exposed.
3. Hang the bracket and hub from the screw.
4. Center the other wood screw in the lower lobe of the bracket cutout, and screw it into the wall.
5. Tighten both screws.

For more installation details, see the hub's user's guide.



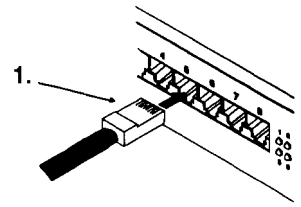
Example wall mounting. See the user's guide for more information.

Connect the hub to the network devices.

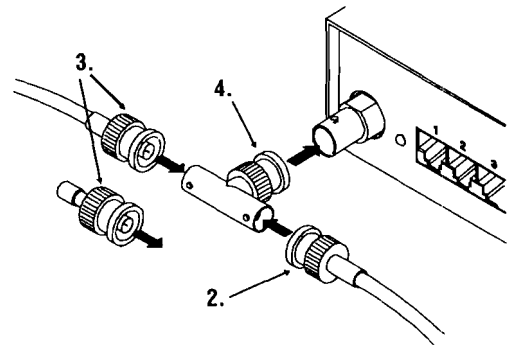
1. Push each twisted-pair network cable's 8-pin plug into a hub jack until it clicks into place. Use any available jack; it is not necessary to use the jacks in any particular order.

If you are attaching the hub to a ThinLAN network:

2. Attach a properly terminated ThinLAN cable section to one side of the BNC "T"connector supplied.
3. Attach another properly terminated ThinLAN cable section or a 50-ohm terminator to the other side of the "T"connector.
4. Attach the "T" connector to the hub's ThinLAN port.
5. Fold the BNC "T"connector cover around the connection and press the surfaces together around the edges.



OR



Press in and turn each connector so it is locked in place.

Plug in the hub and verify its operation.

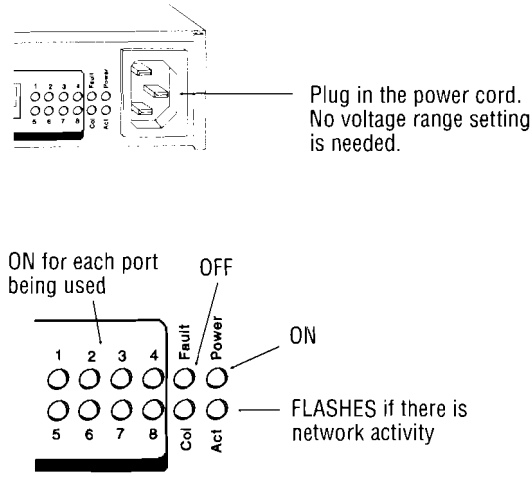
1. Plug the power cord into the hub's power socket and into an ac power source.

   The hub automatically adjusts to any ac power between 90 and 240 volts.

2. Check the LEDs on the hub's back panel.

   After five seconds you should see the LED pattern shown in the illustration. The ThinLAN port LED will also be ON if that port is being used.

See the hub's user's guide for more information.

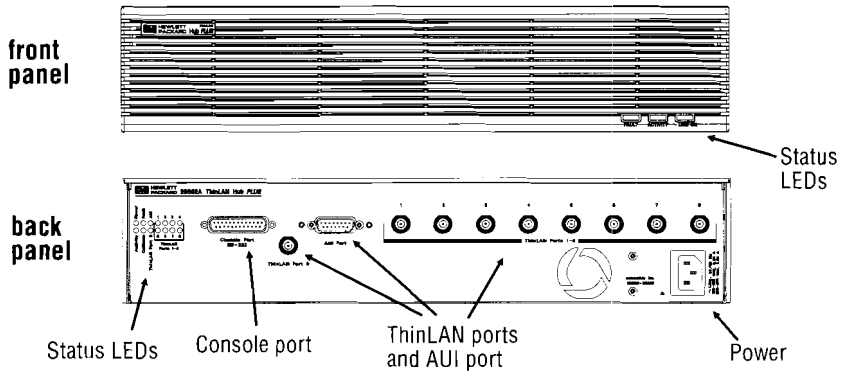


HP EtherTwist Hubs

Installation Steps

HP 28692A ThinLAN Hub Plus

These installation steps describe how to set up the HP ThinLAN Hub Plus (HP 28692A). Installation details and a complete description of this HP hub are provided in the *HP ThinLAN Hub Plus Installation and Reference Guide* (28692-90001).



Mount the hub

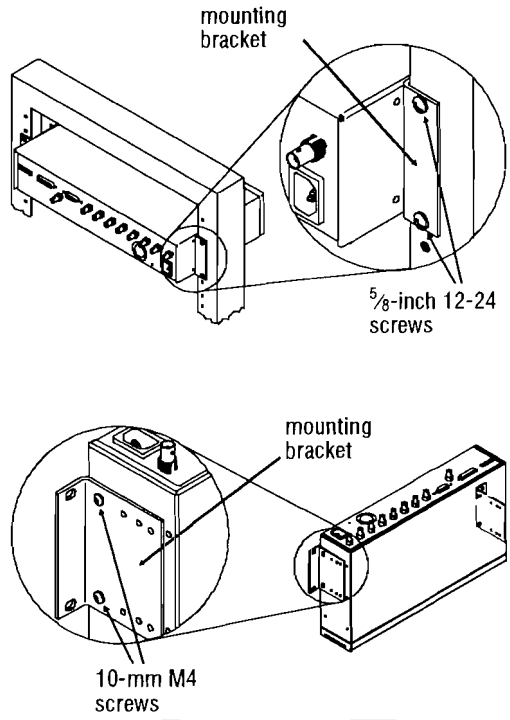
Mount the hub in a 19-inch telco rack, or on a wall, or attach the rubber feet to the bottom of the hub and place it on a table or other surface near a power source.

For rack mounting:

1. Attach the mounting brackets to the hub's sides with the 10-mm M4 screws provided. The brackets can be oriented so the hub mounts with the front or back facing out.
2. Position the hub in the rack and secure with the 5/8-inch 12-24 screws provided.

For wall mounting:

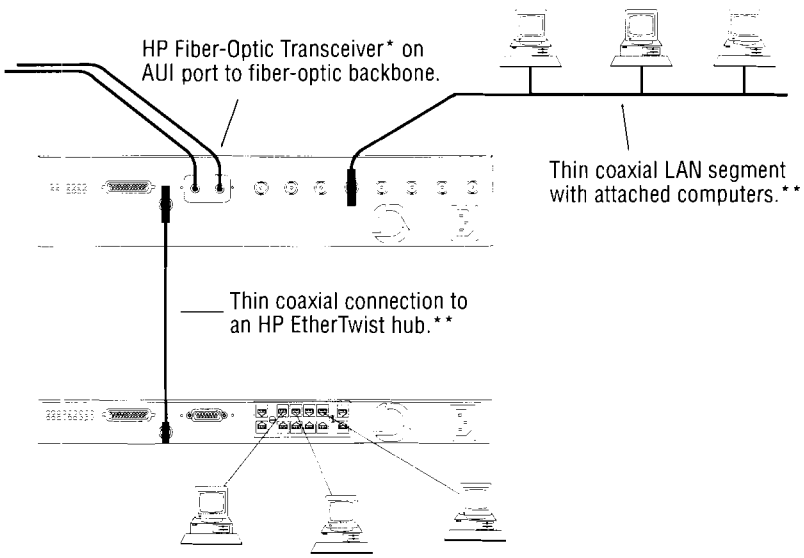
1. Attach the mounting brackets to the hub's sides with the 10-mm M4 screws provided. The brackets can be oriented so the hub mounts flat against the wall or straight out from the wall.
2. Secure the hub to the wall with 5/8-inch number 12 wood screws (not provided.)



Connect the hub to the networks and devices

The nine ThinLAN ports and the AUI port on the HP ThinLAN Hub Plus can be used to connect networks and devices in a variety of ways. The illustration shows a few examples.

See the *HP ThinLAN Hub Plus Installation and Reference Guide* for details on attaching cables and devices to the hub's ports.



* Make sure the SQE test is disabled on any transceiver attached to the hub's AUI port.
** Both ends of every thin coaxial segment must be terminated with a 50-ohm terminator.

Plug in the hub and verify its operation

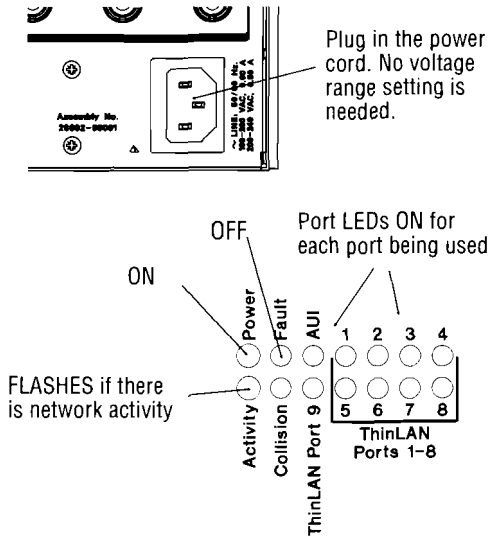
3. Plug the power cord into the hub's power socket and into an ac power source.

   The hub automatically adjusts to any ac power between 90 and 240 volts.

4. Check the LEDs on the hub's back panel.

   If the hub is working properly, after about ten seconds you should see the LED pattern shown in the illustration.

See the *HP ThinLAN Hub Plus Installation and Reference Guide* for more information, including how to customize the hub's configuration from the hub's console interface.



HP EtherTwist Hubs

Third-Party Compatibility List

Type 10Base-T Network Devices

HP designs EtherTwist hubs (HP 28691A, 28688B, 28699A) to operate with industry-standard hardware and software products. Based on limited testing, HP believes the following products achieve compatibility with HP's EtherTwist hubs.

HP relies in part upon information from the suppliers of the products and makes no warranty, expressed or implied, with respect to the following products' operation or compliance with worldwide regulatory requirements. HP advises customers to conduct independent examination to determine suitable levels of compatibility for the customer's individual needs.

HP Product	3rd Party Product	Configuration
28691A, 28688B, and 28699A hubs	SynOptics 3030 concentrator with 10Base-T module	cascading up to 4 units
	3Com's Multiconnect with 10Base-T module	cascading up to 4 units
	Cabletron MMAC-3 with MR-9000PT concentrator module	cascading up to 4 units
	SynOptics 502A transceiver	connect non-10Base-T LAN card to HP hub using transceiver
	Cabletron TPT-S transceiver	connect non-10Base-T LAN card to HP hub using transceiver

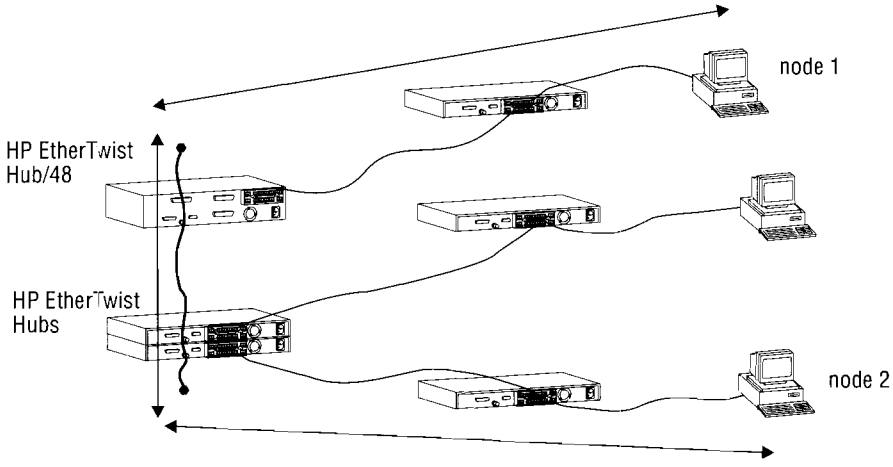
Workgroup LAN Design

Product Note

General Rules

The IEEE 802.3 standard provides general rules for cable lengths, and network connections on single segments of cable or on point-to-point links. Maximum topologies for 802.3 networks are largely a function of media attenuation and signal propagation delay. Limitations are placed on cable lengths, the number of cable segments and repeaters (hubs), and so on. The rules help to ensure that the communication path between the two farthest nodes on the network are trouble-free.

Communication path between two nodes



The following topology rules and guidelines will help you easily design workgroup LANs for proper network operation. It is possible that some network designs will not simply fit within the rules and guidelines. In such cases, you should consult your HP authorized dealer or local HP sales representative for further assistance.

Maximum Number of Repeaters

For any network that does not include bridges, the maximum number of repeaters (hubs) in the data path between any two nodes are:

- Four EtherTwist hubs.
- Four ThinLAN hubs.
- Four (total) any combination of EtherTwist hubs and ThinLAN hubs.

Maximum Number of Cable Segments

For any network that does not include bridges, the maximum number of cable segments in the data path between any two nodes are:

- With four repeaters, the maximum is five segments. (No more than 3 segments can be coaxial cable.)

Maximum Cable Lengths

The maximum lengths for each cable type are:

Twisted-pair: 100 m (standard Type 10Base-T cable)*
Thin coaxial: 185 m

* Longer distances can be used between two HP 28685B transceivers using the long cable option. For more information, refer to the Product Note: "Long Cable Option on the HP 28685B EtherTwist Transceiver" located in the Advanced Topics section of this document.

Maximum Number of Bridges

The maximum number of bridges (or routers functioning as bridges) in the data path between any two nodes on the network is seven. This is an IEEE 802.1 spanning tree protocol recommendation.

With regard to the maximum repeater and segment numbers stated above, when a bridge is crossed in the data path, the count for repeaters and cable segments resets to zero.

A bridge isolates local traffic by avoiding forwarding packets to destinations on the same side of the bridge as the source. The bridge does not forward collision packets. Collisions are resolved locally on each LAN the bridge connects.

Maximum Number of LAN Connections per Cable Segment

A LAN connection means that an electrical load exists at the point of (physical) connection on the cable. A transceiver and a BNC "T" connection is an example of a LAN connection on a cable segment.

Cable Type	Data Rate	Cable Connection	Maximum Connections	IEEE 802.3 Standard
Twisted-pair	10 Mbit/s	pt-to-pt*	2	Type 10Base-T
Thin coaxial	10 Mbit/s	segment*	30	Type 10Base2
Thick coaxial	10 Mbit/s	segment*	100	Type 10Base5

* A point-to-point (pt-to-pt) cable connection means that there can be only two devices connected on the ends of the cable. A segment cable attachment means that multiple devices can be attached on the cable.

Workgroup LAN Design

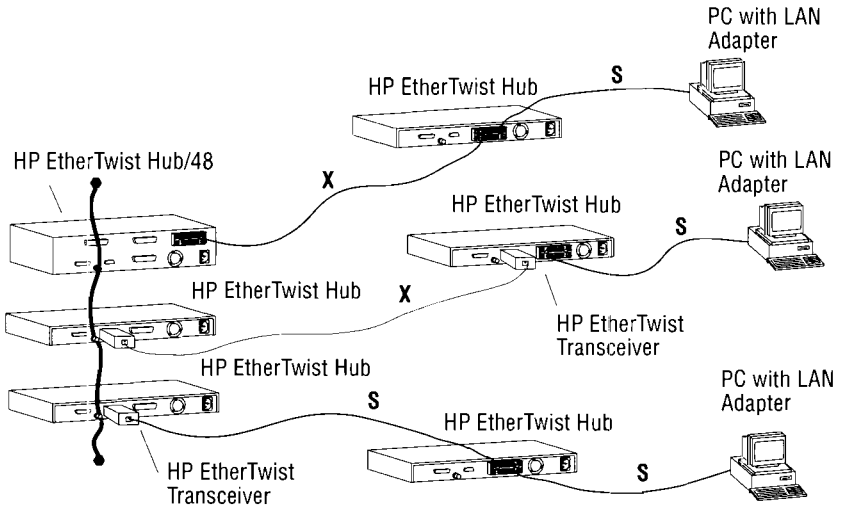
Product Note

Tips for Designing Workgroup LANs

The following are a few helpful tips and common network practices to consider when designing workgroup LANs using unshielded twisted-pair (UTP) or thin coaxial cabling.

1. It is best not to cascade (via twisted-pair cable) more than two EtherTwist hubs off of a backbone connection. This limitation will make network expansion easier.
2. Use a crossover twisted-pair cable when connecting two EtherTwist hubs or two EtherTwist transceivers together.

   Use a straight-through cable when connecting a PC (with LAN adapter) and an EtherTwist hub or an EtherTwist transceiver and an EtherTwist hub.



X = crossover cable
S = straight-through cable

3. HP EtherTwist hubs and ThinLAN hubs can be stacked (or mounted in racks) and connected with thin coaxial cable. This is the preferred method to organize your hubs. This keeps your network equipment in controlled locations and reduces the risks of any interruptions to the network connections.
4. Use at least 0.5 meters of thin coaxial cable between neighboring network devices. This 802.3 recommendation is to prevent electrical reflections on the coaxial cable from occurring between neighboring devices.
5. Minimize the use of AUI cables whenever possible. HP's transceivers are compact in size and can connect directly to the AUI port of any 802.3/Ethernet device. Not using AUI cables eliminates potential failure points in your cable system.
6. Use a bridge to help isolate traffic within your workgroup LAN. The bridge can also expand your workgroup LAN by allowing you to add more hubs, and extend your cable distances. For information on HP bridges, refer to the Site LAN section of this document.
7. When using unshielded twisted-pair (UTP) cabling, at least two pairs of 22, 24, or 26 AWG UTP cable are required for each connection in the workgroup LAN. Ordinary telephone cable can be used, provided that it is tested first for suitability. It is recommended that you use the HP 28687A Wire Test Instrument to test the cable. Additional information on the HP Wire Test Instrument is provided at the end of the Workgroup LAN section.
8. Shielded twisted-pair cable may be used for HP EtherTwist workgroup LANs. It is recommended that shielded twisted-pair cabling be grounded at one end only and pass the tests performed by the HP 28687A Wire Test Instrument.
9. When using thin coaxial cabling, you must terminate each thin coaxial cable segment at both ends with 50-ohm resistive terminators. Do not ground each segment unless required by your local building code. In all cases, adhere to the local code. If grounding is required, each thin coaxial cable segment must be grounded at only one point.
10. Nodes are connected to thin coaxial segments through BNC "T" connectors either directly from thin coaxial adapters (residing in computers) or through HP 28641B ThinLAN transceivers. For additional information, refer to the "Thin Coaxial Cable Connections" Product Note located later in this section.

Workgroup LAN Design

Product Note

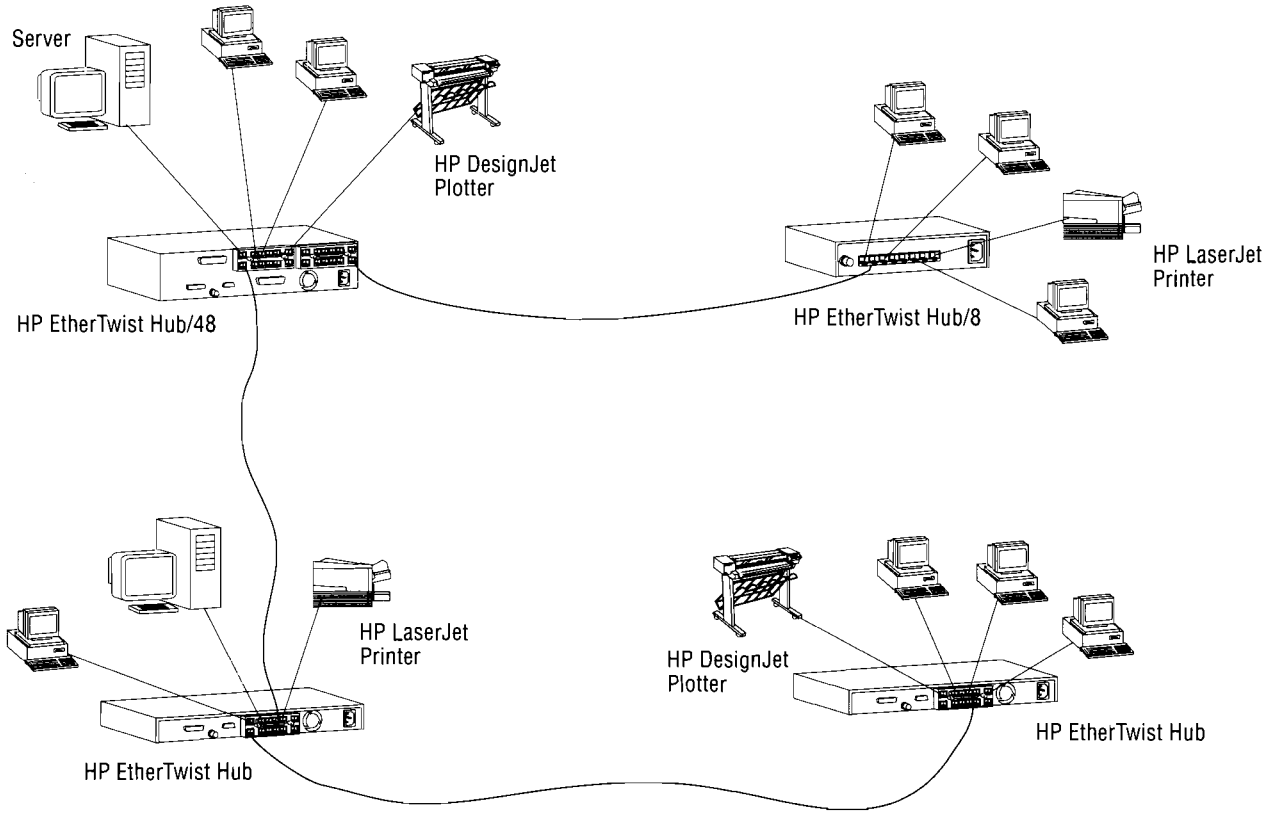
When planning the network topology, count hubs as repeaters and follow these rules:

1. Plan your cable segment lengths as follows:
   - For typical twisted-pair telephone cable, limit segment lengths to 100 meters. Longer cable lengths are possible when used between HP 28685B transceivers with their long cable options enabled.
   - For thin coaxial cable, limit segment lengths to 185 meters.
   - For thick coaxial cable, limit segment lengths to 500 meters.
   - For fiber-optic cable, limit segment lengths to 1 kilometer.
   - Each thin coaxial cable segment can have a maximum of 30 electrical connections.
   - Each thick coaxial cable segment can have a maximum of 100 electrical connections.
2. For any network or subnetwork that does not include bridges:
   - There can be no more than 4 repeaters between any two computers.
   - There can be no more than 3 segments of coaxial cable between any two computers.
3. There can be no more than 7 HP bridges between any two computers on the network. Each time a bridge is crossed, the repeater and the cable segment count is reset to zero. Cable segments and repeaters count as in rule 2 above.

   It is best not to cascade (via twisted-pair cable) more than 2 hubs off of a coaxial backbone connection. Adhering to this limitation will make network expansion easier.

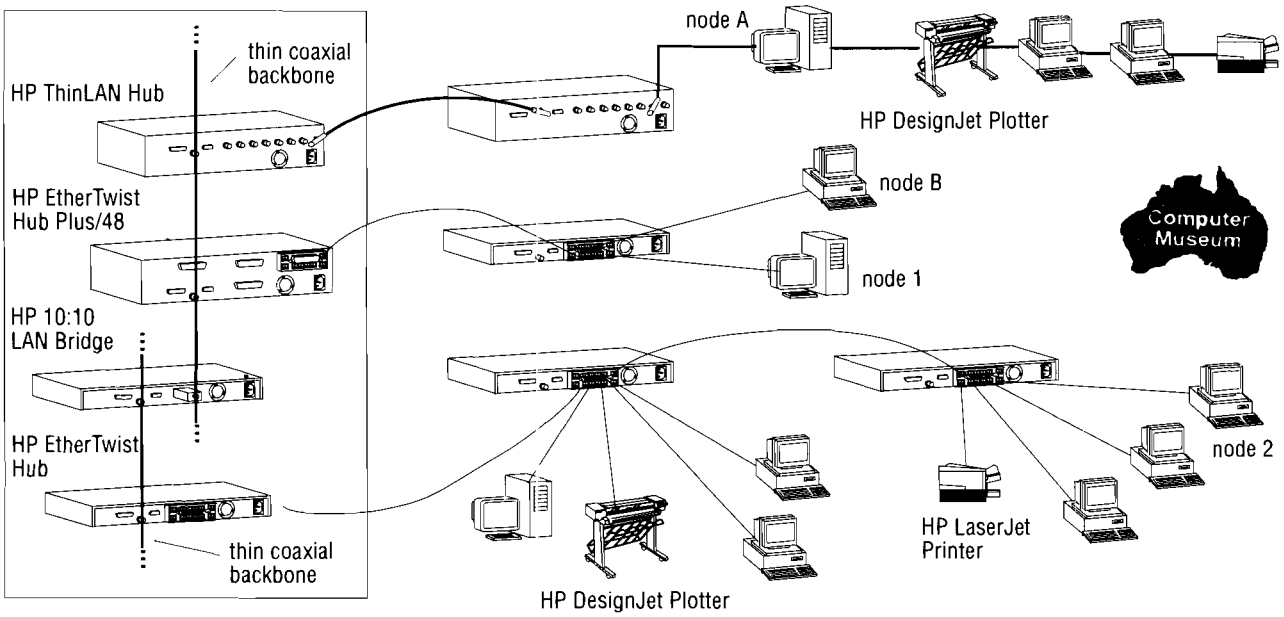
Sample Network Configurations

Example 1



Four hubs can be cascaded since there is no backbone.

Example 2



HP hubs and bridges may be stacked (or mounted in a rack) together and placed in a wiring closet or in any area you choose. Thin coaxial cable connects each device's BNC port to form a backbone between them. (To conserve space, HP hubs and bridges can be placed right on top of each other. The space gaps in the drawing are exaggerated to show the thin coaxial backbone connections.)

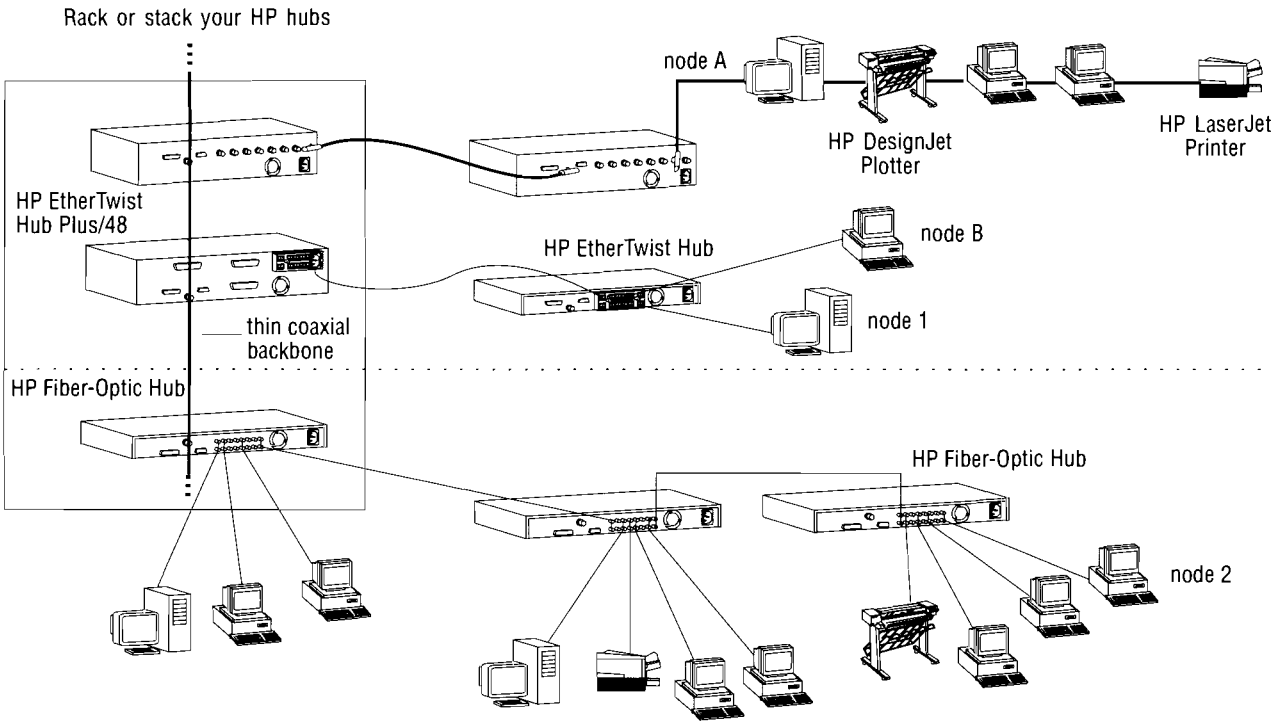
Unless a bridge is used, no more than two hubs are cascaded from the thin coaxial backbone. Crossing a bridge restarts the repeater count to allow for more cascading.

In example 2, an HP 10:10 LAN Bridge separates two thin coaxial backbone segments. (Information on HP bridges is discussed in the site LAN section of this document.) Two HP ThinLAN hubs and two EtherTwist hubs (an EtherTwist Hub/48 and an EtherTwist hub) are cascaded from the thin coaxial backbone segment above the bridge. There are four repeaters (two ThinLAN hubs and two EtherTwist hubs) in the communication path between node A and node B. Also, there are five segments (three thin coaxial and two twisted-pair) in the path between node A and node B. Three thin coaxial segments is the maximum between two nodes.

On the thin coaxial backbone segment below the bridge, there are three EtherTwist hubs cascaded off the backbone. Let's look at the communication path between node 2 and node 1. When node 2 sends data to node 1, the initial data path includes three EtherTwist hubs. When the data crosses the bridge, the hub count resets to zero. (When crossing a bridge, the segment count also resets to zero.) The data then travels through two hubs (an EtherTwist Hub/48 and an EtherTwist Hub) to reach node 1. If the bridge were not in the data path between node 2 and node 1, then there would have been five repeaters in the path between these nodes. This would have exceeded the four repeater rule.

It is best to organize your hubs by cascading two hubs on a thin coaxial backbone. In this manner, you can easily expand your network without exceeding the four repeater rule.

Example 3

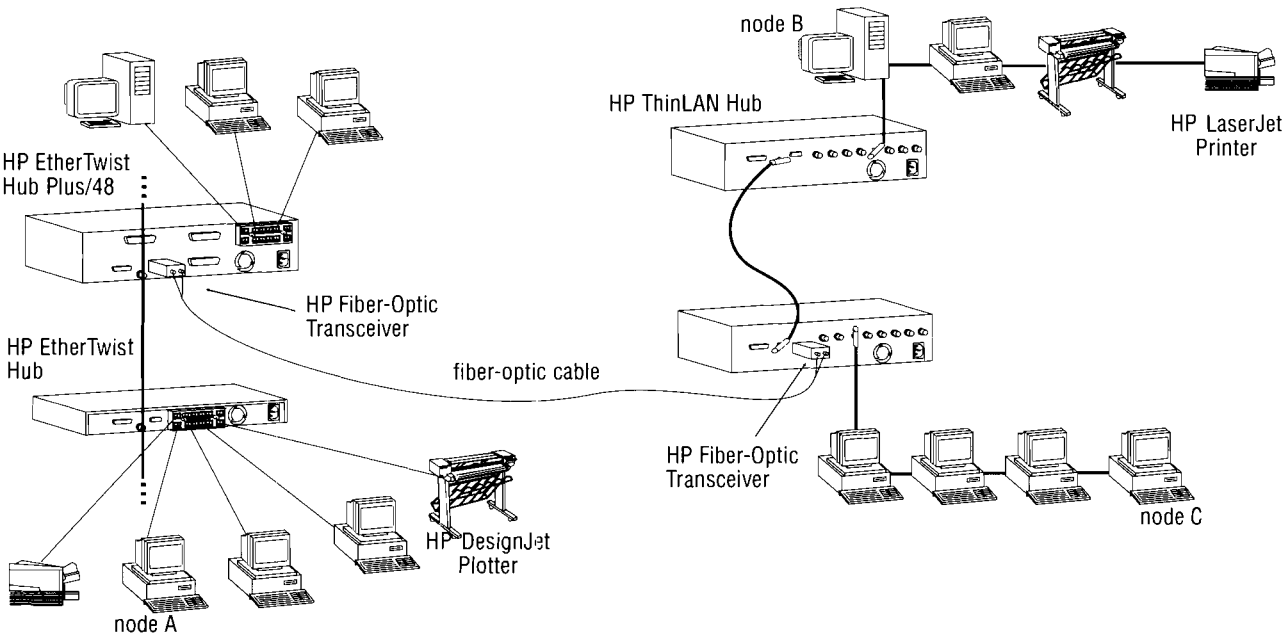


Even though HP Fiber-Optic Hubs are discussed in the Site LAN section of this document, they may also be used in the workgroup environment. Some benefits of using fiber-optic cabling includes long cable distances, security (unauthorized taps onto fiber cables are not possible), and noise immunity.

Example 3 shows a ThinLAN hub, an EtherTwist hub, and a fiber-optic hub connected to a thin coaxial backbone. The fiber-optic hubs (shown under the dotted line) may be used to connect a workgroup in a noisy environment for example. For each connection to the fiber-optic hub, each network device (such as servers, clients, workstations, and network peripherals) requires a LAN adapter that has an AUI port. Attach an HP Fiber-Optic Transceiver (HP 28683A) to the LAN adapter's AUI port and use fiber-optic cabling between the transceiver and the fiber-optic hub.

There are four repeaters in the communication path between node A and node B. However, there are five repeaters (two EtherTwist hubs and three fiber-optic hubs) in the path between node 1 and node 2. There are also five repeaters (two ThinLAN hubs and three fiber-optic hubs) between node A and node 2. This configuration is an exception to the four-repeater rule. That is, when one or more fiber-optic hubs are used in a path that is mixed with HP EtherTwist hubs, and/or HP ThinLAN hubs, then a total of five repeaters may be used in the path between two nodes. (Please refer to the "Site LAN Design" product note later in this document for more information.)

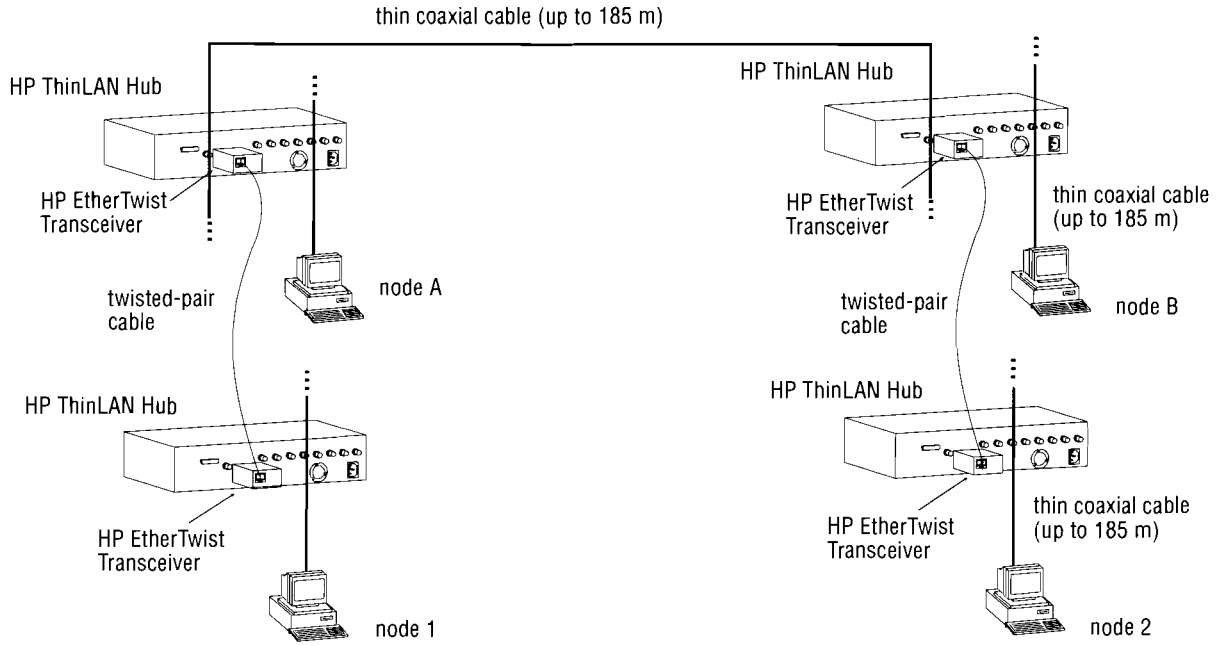
Example 4



Example 4 illustrates how you can mix different types of media such as fiber-optic, thin coaxial, and twisted-pair cabling in your workgroup LAN. You don't always have to place your hubs in the same location (or wiring closet). Hubs and bridges may be placed where you need them in the network. In this example, one HP 28683A Fiber-Optic Transceiver attaches to the EtherTwist Hub/48's AUI port and another fiber-optic transceiver is attached to one of the ThinLAN hubs' AUI port. Fiber-optic cabling is used to connect the two transceivers. Alternatively, HP 28685B EtherTwist transceivers and HP 28641B ThinLAN transceivers can be easily used in place of the fiber-optic transceivers. This illustrates the extreme flexibility of HP EtherTwist network products. Since all HP hubs (except the EtherTwist Hub/8), bridges, and routers have built-in AUI ports, you can use any of the HP transceivers and any type of cabling that you may already have or new cabling to mix and match network devices.

In this example, there are four repeaters (two EtherTwist hubs and two ThinLAN hubs) in the communication path between node A and node B. Also, of the five segments (one twisted-pair, three thin coaxial and one fiber-optic) between node A and node B, a maximum of three thin coaxial segments is allowed. By contrast, let's look at the communication path between node B and node C. There are two repeaters (two ThinLAN hubs) and three thin coaxial segments. See example 5, following, for an illustration of using four ThinLAN hubs.

Example 5



In example 4, we saw that the communication path between node B and node C has two ThinLAN hubs and three thin coaxial segments. This does not imply that when using ThinLAN hubs that you are limited to using only two hubs (because of the three thin coaxial segment rule).

Example 5 shows a configuration that uses four repeaters (ThinLAN hubs) in the communication path between node 1 and node 2. Note that of the five segments in this path, three are thin coaxial segments and two are twisted-pair segments. (Three coaxial segments are the maximum you can have between two nodes.)

Example 5 also illustrates the use of different HP transceivers that can be attached to each ThimLAN Hub's AUI port. In this example, HP EtherTwist Transceivers are used. Fiber-optic transceivers can be used in place of the EtherTwist transceivers. Can HP 28641B ThinLAN Transceivers be used in place of the EtherTwist transceivers? Not in this example. If ThinLAN transceivers were used in place of the EtherTwist transceivers, there would be five thin coaxial segments in the communication path between node 1 and node 2. This exceeds the three coaxial segment rule.

Workgroup LAN Design

Product Note

The Network Map and Floor Plan

The network topology should be drawn in the form of a network map and should show the devices that will be included in the network, the basic layout of their connections, and the types of cable that will be used to connect them.

End-to-End Continuity

For unshielded twisted-pair (UTP) cabling, each connection from any HP EtherTwist hub to a station (PC or system) typically uses a straight-through UTP cable consisting of 4 pairs of twisted-pair wires. Two of these pairs are used for data (transmit and receive), one pair can be used for phone signals, and one pair is unused.

In cases where UTP cabling is used between two HP EtherTwist hubs or two HP EtherTwist transceivers, remember to use a crossover cable. The crossover cable ensures that the transmit pair of one device is connected to the receive pair of the other device.

A UTP cable may contain 4 pairs (a single connection), or 25 pairs (up to 12 connections). Often, these pairs will be routed through cross-connect blocks, which help keep the wiring organized and allow greater flexibility in configuration. Make sure that end-to-end continuity for either a straight-through or crossover UTP cable is maintained throughout the wiring path.

Mounting HP EtherTwist Devices

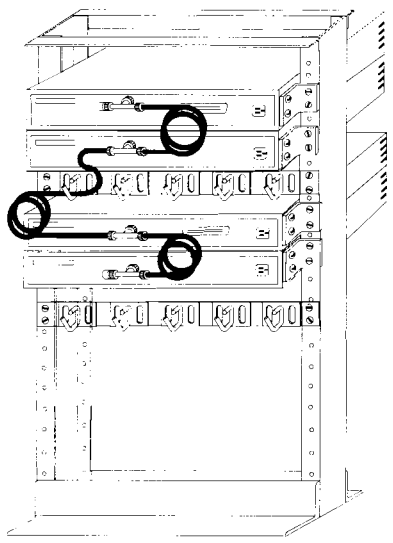
Before beginning the planning steps, you should have a general idea of how you will mount the devices. You may decide on one or on a combination of the following.

Rack Mounting. Rack mounting your HP EtherTwist devices will help keep them neat and organized. Thin coaxial cable connections between the devices provide a virtual backplane that is easy to install and modify. The modular design of the devices makes it easy to make changes to the network design as need arises.

Wall and Table Mounting. If you do not use racks for mounting your devices, you can mount them on a wall or table. In a small network (one or two hubs/bridges at each location), table mounting may be the easiest option. Otherwise, you will probably need to wall mount the devices to keep them neat and organized.

Planning Steps

1. Make sure you have a good network map and floor plan. Keep the following general guidelines in mind.
   - Make sure maximum cable distances between devices are not exceeded. Try to minimize cable runs when possible.
   - Consider ease of access to network devices. Centralized locations (such as wiring closets) make it easier to manage and maintain the network.
   - Consider the logical organization of the network. Keeping logical groups together makes record keeping and maintenance easier. It also allows you to install and verify your network in stages, one logical group at a time.
2. If you are using cross-connect blocks or patch panels, be sure your have the specific wiring layouts planned for each.
3. Plan the specifics of your device mounting strategy. This will be used to make your equipment list. Keep the following general guidelines in mind:
   - For HP EtherTwist devices, direct the cabling to the right-hand side (away from the device's LEDs) when possible.
   - Place cable guide units between devices as needed to provide neat cable management. You can also attach individual cable guide rings to the sides of the rack.
   - Remember that, if you connect network devices with thin coaxial cable, you need 0.5 meters of thin coaxial cable between devices. You can keep this cable coiled between devices.
   - Consider possible future changes. You may want to keep devices that might be moved later near the top or bottom of the rack.



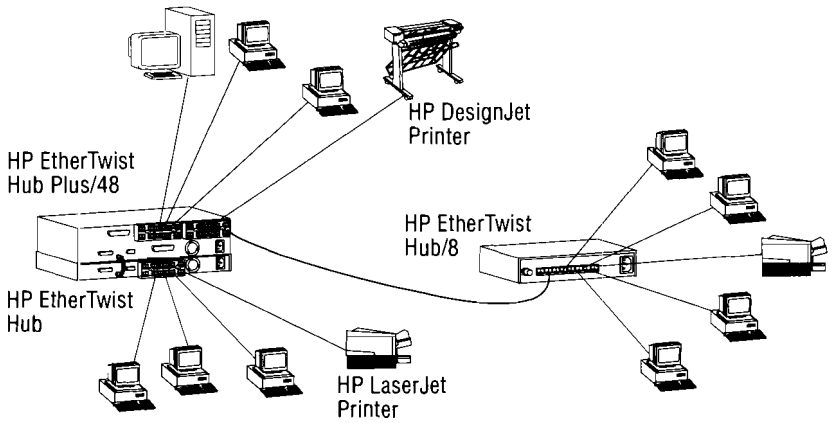
Examples

The following examples show equipment layouts for a UTP workgroup LAN topology and a thin coaxial workgroup LAN topology. You will need to adapt your layout plans to the constraints of your particular network environment.

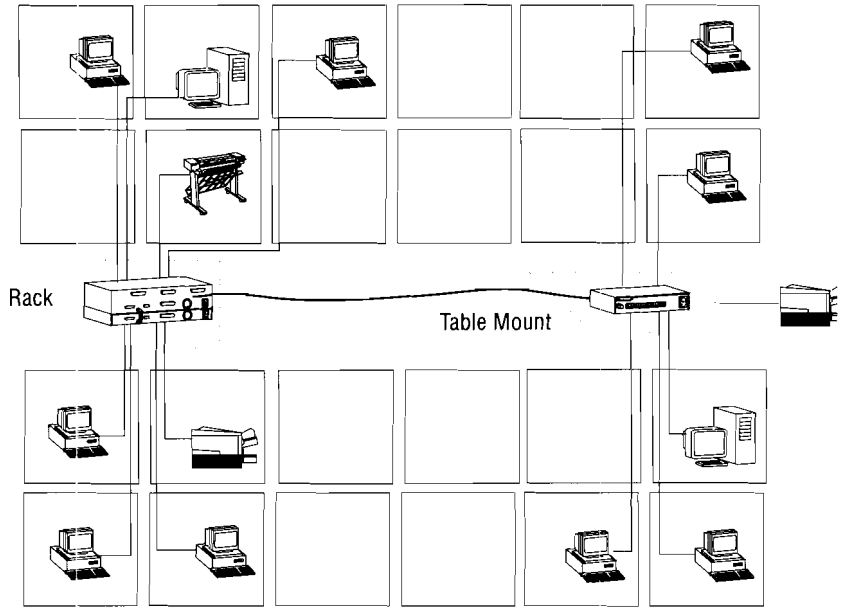
Example 1: UTP Workgroup LAN Topology

An HP EtherTwist Hub and an HP EtherTwist Hub/48 are placed in a rack in a wiring closet and connected with thin coaxial cable. An HP EtherTwist Hub/8 is placed on a table (away from wiring closet) and connected to the HP EtherTwist Hub/48 with UTP cable.

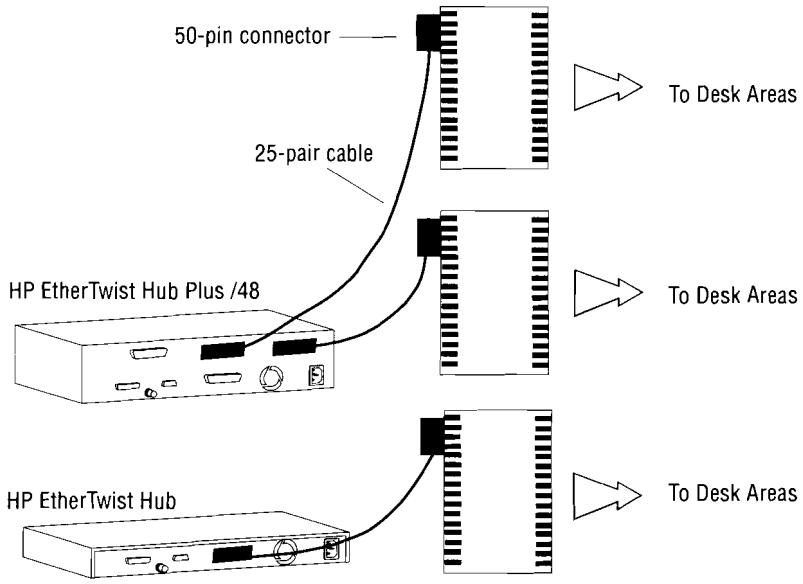
Network map for a UTP workgroup LAN



Floorplan for a UTP workgroup LAN.

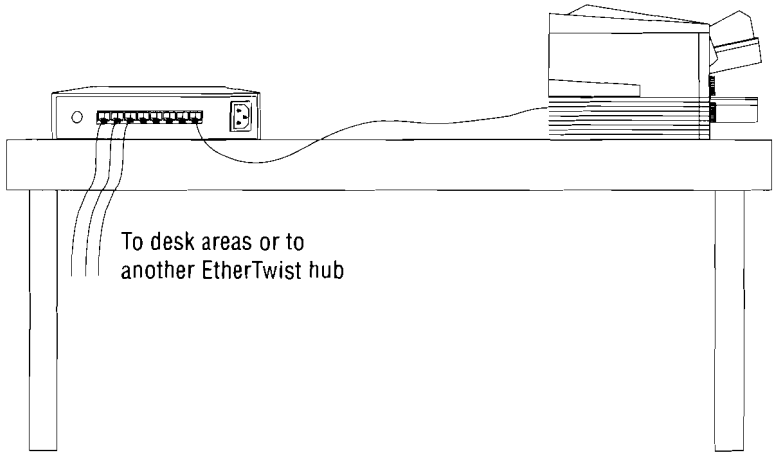


EtherTwist hubs and cross-connect blocks.



Details for cross-connect wiring can be found in the "Cable Connections for HP EtherTwist Networks" product note, located in the Workgroup LAN cabling section.

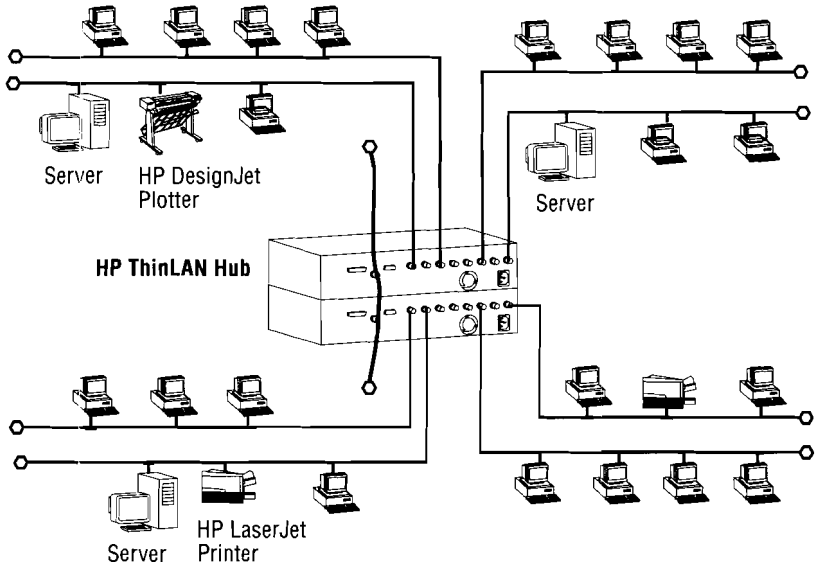
Table mount for HP EtherTwist Hub/8 and HP LaserJet printer.



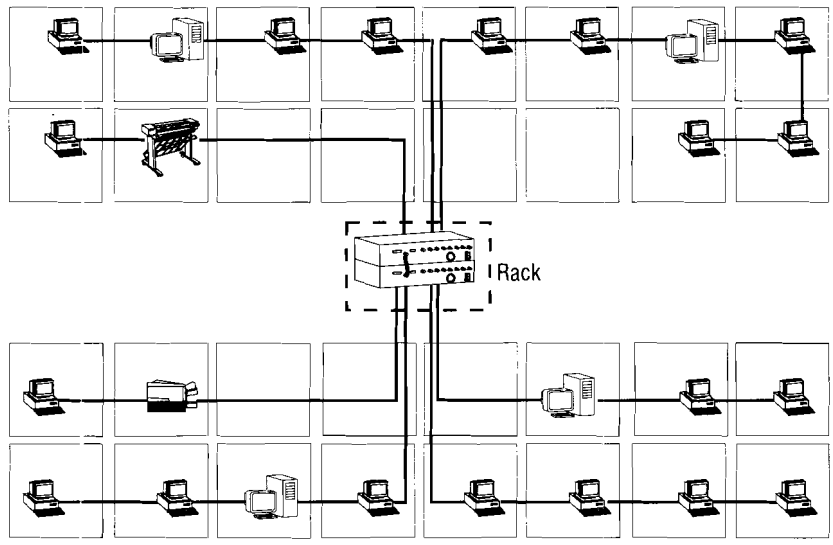
Example 2: Thin Coaxial Workgroup LAN Topology

HP ThinLAN hubs are connected with thin coaxial cable. Thin coaxial cable segments are run to stations.

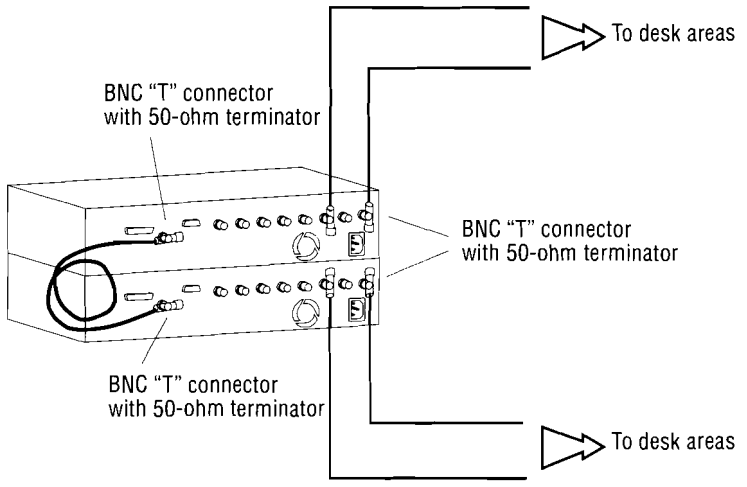
Network map for a thin coaxial workgroup LAN.



Floorplan for a thin coaxial workgroup LAN.



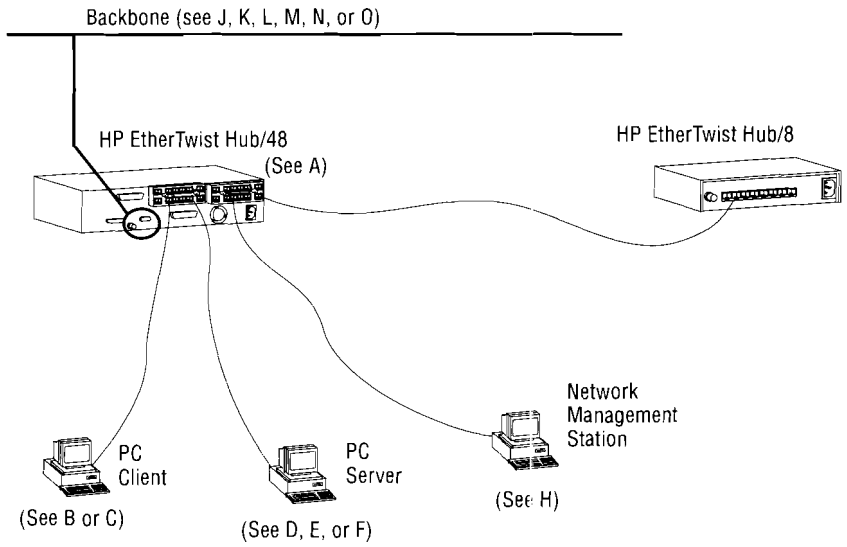
Detail of rack (ThinLAN hubs)



HP EtherTwist Networks

Ordering Guide

Workgroup LAN



To create an HP EtherTwist network, the following items are needed:

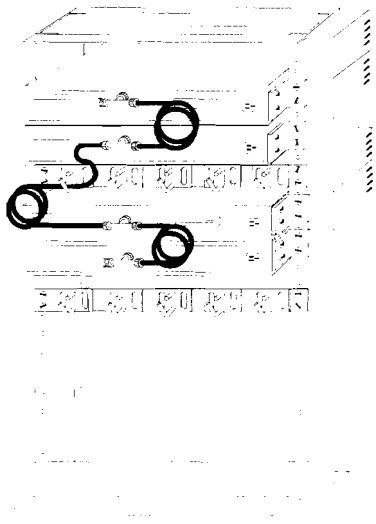
- at least one hub,
- at least one server,
- clients,
- LAN adapters or HP EtherTwist transceivers for all system connections, and
- twisted-pair cabling.

The letters referenced on the illustration correspond to the ordering sections that follow.

HP EtherTwist network devices fit neatly and securely in a 19-inch equipment rack. The illustration shows a configuration with:

- 19-inch equipment rack
- cable guide
- mounting brackets

The illustration also shows thin coaxial connections between EtherTwist devices creating a virtual extended backplane. See section J for ordering details.



Product Number	Description
A. What you need to order for an EtherTwist subnetwork.	
28691A*, 28688B* or 28699A*	EtherTwist Hub/8, Hub Plus, or Hub Plus/48. Includes hub, documentation, rack-mount hardware, AUI retainer.
28638A *(optional)*	12-port Modular Adapter for Hub (1 for each 50-pin connector on the hub). Includes adapter for 50-pin connector to twelve 8-pin jacks, documentation. *Note:* A modular adapter is included with the HP 28688B EtherTwist Hub Plus product.
B. What you need to order to connect one PC AT client to the LAN.	
27245A* or 27247B*	PC LAN Adapter/8 TP or PC LAN Adapter/16 TP Plus. Includes adapter, Support Disk with LAN drivers and diagnostic tool, documentation.
27267A* *(optional)*	PC LAN Adapter/8 TP 6-pack. Includes 6 8-bit ISA adapters, 1 set of documentation and Support Disk.
27269B* *(optional)*	PC LAN Adapter/16 TP Plus 6-pack. Includes 6 16-bit ISA adapters, 1 set of documentation and Support Disk.
—	Qualified twisted-pair cable and connectors (see item K).
—	Network operating system (NOS) client software.
—	Must have one hub twisted-pair port available.
C. What you need to order to connect one PC Micro Channel client to the LAN.	
27246A*	MC LAN Adapter/16 TP. Includes adapter, Support Disk with LAN drivers and diagnostic tool, documentation.
—	Qualified twisted-pair cable and connectors (see item K).
—	Network operating system (NOS) client software.
—	Must have one hub twisted-pair port available.
D. What you need to order to connect one PC AT server to the LAN.	
27247B*	PC LAN Adapter/16 TP Plus. Includes adapter, Support Disk with LAN drivers and HP LANSet, documentation.
—	Qualified twisted-pair cable and connectors (see item K).
—	Network operating system (NOS) server software.
—	Must have one hub twisted-pair port available.
E. What you need to order to connect one EISA PC server to the LAN.	
27248A	EISA LAN Adapter/32 TP. Includes adapter, Support Disk with LAN drivers and diagnostic tool, documentation.
—	Qualified twisted-pair cable and connectors (see item K).
—	Network operating system (NOS) server software.
—	Must have one hub twisted-pair port available.
F. What you need to order to connect one PC Micro Channel server to the LAN.	
27246A*	MC LAN Adapter/16 TP. Includes adapter, Support Disk with LAN drivers and diagnostic tool, documentation.
—	Qualified twisted-pair cable and connectors (see item K).
—	Network operating system (NOS) server software.
—	Must have one hub twisted-pair port available.

* Order appropriate language and line cord option (see item O).

Product Number	Description
G. What you need to order to connect one system LAN card (with AUI port) to the LAN.	
28685B	EtherTwist Transceiver. Includes transceiver (medium attachment unit), documentation. Does not include AUI cable.
—	Qualified twisted-pair cable and connectors (see item K).
—	Network operating system (NOS).
—	AUI cable *(optional)*.
—	Must have one hub twisted-pair port available.
H. What you need to order for one PC-based network management station.	
27245A, 27246A, 27247B, 27248A	EtherTwist LAN Adapter. Includes adapter, Support Disk with LAN drivers and diagnostic tool, documentation.
or	
third-party LAN adapter	See list of tested third-party LAN adapters in the "Network Management Question and Answer" section of this technical reference guide.
28686D	HP OpenView Hub Manager/DOS software. Includes Hub Manager disks, HP OpenView Windows disks, training disks, HP IP software, documentation.
or	
27257D	HP OpenView Interconnect Manager/DOS software. Includes Interconnect Manager disks, HP OpenView Windows disks, training disks, HP IP software, documentation.
—	MS-DOS 3.2, 3.3, 4.01, 5.0 or later.
—	MS Windows 3.00a, 3.1, or later.
—	Personal computer (with at least 4 Mbytes of RAM), color monitor, and mouse.
—	RS-232 cable for console port connection to a hub (see section I). Used to configure the IP address of the hub(s) to be managed.
I. What you need to order for a console port connection to the EtherTwist hubs.	
For direct terminal connections:	
13242G, 40242G	25-pin male to 25-pin male cable.
13242H	25-pin male to 25-pin female cable.
24542G	25-pin male to 9-pin female cable.
92221P	9-pin male to 25-pin male cable (for use with HP 110 portable computer).
BlackBox # EVNBPC	25-pin male to 9-pin female cable.
Tandy # 26-1496	25-pin male to 25-pin female null modem adapter (for use with a straight-through modem cable).
For modem connections:	
13242M, 13242N, 17355M	25-pin male to 25-pin male straight-through modem cable.
31391A	25-pin male to 25-pin female straight-through modem cable.

* Order appropriate language and line cord option (see item O).

Product Number	Description
J. What you need to order for "racking and stacking" your HP EtherTwist hubs and other HP network devices (Fiber-Optic Hub Plus, LAN bridge, remote bridge).	
46298D	19-inch free-standing equipment rack. Can accommodate up to 48 EtherTwist Hubs or Hub Pluses, or up to 24 Hub Plus/48s.
5957-8467 *(optional)*	Floor bolt set. Bolts rack to concrete floors.
35199D *optional*	19-inch cable guide (height=1.75 inches). Includes 5 metal rings for keeping cables organized. Order 1 cable guide for every 2 or 3 hubs in the rack.
—	Hub brackets (ship with hubs). Used for hanging hubs in 19-inch rack.
92214U	Thin coaxial cable assembly. Includes 0.5 meter thin coax, 1 "T" connector, 1 50-ohm terminator. Order 1 cable for each hub in the rack.
92227P	Thin coaxial 50-ohm terminator pair. Order 1 pair for one thin coaxial backbone (not needed if 92214U cables ordered).
28638A *optional*	12-port Modular Adapter. Includes adapter for 50-pin connector to twelve 8-pin jacks. Used to connect 2-, 3-, or 4-pair twisted-pair cables with 8-pin (RJ-45) plugs directly to the hub.
92214R, 92214S, 92214T *optional*	25-pair cable with male 50-pin connectors on each end (5 feet, 10 feet, 25 feet, respectively). Used to connect hub's 50-pin connector to a pre-wired cross-connect block or patch-panel block. Order 1 cable for each Hub Plus in the rack (order 4 cables for each Hub Plus/48 in the rack).
5062-3350	Mounting kit and accessories for HP EtherTwist Hubs, Bridges, and Routers. (The mounting kit ships with every product. Order this part number if you need extras.)
5062-9325	Mounting kit and accessories for HP ThinLAN Hub, HP EtherTwist Hub/8 and the HP EtherTwist Hub/48. (The mounting kit ships with every product. Order this part number if you need extras.)
1400-1497	Velcro strap bracket for 50-pin connector.
K. Additional support and ancillary products for use with HP EtherTwist networks.	
28687A	Wire Test Instrument. Includes 12 loopback hoods, one 12-port modular adapter, documentation.
28689B	EtherTwist Troubleshooting Kit *(order one per installation or order individual parts listed below)*. Includes 50-pin loopback connector, AUI loopback connector, RS-232 loopback connector, 8-pin loopback connector, BNC loopback connector, and V.35 loopback connector.
28663-63001	AUI loopback connector.
28606-63067	RS-232 loopback connector.
28663-63002	50-pin loopback connector.
28606-63037	V.35 loopback connector.
28606-63007	WAN (DB-62) loopback connector.
5061-2550	Token ring loopback connector.
5041-3738	Fiber-optic loopback connector.
5181-6181	ST-SMA optical fiber adapter. Includes ST connectors on one end of the adapter and SMA connectors on the other end.

* Order appropriate language and line cord option (see item O).

Product Number	Description
K. Additional support and ancillary products for use with HP EtherTwist networks. ***(continued)***	
92268P	RJ-45 modular plugs (box of 25).
92268T	RJ-45 hand crimp tool.
92227L	BNC connectors (2) crimp-on type.
92227M	BNC connector hand crimp tool.
92227N	"T"BNC connector with cover.
92227P	50-ohm terminators (2).
92227Q	ThinLAN loopback ("T"with terminators).
92227R	Insulation cover for the "T"connector.
92268J	Wallplate (duplex RJ-45/RJ-11).
92224F	RS-232-C female gender converter.
92224M	RS-232-C male gender converter.
Twisted-Pair Cables and Connectors:	
92268A	4-meter twisted-pair cable. Includes 8-pin modular plugs on each end.
92268B	8-meter twisted-pair cable. Includes 8-pin modular plugs on each end.
92268C	16-meter twisted-pair cable. Includes 8-pin modular plugs on each end.
92268D	32-meter twisted-pair cable. Includes 8-pin modular plugs on each end.
92268N	300-meter twisted-pair cable (no connectors, cut to length).
92268P	8-pin modular plugs (package of 25).
92268J	8-pin modular wall jack (package of 12).
92268S	6-pin to 8-pin adapter cable (5 meters long).
92268T	8-pin modular plug crimp tool. Includes 25 8-pin modular plugs.
92214W	Crossover cable with coupler. Includes 8-pin modular plugs on each end (20 cm long).
Note:	*For other suitable twisted-pair cables, see the "Cabling" section of this guide .*
AUI Cables:	
92264D	1-meter thin AUI cable, with connectors. Includes 1 male and 1 female connector. Outer jacket material made of PVC.
92254J	5-meter thin AUI cable, with connectors. Includes 1 male and 1 female connector. Outer jacket material made of PVC.
92254A–D	6-, 12-, 24-, 48-meter thick AUI cables, with connectors. Includes 1 male and 1 female connector. Outer jacket material made of FEP (Teflon).
92254E–H	6-, 12-, 24-, 48-meter thick AUI cables, with connectors. Includes 1 male and 1 female connector. Outer jacket material made of PVC.
Thin Coaxial Cables:	
92227A–H	1-, 2-, 4-, 8- 16- 32- 64-, 128-meter thin coaxial cables, with connectors. Outer jacket material made of PVC.
92227S	300-meter thin coaxial cable, without connectors. Outer jacket material made of PVC.
92227T	100-meter thin coaxial cable, without connectors. Outer jacket material made of FEP (Teflon).
92227U	300-meter thin coaxial cable, without connectors. Outer jacket material made of FEP (Teflon).

* Order appropriate language and line cord option (see item O).

Product Number	Description
K. Additional support and ancillary products for use with HP EtherTwist networks. ***(continued)***	
Thick Coaxial Cables:	
92253A	23.4-meter thick coaxial cable, without connectors. Outer jacket material made of FEP (Teflon).
92253B	23.4-meter thick coaxial cable, with connectors. Outer jacket material made of FEP (Teflon).
92253C	117-meter thick coaxial cable, without connectors. Outer jacket material made of FEP (Teflon).
92253D	500-meter thick coaxial cable, without connectors. Outer jacket material made of FEP (Teflon).
92253E	23.4-meter thick coaxial cable, without connectors. Outer jacket material made of PVC.
92253F	23.4-meter thick coaxial cable, with connectors. Outer jacket material made of PVC.
92253G	117-meter thick coaxial cable, without connectors. Outer jacket material made of PVC.
92253H	500-meter thick coaxial cable, without connectors. Outer jacket material made of PVC.
Coaxial Connectors:	
30241B	Thick coaxial cable tap.
92253J	Package of 4 "N" connectors.
92253K	Package of 2 barrel connectors and 2 barrel insulators.
92253L	Package of 1 non-grounded 50-ohm terminator, 1 grounded 50-ohm terminator, and 1 insulator. Used with thick coaxial cable.
92256E	Thick coaxial cable surge protector.
92229B	Crimp tool for "N" connectors. Requires die found in 92256A product.
92256A	Thick coaxial cable installation tool kit. Includes coaxial cable stripper and hex crimp die for 92229B crimp tool.
92227L	Package of 2 crimp-on style BNC connectors.
92227M	Thin coaxial cable installation tool kit. Includes cable stripper and crimp tool.
92227N	"T" connector with insulating cover. Includes 1 connector.
92227P	Thin coaxial 50-ohm terminator pair.
92227Q	Thin coaxial loopback connector. Includes 1 "T" connector, 1 50-ohm terminator pair, and insulating cover.
92227R	Insulating cover for "T" connector.
L. What you need to order for thin coaxial backbone connections to other network devices that have no thin coax (BNC) port but do have an AUI port.	
28641B	ThinLAN transceiver.
92227N	"T" connector.
—	Thin coaxial cable.
—	AUI cable (optional).

* Order appropriate language and line cord option (see item O).

Product Number	Description
M. What you need to order for ThickLAN backbone connections to the hub and other network devices.	
30241A	HP Thick MAU (transceiver). Includes coaxial cable tap. (Older thick MAUs with date code D-3017 or earlier cannot be used with HP 28699A Hub Plus/48 or HP 28688B Hub Plus. Newer thick MAUs with date code F-3105 or later can be used with these products.)
—	Thick coaxial cable.
—	AUI cable.

N. What you need for fiber optic backbone connections to the hub and other network devices.	
28683A	Fiber-Optic Transceiver.
—	AUI cable (optional).
—	Fiber-optic cable. Refer to the site LAN section of this document for more information on fiber-optic cables.

O. Language and Line Cord Options.

HP EtherTwist Hubs

Option	*Language*	*Line Cord*
ABA	English	U.S.
ABB	English	Europe
ABC	English	U.S.
ABD	English	Europe
ABE	English	Europe
ABF	English	Europe
ABM	English	Latin America
ABP	English	Switzerland
ABQ	English	Switzerland
ABU	English	United Kingdom
ACE	English	Denmark
ABZ	English	Europe
ABG	English	Australia
ACF	English	Japan

HP EtherTwist Adapters (HP 27245, HP 27246)

Option	*Language*	*Line Cord*
ABA	English	not applicable
ABD	German	not applicable
ABE	Spanish	not applicable
ABF	French	not applicable
ABZ	Italian	not applicable

HP 27247B PC LAN Adapter/16 TP Plus, HP 27252A PC LAN Adapter/16 TL Plus

Option	*Language*	*Line Cord*
ABA	English	not applicable

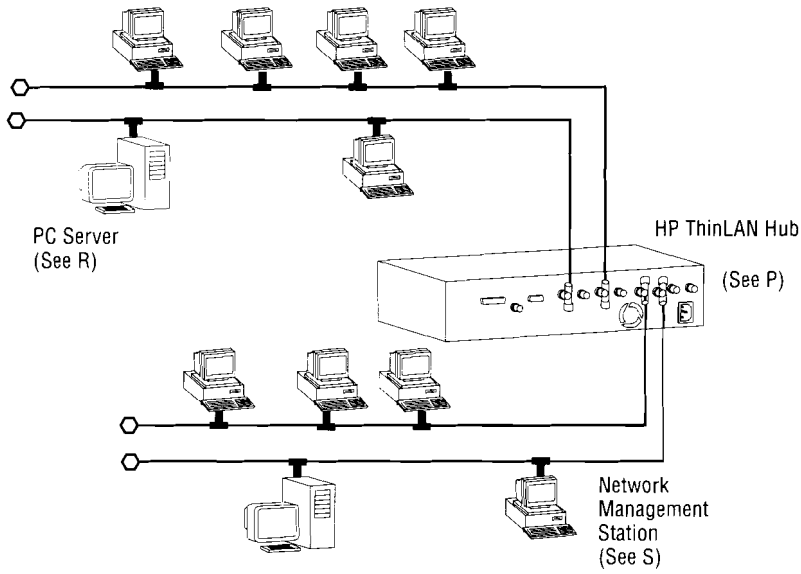
HP 27248A EISA LAN Adapter/32 TP

No options available.

HP 28687A Wire Test Instrument

Option	*Language*	*Line Cord*
none	English	appropriate line cord ships automatically

* Order appropriate language and line cord option (see item O).



To create a simple HP ThinLAN network, the following items are needed:

- at least one ThinLAN hub,
- at least one server,
- clients,
- ThinLAN PC LAN adapters or HP ThinLAN transceivers for all system connections, and thin coaxial cabling.

The letters referenced on the illustration correspond to the ordering sections that follow.

Product Number	Description
P. What you need to order for ThinLAN network.	
28692A	ThinLAN Hub Plus. Includes hub, documentation, rack-mount hardware, AUI retainer.
92227N	"T"Connector. One for each ThinLAN port used on the hub.
92227P	Thin coaxial 50-ohm terminator pair. One pair for each segment.
Q. What you need to order to connect one PC AT client to the ThinLAN network.	
27252A	PC LAN Adapter/16 TL Plus. Includes 16-bit ThinLAN adapter, 1 set of documentation, and Support Disk with drivers and HP LANSet.
92227N	"T"Connector. One for each client
—	Thin coaxial cables (see item K).
—	Network operating system (NOS) client software.
R. What you need to order to connect one PC AT server to the LAN.	
27252A	PC LAN Adapter/16 TL Plus. Includes 16-bit ThinLAN adapter, 1 set of documentation, and Support Disk with drivers and HP LANSet.
92227N	"T"Connector. One for each client
—	Thin coaxial cables (see item K).
—	Network Operating System (NOS) client software.
S. What you need to order for one PC-based network management station.	
27252A	PC LAN Adapter/16 TL Plus. Includes 16-bit ThinLAN adapter, 1 set of documentation, and Support Disk with drivers and HP LANSet.
or	
third-party LAN adapter	See list of tested third-party LAN adapters in the "Network Management Question and Answer" section of this technical reference guide.
28686D	HP OpenView Hub Manager/DOS software (see item H).
or	
27257D	HP OpenView Interconnect Manager/DOS software (see item H).

Workgroup LAN Cabling

Specification Note

Type 10Base-T Cabling

Following are key parameters of the cabling specifications defined in the Type 10Base-T addition to the IEEE 802.3 standard.

Twisted-Pair Cable

All cabling must be twisted-pair (at least 2 twists per foot, 6 twists per meter). Untwisted cable must not be used. This includes even short pieces of flat cable.

Cable should be unshielded if possible. Shielded twisted-pair cable may be used. It is recommended that the shield be grounded at one and only one end (the hub end) of the cable.

Attenuation

Attenuation must be less than or equal to 10 dB from 5 MHz to 10 MHz.

The maximum attenuation of a complete cable path between a transmitter and the corresponding receiver is 11.5 dB at all frequencies between 5 MHz and 10 MHz. This consists of a maximum of 10 dB attenuation for the cable, plus a 1.5 dB allocation for connectors (cross-connect blocks, wall jacks, etc.).

The attenuation of PVC-insulated cable is temperature dependent. At temperatures greater than 40°C (104°F), it may be necessary to use a less temperature-dependent cable such as a plenum-rated (FEP) cable.

Characteristic Impedance

The differential characteristic impedance at frequencies between 5 MHz and 10 MHz must be between 85 and 110 ohms.

Pair-to-Pair Crosstalk

The minimum near-end, differential crosstalk attenuation between each twisted pair and each other pair in the same cable bundle must be greater than or equal to the values shown for each cable type.

4-pair cable
- 30.5 dB at 5 MHz
- 26 dB at 10 MHz

25-pair cable
- 35 dB at 5 MHz
- 30.5 dB at 10 MHz

Multiple Disturber Crosstalk

The minimum near-end, differential crosstalk attenuation between multiple disturbing wire pairs and a disturbed pair in the same cable must be greater than or equal to the values shown when the pairs are driven with synchronized sine waves.

- 27.5 dB at 5 MHz
- 24.9 dB at 7.5 MHz
- 23 dB at 10 MHz

The HP 28687A Wire Test Instrument can determine whether a cable is suitable for a Type 10Base-T network by testing attenuation, crosstalk, continuity, and burst noise.

Workgroup LAN Cabling

Tested Cables List

Cables Suitable for HP EtherTwist Networks

Previously Hewlett-Packard has tested twisted-pair cable for suitability in HP EtherTwist (Type 10Base-T) networks. HP no longer tests cables for suitability, as most cable manufacturers now test for and specify their cables to the Type 10Base-T cabling specifications. The most recent, January 1990, list of HP-tested cable is repeated here for convenience only. It is not an exhaustive list. For cables not listed here please check the manufacturer's cable specifications against the Type 10Base-T specifications or use the HP 28687A Wire Test Instrument to test and verify cable. HP recommends that you work with a qualified LAN cable installer or cable distributor to provide a complete cabling solution for you or your customer.

Even though cables are suitable for HP EtherTwist networks, installation and environmental factors may cause poor performance. The HP 28687A Wire Test Instrument should be used to verify twisted-pair cable installations.

Asia Pacific

Vendor	Part Number	Description	Cable Length (Maximum Allowed)
Pirelli	323/6522	Australian Telecom cable, 3-pair	100 meters
Duratube & Wire Ltd.	1293	4-pair	100 meters
Hua Eng. Wire & Cable Co. Ltd.	PT/183/87(W)	Singapore Telcom cable, 4-pair	100 meters

Europe

Vendor	Part Number	Description	Cable Length (Maximum Allowed)
British Telecom	035144	4-pair	100 meters
Duratube & Wire Ltd.	DI5004B	4-pair, 24 gauge	130 meters
Eb DataKabel	PTS 03102	2-pair, 22 gauge, shielded	65 meters
Lapp Kabel	29304R	2-pair	100 meters
Muckenhaupt & Nusselt	—	MUNFLEX-CY-0, 2x2x0.25mm2, 2-pair, shielded	65 meters
Nokia Jamak	263850	2-pair, 1 drain wire	80 meters
Nokia Datajamak	408881	2-pair, 1 drain wire	90 meters
Nokia MHS	416515	3-pair	100 meters
SEL Kabelwerke	ITT-21100292	4-pair	100 meters
SEL Kabelwerke	554-982	2-pair, shielded	70 meters
Siemens	45412-E20-B7	20-pair	150 meters

United States

Vendor	Part Number	Description	Cable Length (Maximum Allowed)
AT&T	403101140	4-pair, 24 gauge, D-inside wire	100 meters
AT&T	106371487	4-pair, 24 gauge, shielded	185 meters
Anixter	CM-00424BAG-3	4-pair, 24 gauge	100 meters
Anixter	CM-02524BAG-3	25-pair, 24 gauge	100 meters
Anixter	CMP-00424G-3	4-pair, 24 gauge, plenum rated	100 meters
Anixter	CMP-02524G-3	25-pair, 24 gauge, plenum rated	100 meters
Belden	9566	6-pair, 24 gauge	100 meters
Belden	1154A	4-pair, matches IBM Type 3 specifications	100 meters
Hewlett-Packard	92179D	terminal cable	70 meters
Hewlett-Packard	92268A	4-pair, 24 gauge, straight-through cable with 8-pin modular plugs at each end, 4 meters	—
Hewlett-Packard	92268B	4-pair, 24 gauge, straight-through cable with 8-pin modular plugs at each end, 8 meters	—
Hewlett-Packard	92268C	4-pair, 24 gauge, straight-through cable with 8-pin modular plugs at each end, 16 meters	—
Hewlett-Packard	92268D	4-pair, 24 gauge, straight-through cable with 8-pin modular plugs at each end, 32 meters	—
Hewlett-Packard	92268M	4-pair, 24 gauge, 100 meters	—
Hewlett-Packard	92268N	4-pair, 24 gauge, sold in 300 meter sections	100 meters
Hewlett-Packard	92268S	3-pair, 24 gauge, 6-pin to 8-pin adapter cable, 5 meters	—
IBM *	4716748	Type 1, 2-pair, 22 gauge, shielded	340 meters
IBM *	4716739	Type 2, 2-pair data grade, 22 gauge, shielded	340 meters
IBM *	4716739	Type 2, 4-pair voice grade, 24 gauge	200 meters
IBM	depends on distributor	Type 3, 4-pair, 24 gauge	100 meters
IBM *	4716743	Type 6, 2-pair, 26 gauge, shielded	225 meters
IBM *	6339583	Type 9, 2-pair, 26 gauge, shielded	235 meters
Northern Telecom	—	IBDN cable, 3- or 4-pair, 24 gauge	100 meters

* These cables have a characteristic impedance of 150 ohms. Impedance discontinuities (connecting 150 ohm cable to 100 ohm cable) cause signal reflections that can increase the error rate or even disable the network. To reduce the effects of impedance discontinuities, do not use lengths of 150-ohm cable less than 75 meters. If lengths less than 75 meters cannot be avoided, then 150-ohm to 100-ohm impedance matching devices (transformers) must be used on each twisted-pair connection. When these transformers are attached to the 150-ohm cables the maximum allowed length is slightly reduced. When HP EtherTwist and HP StarLAN 10 hardware components are mixed in a network, use transformers on any length of 150-ohm cabling.

Cable Description	Maximum Allowed Length with Transformers
IBM Type 1	320 meters
IBM Type 2	320 meters
IBM Type 6	210 meters
IBM Type 9	220 meters

Transformers can be ordered from:

North Hills Electronics
1 Alexander Place
Glen Cove, NY 11542
phone: (516) 671-5700
FAX: (516) 759-3327

Part Number	Transformer Description
L1E3382	IBM Data Connector to 8-pin jack
L1E3331	IBM Data Connector to 8-pin plug (12 feet long)

Transformer pin-out:

IBM connector	8-pin modular (RJ-45) connector
red	pin 3
green	pin 6
orange	pin 1
black	pin 2

Workgroup LAN Cabling

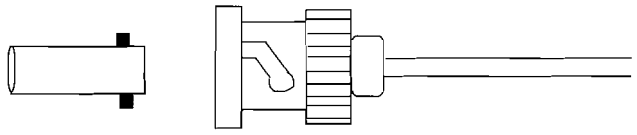
Product Note

Cable Connections for HP EtherTwist Networks

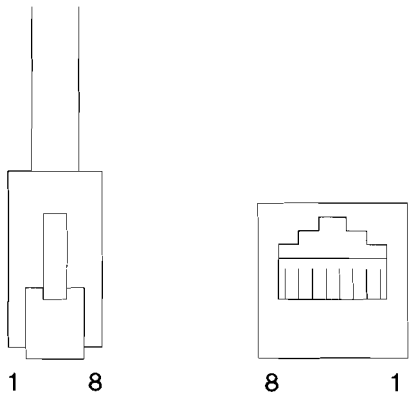
Product	Available Connections (Ports)
HP 27245A PC LAN Adapter/8 TP	1 8-pin modular (RJ-45) jack (female), 1 6-pin modular (RJ-11) jack (female) [phone]
HP 27246A MC LAN Adapter/16 TP	1 8-pin modular (RJ-45) jack (female), 1 6-pin modular (RJ-11) jack (female) [phone]
HP 27247B PC LAN Adapter/16 TP Plus	1 8-pin modular (RJ-45) jack (female), 1 female AUI
HP 27252A PC LAN Adapter/16 TL Plus	1 8-pin modular (RJ-45) jack (female), 1 female AUI
HP 27248A EISA Adapter Card/32	1 8-pin modular (RJ-45) jack (female), 1 female AUI
HP 28685B EtherTwist Transceiver	1 8-pin modular (RJ-45) jack (female), 1 male AUI
HP 28641B ThinLAN Transceiver	1 BNC, 1 male AUI
HP 28691A EtherTwist Hub/8	1 BNC, 8 8-pin modular (RJ-45) jack (female)
HP 28688B EtherTwist Hub Plus	1 BNC, 1 female AUI, 1 female 50-pin telco (12 twisted-pair ports), 1 female 25-pin RS-232 (console port)
HP 28699A EtherTwist Hub Plus 48	1 BNC, 1 female AUI, 4 female 50-pin telco (48 twisted-pair ports), 1 female 25-pin RS-232 (console port)
HP 28638A 12-port Modular Adapter	1 male 50-pin telco, 12 8-pin modular (RJ-45) jacks (female)
HP 28692A ThinLAN Hub Plus	9 BNC, 1 female AUI, 1 female 25-pin RS-232 (console port)

Connectors

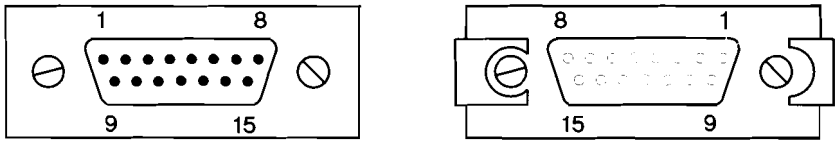
BNC Connectors



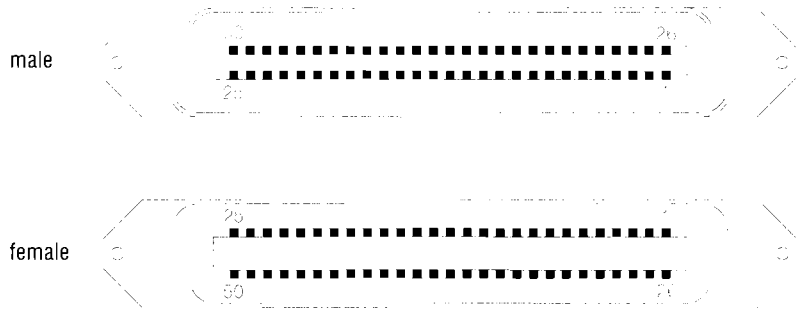
8-Pin Modular (RJ-45) Connectors



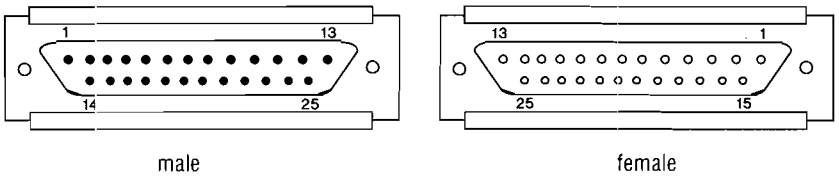
15-Pin D (AUI) Connector



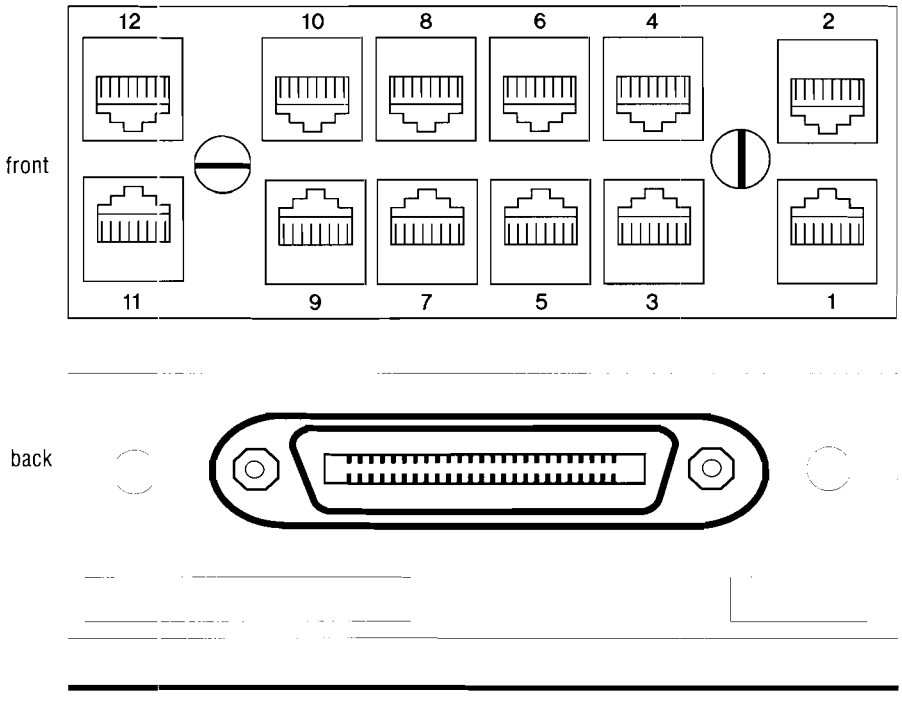
50-Pin Telco Connector



Standard 25-Pin RS-232-C Connector



HP 28638A 12-Port Modular Adapter



Twisted-Pair Cables

4-Pair Twisted-Pair Cable (straight-through cable)

	8-pin plug (male)		8-pin plug (male)	
hub Rx+	1	——	1	data Tx+
hub Rx–	2	——	2	data Tx–
hub Tx+	3	——	3	data Rx+
	4	——	4	not used
	5	——	5	not used
hub Tx–	6	——	6	data Rx–
	7	——	7	not used
	8	——	8	not used

Note: Pins 1 and 2 must be wired to a twisted pair. Pins 3 and 6 must be wired to a twisted pair.

Available HP cables: 92268A/B/C/D

6-Pin to 8-Pin Adapter Cable

6-pin plug (male)		8-pin plug (male)	
1	——	3	data Rx+
2	——	1	data Tx+
3	——	4	not used
4	——	5	not used
5	——	2	data Tx–
6	——	6	data Rx–
		7	not used
		8	not used

Available HP cable: 92268S

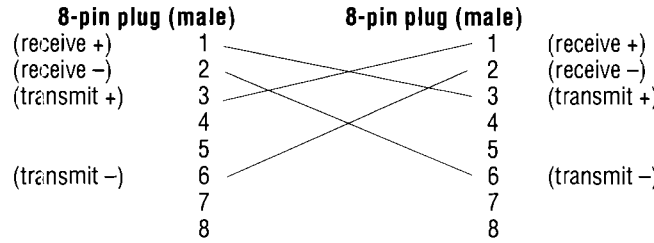
4-Pin to 8-Pin Adapter Cable

	4-pin plug (male)		8-pin plug (male)	
(position 2)	1	——	3	data Rx+
(position 3)	2	——	1	data Tx+
(position 4)	3	——	2	data Tx–
(position 5)	4	——	6	data Rx–
			4	not used
			5	not used
			7	not used
			8	not used

No HP cable available.

Crossover Cable

(For twisted-pair port to twisted-pair port connection between hubs)

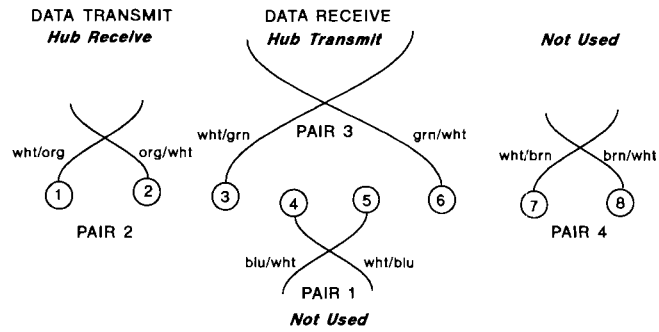


Available HP cable: 92214W

Common 4-Pair-Cable Color Coding Scheme

Plug/Jack Pin No.	Wire Color (base/stripe)	Pair
1	white/orange	2
2	orange/white	2
3	white/green	3
4	blue/white	1
5	white/blue	1
6	green/white	3
7	white/brown	4
8	brown/white	4

258A 8-pin Modular Plug/Jack Wiring



15-Pin to 15-Pin AUI Cable

15-pin female		15-pin male	
2	———	2	CI A
3	———	3	DO A
4	———	4	DI shield
5	———	5	DI A
6	———	6	voltage common
9	———	9	CI B
10	———	10	DO B
12	———	12	DI B
13	———	13	voltage plus

Available HP cables: 92254A/.../H, 92254J, 92264D

Standard 25-Pair Cable

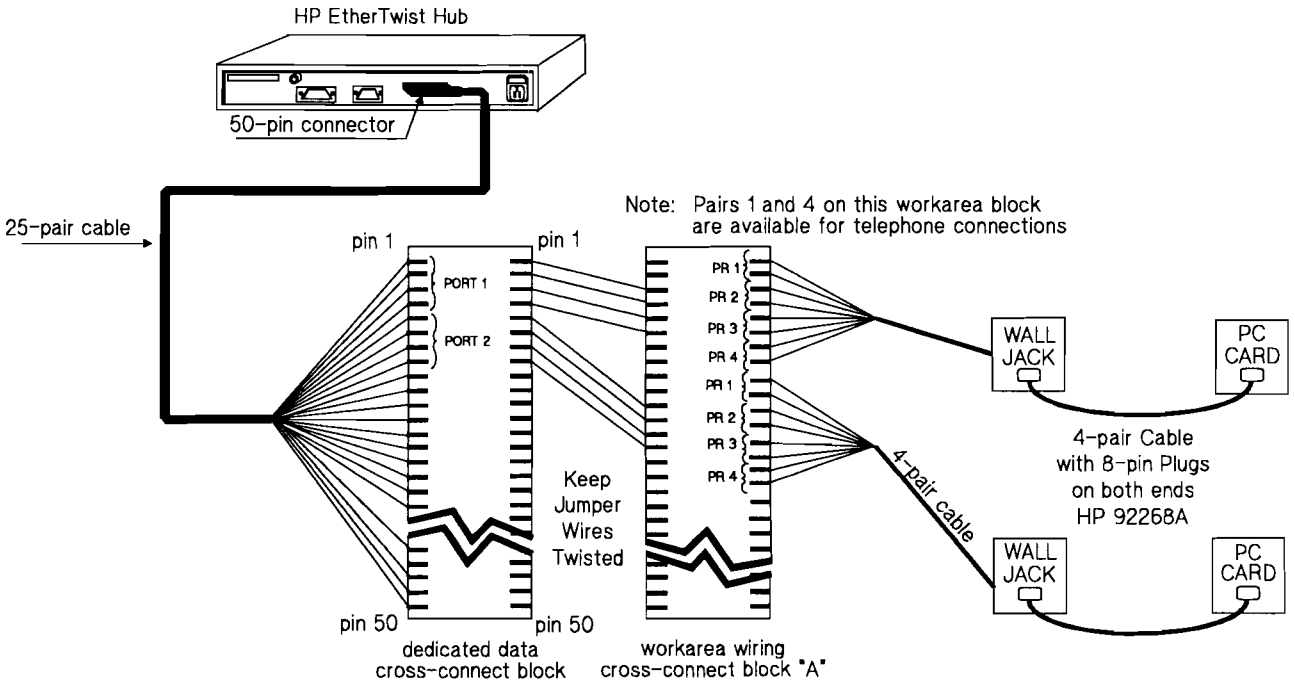
	50-pin male/female		50-pin male/female	
hub Rx+	26	——	26	pair 1
hub Rx–	1	——	1	pair 1
hub Tx+	27	——	27	pair 2
hub Tx–	2	——	2	pair 2
hub Rx+	28	——	28	pair 3
hub Rx–	3	——	3	pair 3
hub Tx+	29	——	29	pair 4
hub Tx–	4	——	4	pair 4
hub Rx+	30	——	30	pair 5
hub Rx–	5	——	5	pair 5
hub Tx+	31	——	31	pair 6
hub Tx–	6	——	6	pair 6
hub Rx+	32	——	32	pair 7
hub Rx–	7	——	7	pair 7
hub Tx+	33	——	33	pair 8
hub Tx–	8	——	8	pair 8
hub Rx+	34	——	34	pair 9
hub Rx–	9	——	9	pair 9
hub Tx+	35	——	35	pair 10
hub Tx–	10	——	10	pair 10
hub Rx+	36	——	36	pair 11
hub Rx–	11	——	11	pair 11
hub Tx+	37	——	37	pair 12
hub Tx–	12	——	12	pair 12
hub Rx+	38	——	38	pair 13
hub Rx–	13	——	13	pair 13
hub Tx+	39	——	39	pair 14
hub Tx–	14	——	14	pair 14
hub Rx+	40	——	40	pair 15
hub Rx–	15	——	15	pair 15
hub Tx+	41	——	41	pair 16
hub Tx–	16	——	16	pair 16
hub Rx+	42	——	42	pair 17
hub Rx–	17	——	17	pair 17
hub Tx+	43	——	43	pair 18
hub Tx–	18	——	18	pair 18
hub Rx+	44	——	44	pair 19
hub Rx–	19	——	19	pair 19
hub Tx+	45	——	45	pair 20
hub Tx–	20	——	20	pair 20
hub Rx+	46	——	46	pair 21
hub Rx–	21	——	21	pair 21
hub Tx+	47	——	47	pair 22
hub Tx–	22	——	22	pair 22
hub Rx+	48	——	48	pair 23
hub Rx–	23	——	23	pair 23
hub Tx+	49	——	49	pair 24
hub Tx–	24	——	24	pair 24
	50	——	50	not used
	25	——	25	not used

Common 25-Pair-Cable Color Coding Scheme

(50-pin connector)

Pin # on 50-Pin Connector	Wire Color base/stripe	Pair/Port		Pin # on 50-Pin Connector	Wire Color base/stripe	Pair/Port	
26	white/blue	1	Port 1	38	black/green	13	Port 7
1	blue/white	1		13	green/black	13	
27	white/orange	2		39	black/brown	14	
2	orange/white	2		14	brown/black	14	
28	white/green	3	Port 2	40	black/slate	15	Port 8
3	green/white	3		15	slate/black	15	
29	white/brown	4		41	yellow/blue	16	
4	brown/white	4		16	blue/yellow	16	
30	white/slate	5	Port 3	42	yellow/orange	17	Port 9
5	slate/white	5		17	orange/yellow	17	
31	red/blue	6		43	yellow/green	18	
6	blue/red	6		18	green/yellow	18	
32	red/orange	7	Port 4	44	yellow/brown	19	Port 10
7	orange/red	7		19	brown/yellow	19	
33	red/green	8		45	yellow/slate	20	
8	green/red	8		20	slate/yellow	20	
34	red/brown	9	Port 5	46	violet/blue	21	Port 11
9	brown/red	9		21	blue/violet	21	
35	red/slate	10		47	violet/orange	22	
10	slate/red	10		22	orange/violet	22	
36	black/blue	11	Port 6	48	violet/green	23	Port 12
11	blue/black	11		23	green/violet	23	
37	black/orange	12		49	violet/brown	24	
12	orange/black	12		24	brown/violet	24	
				50	violet/slate	25	not used
				25	slate/violet	25	

Hub-to-Workarea Wiring Using Cross-Connect Blocks



(Refer to table on next page.)

Pin # on hub's 50-pin connector	25-pair · Wire Color base/stripe	Data cross-connect block pin #	Workarea cross-connect block "A" pin #	Workarea plug/jack pin #	Workarea Wire Color base/stripe
26	white/blue	1	3	1	white/orange
1	blue/white	2	4	2	orange/white
27	white/orange	3	5	3	white/green
2	orange/white	4	6	6	green/white
28	white/green	5	11	1	white/orange
3	green/white	6	12	2	orange/white
29	white/brown	7	13	3	white/green
4	brown/white	8	14	6	green/white
30	white/slate	9	19	1	white/orange
5	slate/white	10	20	2	orange/white
31	red/blue	11	21	3	white/green
6	blue/red	12	22	6	green/white
32	red/orange	13	27	1	white/orange
7	orange/red	14	28	2	orange/white
33	red/green	15	29	3	white/green
8	green/red	16	30	6	green/white
34	red/brown	17	35	1	white/orange
9	brown/red	18	36	2	orange/white
35	red/slate	19	37	3	white/green
10	slate/red	20	38	6	green/white
36	black/blue	21	43	1	white/orange
11	blue/black	22	44	2	orange/white
37	black/orange	23	45	3	white/green
12	orange/black	24	46	6	green/white
			Workarea cross-connect block "B" pin #		
38	black/green	25	3	1	white/orange
13	green/black	26	4	2	orange/white
39	black/brown	27	5	3	white/green
14	brown/black	28	6	6	green/white
40	black/slate	29	11	1	white/orange
15	slate/black	30	12	2	orange/white
41	yellow/blue	31	13	3	white/green
16	blue/yellow	32	14	6	green/white
42	yellow/orange	33	19	1	white/orange
17	orange/yellow	34	20	2	orange/white
43	yellow/green	35	21	3	white/green
18	green/yellow	36	22	6	green/white
44	yellow/brown	37	27	1	white/orange
19	brown/yellow	38	28	2	orange/white
45	yellow/slate	39	29	3	white/green
20	slate/yellow	40	30	6	green/white
46	violet/blue	41	35	1	white/orange
21	blue/violet	42	36	2	orange/white
47	violet/orange	43	37	3	white/green
22	orange/violet	44	38	6	green/white
48	violet/green	45	43	1	white/orange
23	green/violet	46	44	2	orange/white
49	violet/brown	47	45	3	white/green
24	brown/violet	48	46	6	green/white
50	violet/slate	49			
25	slate/violet	50			

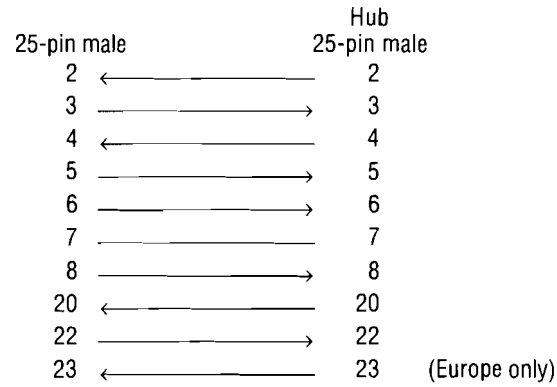
RS-232 Cable and Connector Pin-Outs

Hub 25-Pin Female Connector

Pin	US	CCITT	DIN
1	CHS GND	101	
2	TX	103	D1
3	RX	104	D2
4	RTS	105	S2
5	CTS	106	M2
6	DSR	107	M1
7	GND	102	
8	CD	109	M5
20	DTR	108	S1
22	RI	125	M3
23	SR	111	

RS-232-C Modem Cable

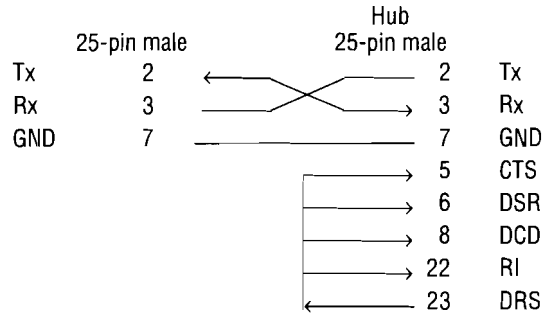
(minimum pin-out)



Available HP Cables: 13242M/N, 17355M. (HP 31391A has one 25-pin female and one 25-pin male connector.)

RS-232-C Cable for Terminal or 25-Pin HP Vectra PC

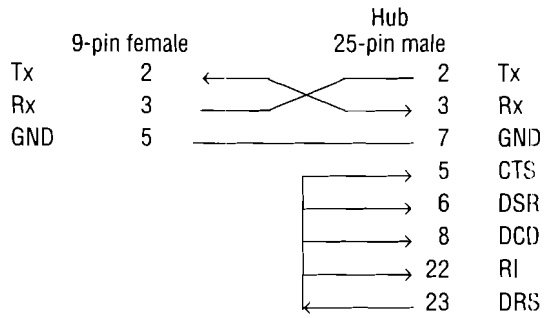
(minimum pin-out)



Available HP Cables: 13242G, 40242G

RS-232-C Cable for 9-Pin HP Vectra PC

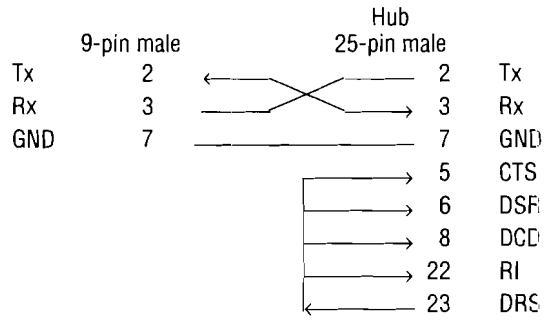
(minimum pin-out)



Available HP Cable: 24542G

RS-232-C Cable for HP 110

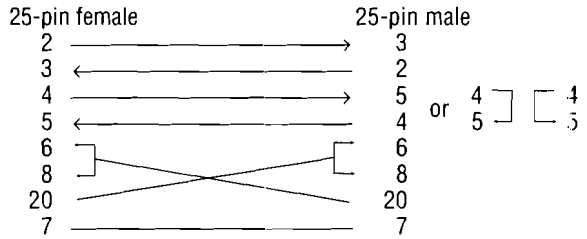
(minimum pin-out)



Available HP Cable: 92221P

Null Modem Adapter for Direct Terminal Connection (use with modem cable)

(minimum pin-out)



No HP adapter available.

Note: If any of the cables listed for direct terminal connection are used, DTR (pin 20) and RTS (pin 4) must be ON, or high, on your terminal or in your terminal emulation program.

12-Port Modular Adapter Wiring

Pin # on 50-Pin Connector	Pair	Port # on Modular Adapter	Pin # on 50-Pin Connector	Pair	Port # on Modular Adapter
26	1		38	13	
1	1	Port 1	13	13	Port 7
27	2		39	14	
2	2		14	14	
28	3		40	15	
3	3	Port 2	15	15	Port 8
29	4		41	16	
4	4		16	16	
30	5		42	17	
5	5	Port 3	17	17	Port 9
31	6		43	18	
6	6		18	18	
32	7		44	19	
7	7	Port 4	19	19	Port 10
33	8		45	20	
8	8		20	20	
34	9		46	21	
9	9	Port 5	21	21	Port 11
35	10		47	22	
10	10		22	22	
36	11		48	23	
11	11	Port 6	23	23	Port 12
37	12		49	24	
12	12		24	24	
			50	25	not used
			25	25	

HEWLETT PACKARD

Workgroup LAN Cabling

Product Note

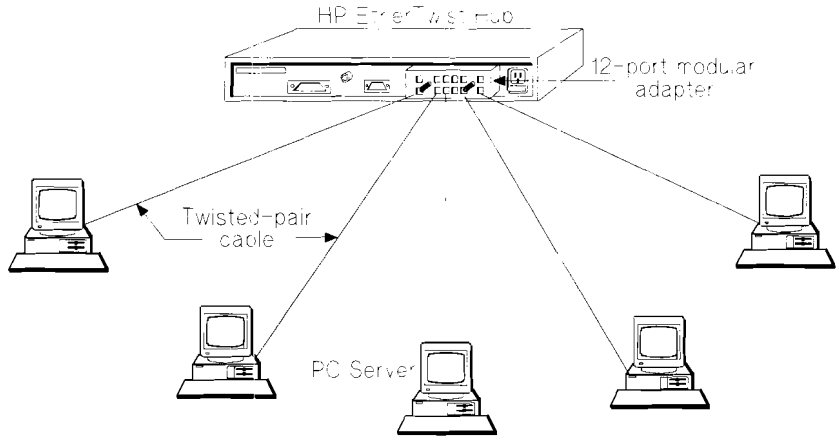
Twisted-Pair Cabling Schemes for HP EtherTwist Networks

Installation Requirements

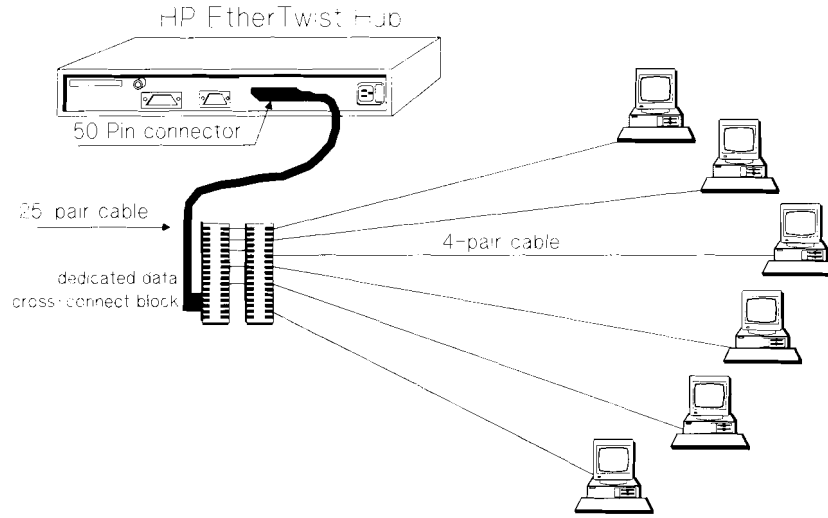
- Use approved cable, compatible with cable specifications defined in the Type 10Base-T addition to the IEEE 802.3 standard.
- The cable must be twisted-pair cable.
- Modular plugs must be 8-pin.
- Existing cable must be tested using the HP 28687A Wire Test Instrument before it can be used in the network.
- It is recommended that newly installed twisted-pair cable be tested using HP 28687A Wire Test Instrument.
- It is recommended that the cable run through no more than four cross-connect blocks.

  Note: Flat untwisted cable must not make up any portion of the cabling in an HP EtherTwist network.

Example A

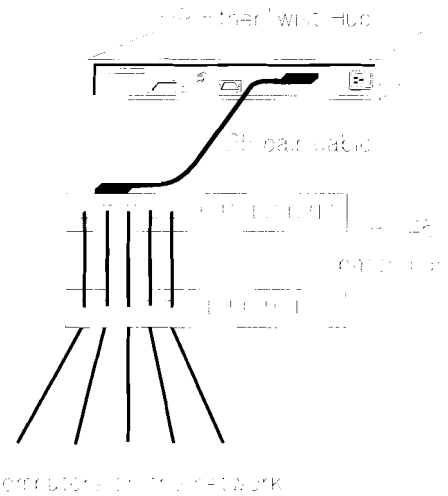


Example B

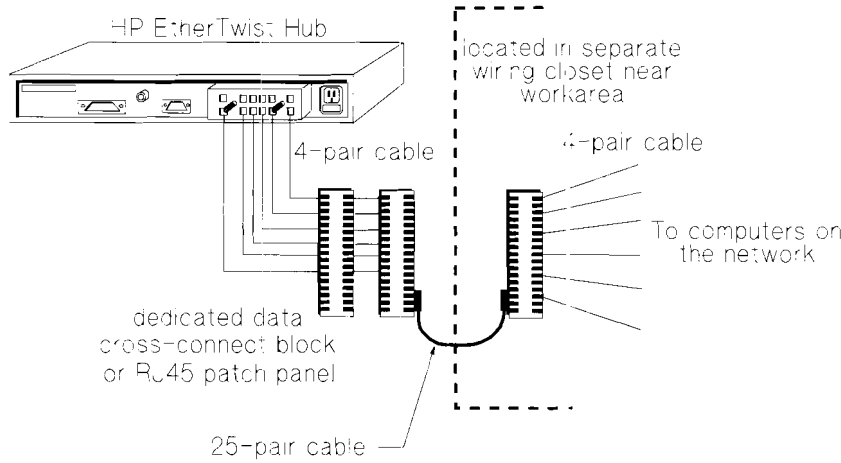


Connection examples

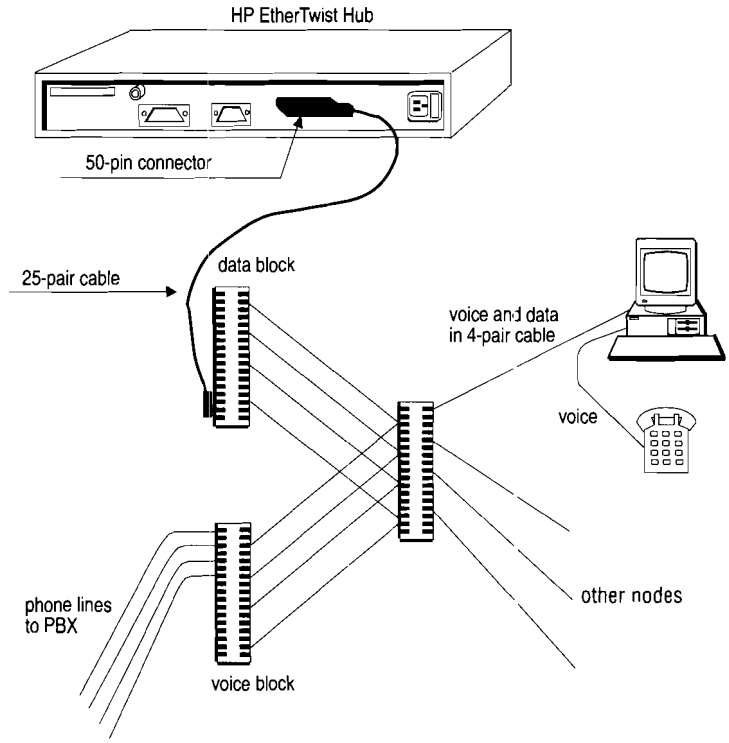
Example C



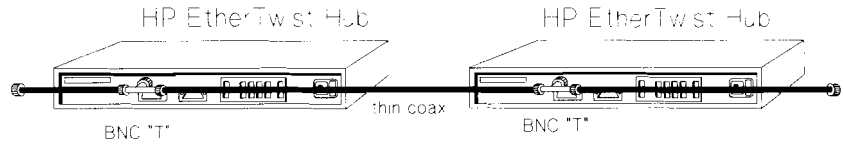
Example D



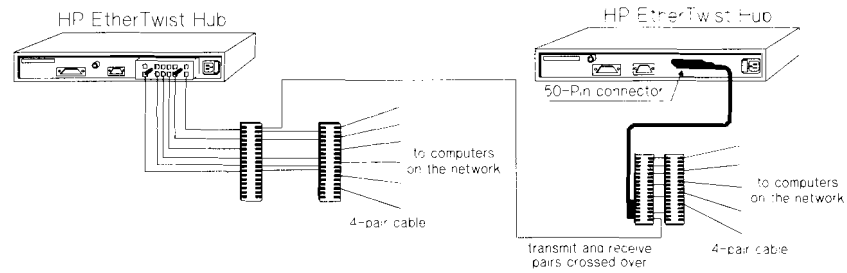
Example E



Example F

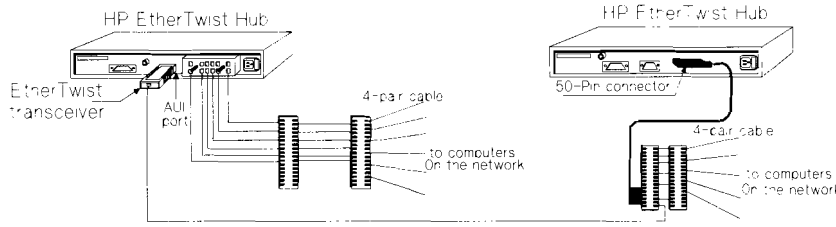


Example G

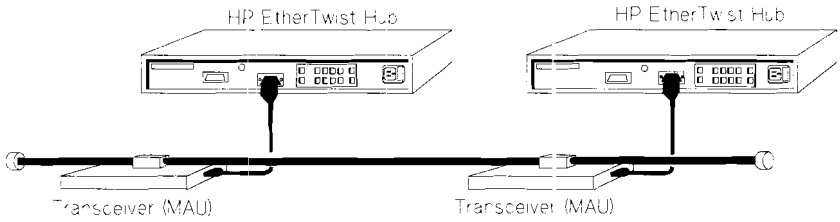


For pin-out details, see the "Cable Connections for HP EtherTwist Networks" section in this guide.

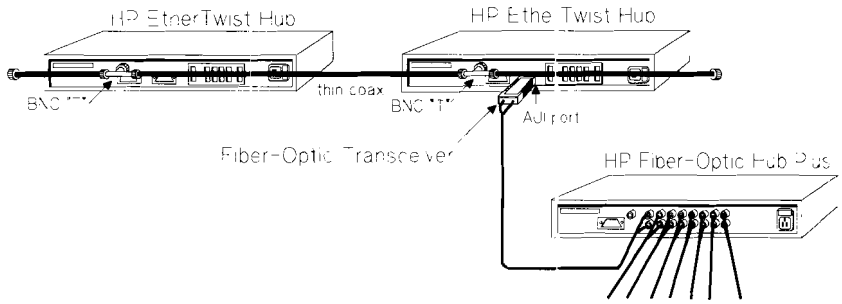
Example H



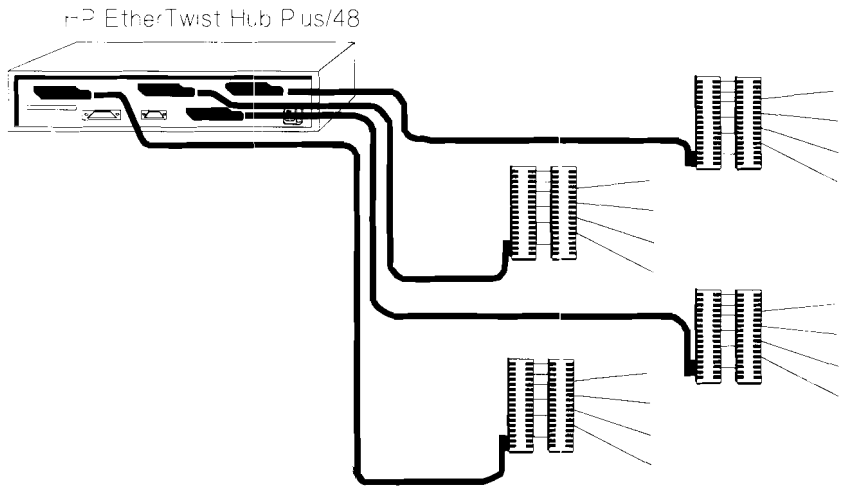
Example I



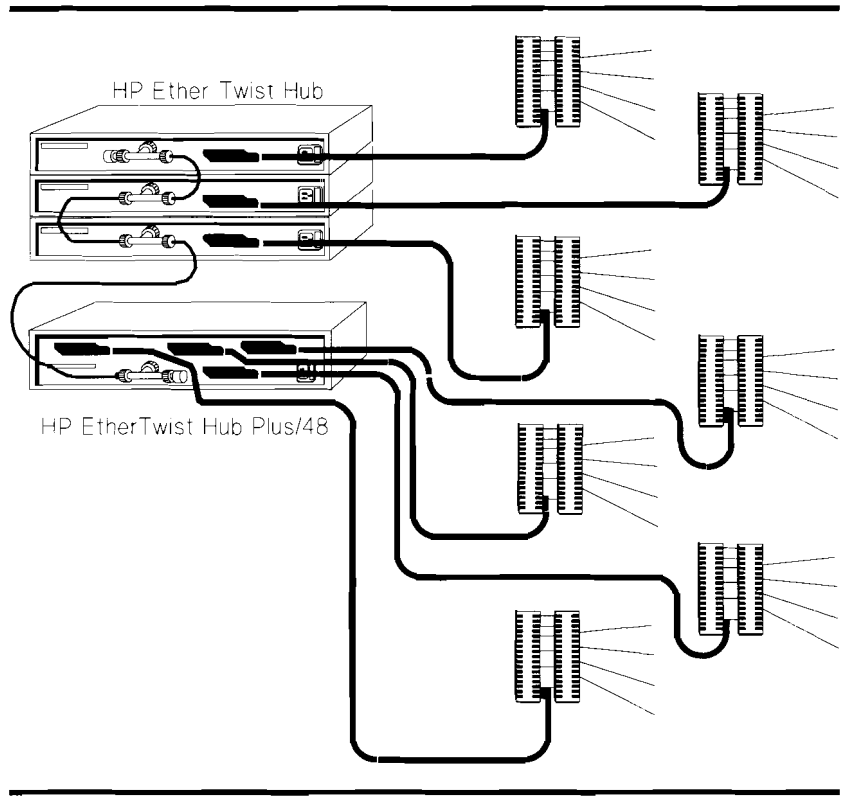
Example J



Example K



Example L

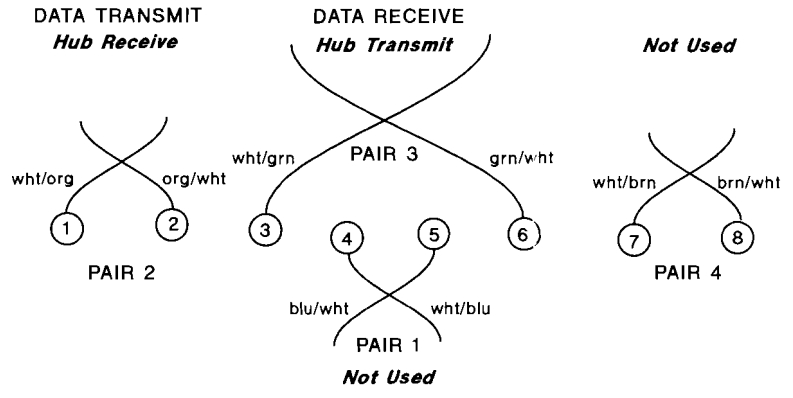


Workgroup LAN Cabling

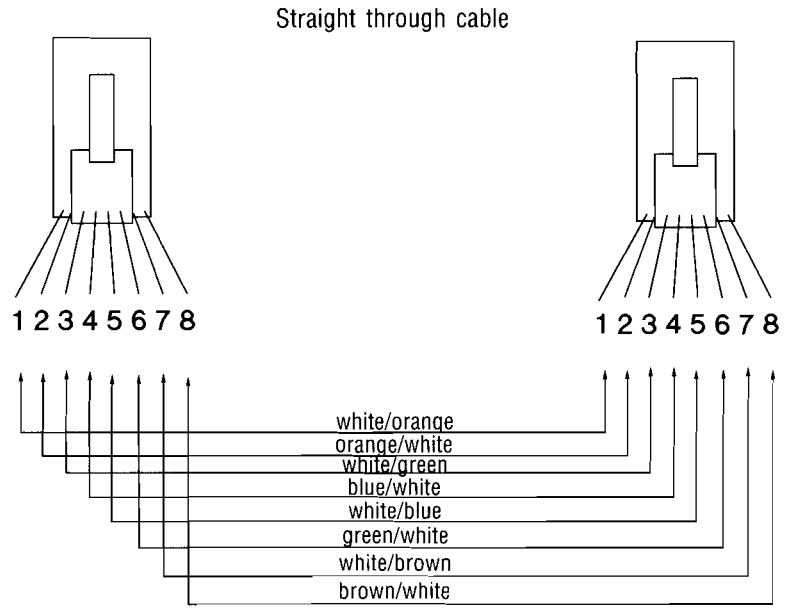
Product Note

Twisted-Pair Cabling Tips

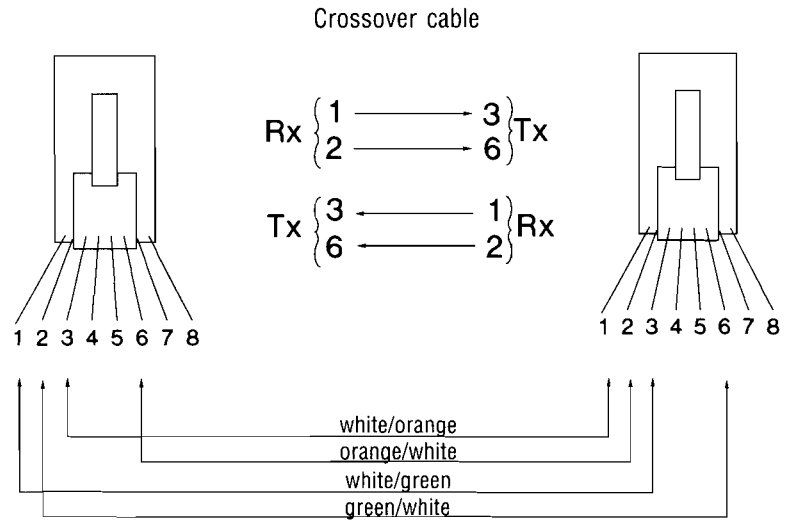
1. Untwisted cable, including flat cable, must not make up any portion of the network cabling.
2. When connecting to cross-connect blocks, keep a pair twisted all the way up to the connecting pins of the cross-connect block. Pairs not kept twisted in this way are susceptible to crosstalk.
3. When making twisted-pair connections, keep conductors of a pair together. Do not form a pair by taking a conductor of one pair and twisting it with a conductor of another pair.



4. For hub-to-EtherTwist transceiver and hub-to-PC connections, cables must be wired "straight through", meaning that a pin at one end connects to a pin with the same number at the other end.



5. For hub-to-hub connections between twisted-pair ports and back-to-back EtherTwist transceiver connections, transmit and receive pairs must be crossed over (not wired "straight through"). A crossover cable, HP part number 92214W, can make the crossover connection.



6. If shielded twisted-pair cable is used, it is recommended that the shield be grounded. The shield should be grounded at the hub end of the cable and make good contact with a grounding post. The workstation end of the shield should be cut back and wrapped with electrical tape or heatshrink tubing. At the hub end of the cable, grounding the shield requires stripping back the cable's jacket and exposing twisted pairs. Unjacketed pairs can form gaps that are susceptible to magnetic fields. Twist the pairs more tightly at these exposed areas to reduce this susceptibility.

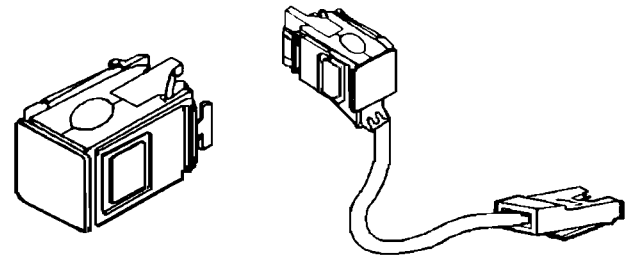
7. Use an 8-position modular jack adapter to terminate some twisted-pair cables with conductors that are too large to fit into 8-pin modular plugs.

8-position modular jack adapter
IBM # 6091030

Receptacle Side Wire Side

8. HP EtherTwist connections to IBM Type 1 or Type 2 (data grade pairs) cable require an adapter. You can make an adapter using a short piece of twisted-pair cable with an 8-pin plug on one end and an IBM data connector (IBM # 8310574) on the other end. You can also purchase an adapter from MOD-TAP System. Remember, for 150-ohm cable (IBM Type 1 and 2) less than 75 meters long, 150-ohm to 100-ohm impedance matching devices must be used. Some 150- to 100-ohm impedance matching devices (transformers) provide the connection from IBM data connector to 8-pin modular connector. (For more details, see the Tested Cables List.)

IBM data connector and adapter cable



Data Connector 8-Pin Modular Plug

MOD-TAP part number	Description
13-328-1	IBM data connector to 8-pin plug
13-318-1	IBM data connector to 8-pin jack

Workgroup LAN Cabling

Product Note

Bundling Different Signal Types in the Same Cable

Laboratory tests were conducted to determine the extent of crosstalk interference produced when HP EtherTwist signals and other signal types run in the same 4-, 25-, 100-, or 200-pair cable bundle.

HP EtherTwist and RS-232

HP EtherTwist and RS-232 signals can run on twisted pairs enclosed in the same cable bundle without interference to either signal type. Combining HP EtherTwist and RS-232 signals in the same cable bundle is supported at the specified RS-232 distance of 50 feet (15 meters).

HP EtherTwist and Phones

HP EtherTwist signals can run in the same cable bundle with telephone signals. Some older analog phone systems may require noise reduction equipment available from a local telephone company. The HP Wire Test Instrument is available to verify that HP EtherTwist will work in your operating environment.

RS-232 and Phones

RS-232 and telephone signals **cannot** share the same cable bundle. RS-232 signals can run in the same cable bundle with telephone signals only if asynchronous data units (ADUs) are used at each end of the RS-232 lines. The ADU allows RS-232 lines to be extended beyond their specified 50 feet and converts the unbalanced RS-232 signal to a balanced signal. RS-232 lines with ADUs can be run 2000 feet at 19.2K baud and 4500 feet at 9600 baud.

HP EtherTwist, Phones, and RS-422

RS-422 signals can run in the same bundle with HP EtherTwist signals and telephone signals. ADUs are not required with RS-422 signals. RS-422 lines can be run 4000 feet. Combining HP EtherTwist signals with RS-422 and telephone signals is supported at the maximum allowed length of HP EtherTwist segments.

HP EtherTwist and Token Ring

HP EtherTwist and Token Ring signals **cannot** share the same cable bundle.

HEWLETT PACKARD

Workgroup LAN Cabling

Product Note

Questions and Answers

Q. Can a 4-pin telephone jack be used with HP EtherTwist Networks?

A. Yes. However, a special cable must be used that has a 4-pin plug on one end and an 8-pin plug on the other end (for attachment to HP EtherTwist hardware). Note that no voice pairs are available. Both pairs are used for data.

Q. Can a 6-pin telephone jack be used with HP EtherTwist Networks?

A. Yes. However, a special cable must be used that has a 6-pin plug on one end and an 8-pin plug on the other end (for attachment to HP EtherTwist hardware). One pair is available for voice. This specially wired 6-pin to 8-pin cable is available from HP as product number 92268S.

Q. Can I use 4-pin or 6-pin modular plugs with HP EtherTwist hardware?

A. No. The HP EtherTwist hardware requires 8-pin modular plugs. However, 2-pair or 3-pair cable can be used since HP EtherTwist uses only two pairs.

Q. Can a 25-pair cable that has a 50-pin connector attach to the hub's 50-pin connector?

A. Yes.

Q. When is the 12-port modular adapter (HP 28638A) used?

A. Use the 12-port modular adapter when you want to connect 2-, 3 -, or 4-pair cables directly to the hub with 8-pin modular plugs. (Note that four of these modular adapters would be required for the HP 28699A Hub Plus/48.)

Workgroup LAN Cabling

Specification Note

Type 10Base2 Cabling

The Type 10Base2 cable is a linear thin coaxial cable (no branches or Y's) that is terminated at both ends by 50-ohm resistors (or terminators). Note that when we say "linear" we mean topologically linear; the physical cable can be laid in a straight line, an L-shape, a U-shape, or any curving line, so long as it doesn't branch.

Type 10Base2 Specifications

Cable type and diameter:	RG-58 A/U or RG-58 C/U coaxial, 0.5 cm diameter
Maximum cable length:	185 m
Maximum number of nodes per LAN segment:	30
Spacing of connections to LAN cable:	minimum 0.5 m apart
Method of attachment to LAN cable:	through HP ThinLAN Transceiver or directly to thin coaxial adapters with BNC "T"
Maximum length of AUI cable:	15 m (thin AUI cab e)

Hardware Specifications

Minimum bend radius:	5 cm (2 in.)
Weight	0.040 kg/m (0.027 lbm/ft)
Diameter (PVC)	4.9 mm (0.19 in)
Diameter (FEP):	4.8 mm (0.19 in)

Environmental Specifications

	PVC Cables	FEP Cables
Storage and operating temperature:	-35° to +60° C	-55° to +200° C
Installation temperature:	-20° to +60° C	-35° to +200° C
Relative humidity:	0 to 100%, occasional condensation permissible	not affected by humidity, condensation, or water splash
Suitable for use in environmental air spaces:	no	yes

PVC versus FEP Cables

Thin coaxial cable is available with two different jacket materials: PVC (polyvinyl chloride) and FEP (flourinated ethylene propylene). PVC is less expensive than FEP and is typically the more frequently used in networks. When you route LAN coaxial cable through environmental air spaces, you should use FEP cable because it is fire-resistant and it is UL approved for environmental air spaces. If you use PVC cable in these spaces, you must run it in metal conduit. Check the local building and electrical codes for exceptions or further specifications on running coaxial cable in environmental air spaces. Local building codes always take precedence when determining which type of coaxial cable you should use.

Grounding

HP recommends that the thin coaxial cable be ungrounded. If your local electrical codes require the thin coaxial cable to be grounded, ground the cable at one (and only one) point. Insulating boots must be used at each network connection (BNC "T" connector, or barrel connector) to ensure that the cable does not become grounded accidentally.

Cable Runs Between Unconnected Buildings

It is not permissible to run thin coaxial cable outdoors between unconnected buildings. If you need to connect thin coaxial cable in two unconnected buildings, you can use a fiber-optic backbone cable for the outdoors cable run and connect it to the thin coaxial cable with HP ThinLAN hubs and a fiber-optic transceiver.

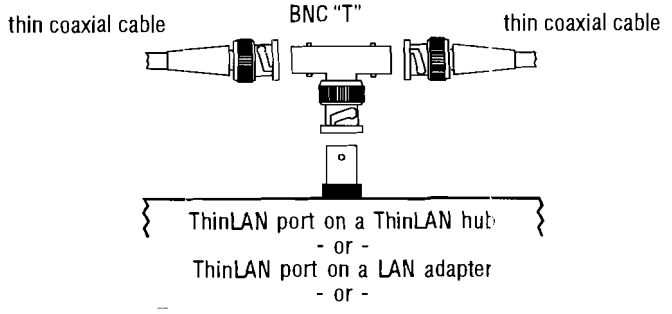
Workgroup LAN Cabling

Product Note

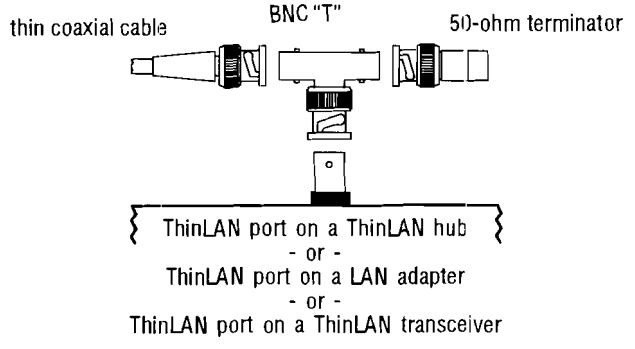
Cable Connections

Connections to thin coaxial cable are made through BNC "T" connectors. These connections can be made directly to the LAN adapter (with a built-in BNC port) that resides inside the computer. The HP 27252A PC LAN Adapter/16 TL Plus has a built-in BNC port and AUI port.

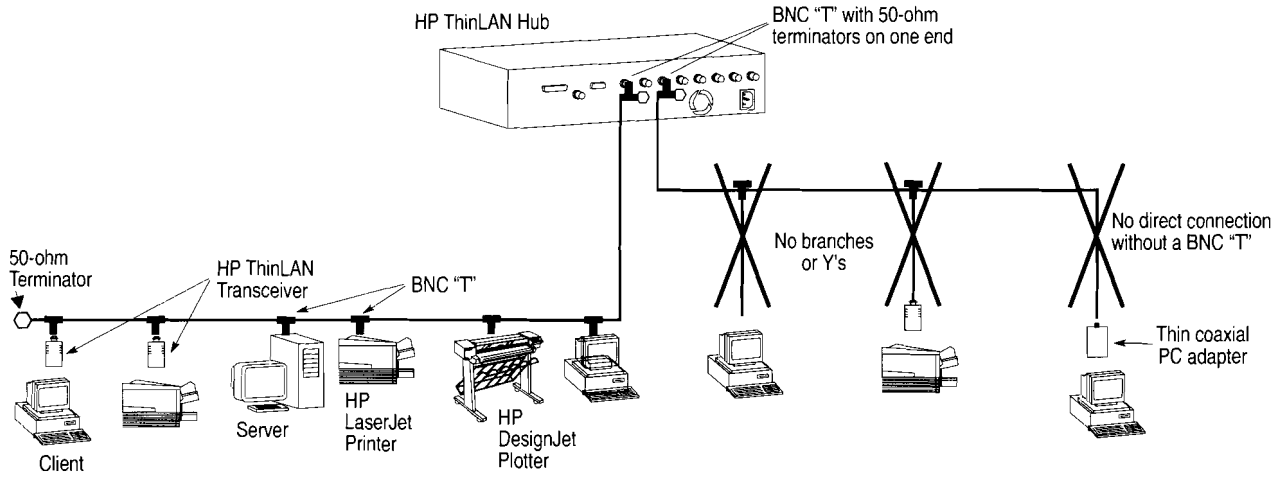
For LAN adapters that don't have a BNC port, but have an AUI port, connection to thin coaxial cable is made through an HP 28641B ThinLAN transceiver. This illustration shows a mid-cable attachment for any ThinLAN port.



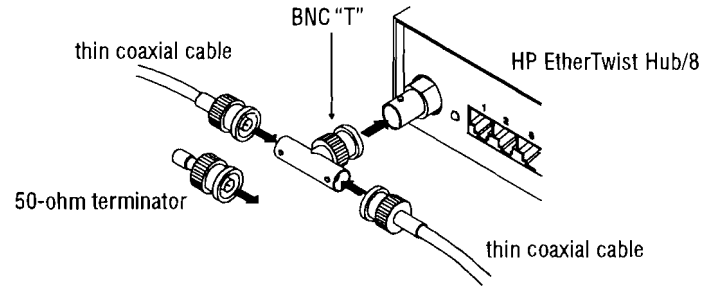
Both ends of every thin coax segment must be terminated with a 50-ohm terminator. This illustration shows the ThinLAN port at the end of a cable segment; the 50-ohm terminator is attached to one side of the BNC "T" connector.



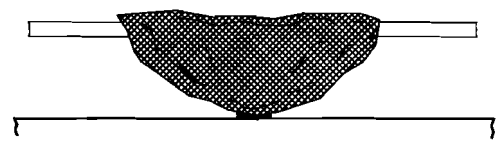
Note that you cannot connect thin coaxial cables directly to a ThinLAN port without using a BNC "T" connector. Also, you cannot create branches off of a thin coaxial segment. The figure below shows the right and wrong ways to connect a network device to thin coaxial cable.



The next illustration shows the thin coaxial cable connections to an HP EtherTwist Hub/8. These connections apply to all HP hubs and bridges that have the built-in BNC port.

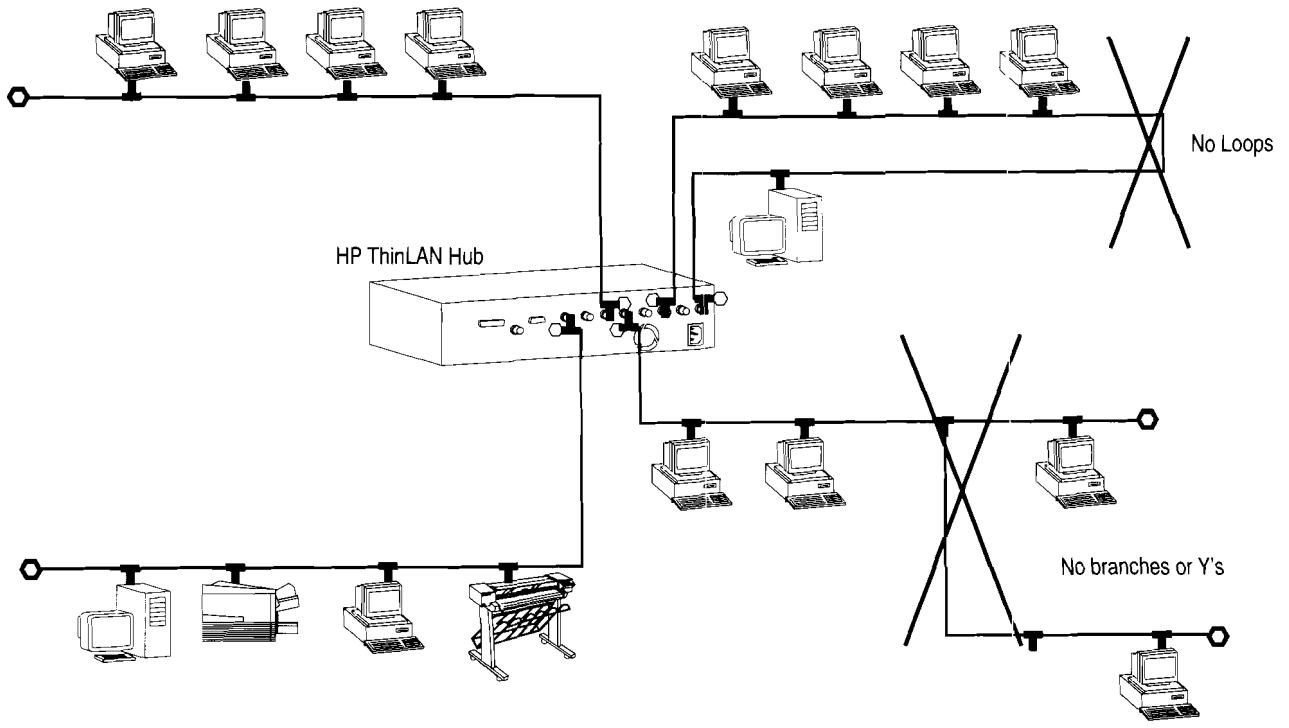


All thin coaxial cable connections should be protected from accidental grounding or from external damage. Use a BNC "T" connector cover around the connection. The cover is made from velcro-like material, so you can squeeze the cover surfaces together around the edges.



Cable Linearity

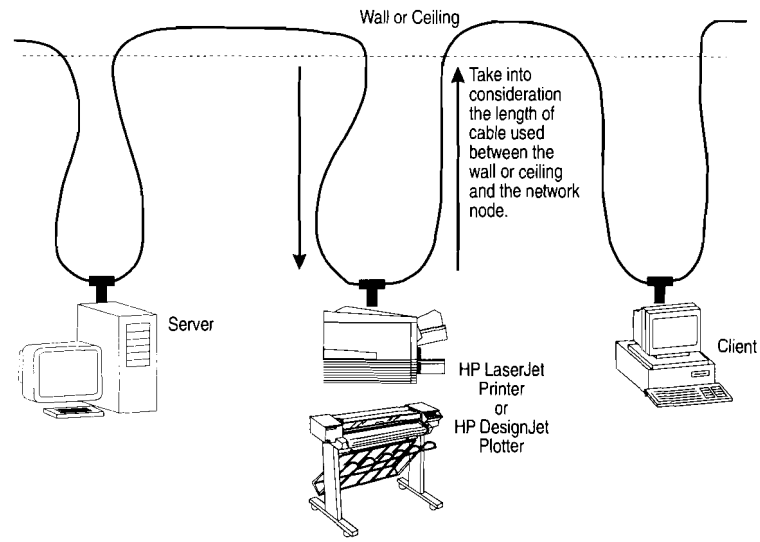
A LAN cable must be linear, with two ends. There must be no branches or Y's in the cable, and the cable segment must not connect back onto itself in a loop. However, if you need redundancy for fault tolerance in your network, you can use the hub's backup link feature or the bridge's spanning tree protocol to support "loops" in your network.



Cable Length Considerations

There are some cable configurations that use up thin coaxial cable more rapidly than you might first anticipate. For example, you may have to run cabling through walls, ceilings, or follow the set path of a cable tray in the floor. Since you must keep thin coaxial segments linear (with branches or Y's), you should account for the extra cable needed to reach desk or work areas when you are calculating cable lengths. The maximum length for a thin coaxial cable segment is 185 meters (approximately 660 feet), with a maximum of 30 network connections per segment.

If your thin coaxial cable is run in a wall or ceiling, remember that the cable length is effectively doubled between the wall (or ceiling) and the computer or network device. That's because the cable must run from the wall to the device and back again.



HEWLETT PACKARD

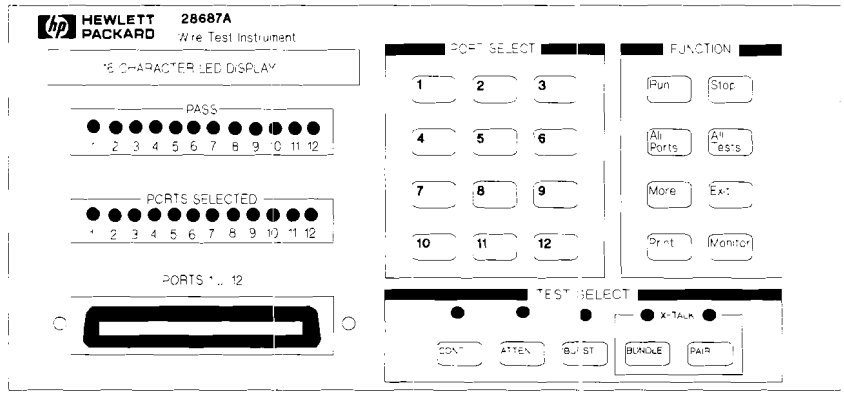
HP Wire Test Instrument

Technical Data

Product Number
HP 28687A

The HP 28687A Wire Test Instrument verifies and troubleshoots twisted-pair cabling for Type 10Base-T networks. It quickly performs the necessary tests to evaluate the key parameters specified by the Type 10Base-T addition to the IEEE 802.3 standard: crosstalk attenuation, signal attenuation at specified frequencies, burst noise, and continuity.

The HP 28687A Wire Test Instrument is a result of HP's commitment and leadership role in the Type 10Base-T arena, as well as HP's experience in the development of high-quality test instruments.



Features

- Tests key parameters for Type 10Base-T networks: crosstalk attenuation, signal attenuation at specified frequencies, burst noise, and continuity. (Crosstalk attenuation and signal attenuation are measured using 5-MHz sine wave, 10-MHz sine wave, and 10-Mbit/s pseudo-random Manchester-encoded data.)
- Evaluates both bundled 25-pair and individual 4-pair twisted-pair cabling.
- Ensures reliability by performing self-test and calibration during power on and recalibrates periodically during use.

- Weighs less than 10 pounds; this portable unit can be easily carried to where you need it.
- The Monitor function lets you take up to a 24-hour look at the cabling for identification of intermittent cabling problems. Data can be printed out as it is collected, or printed and reviewed at the end of the test period.
- The 16-character alphanumeric display steps you through the test procedures and provides you with diagnostic information on each test performed for each twisted-pair.
- Prints out a hard copy of your test results by connecting to any printer that supports the standard RS-232 interface.
- Easy-to-read LEDs indicate which pairs you have selected for testing, which tests you have selected, and which pairs passed or failed.
- For quick wiring connections, the HP 28687A has a built-in 50-pin Telco connector and comes bundled with a 12-port modular adapter for 8-pin jack connections

Functional Description

Complete Testing of Type 10Base-T Cable

Twisted-pair cable, unlike coaxial cable, allows for variations in physical characteristics and has dynamic performance requirements such as crosstalk, signal attenuation, and installation-dependent specifications. Tools developed for the telephone industry are not specialized to test for these specification requirements. The HP 28687A Wire Test Instrument can quickly identify problems in these areas. Designed specifically to verify compliance with the Type 10Base-T standard, the HP 28687A Wire Test Instrument lets you easily verify and troubleshoot twisted-pair LAN cabling.

Easy to Use

This lightweight portable unit saves time by simplifying the complex task of testing twisted-pair cabling. Individual tests or combinations of tests can be run—5 LEDs indicate which tests you have selected. Up to 24 pairs (12 ports) can be tested simultaneously—LEDs indicate which pairs you have selected. The alphanumeric display steps you through the test procedures and gives you complete diagnostic information when you want it. An RS-232 printer port also allows you to print a hard copy of the results. Twelve green LEDs indicate whether the pairs have passed or failed the test(s). Intermittent cabling problems can be identified by pushing the MONITOR button, which performs the selected tests for up to 24 hours.

Troubleshooting and Verification

Network downtime is expensive. While the costs of a downed network cannot always be quantified, daily business depends on a functional network. With the HP 28687A Wire Test Instrument, cable problems can be easily and quickly identified.

To avoid intermittent problems and performance degradation problems, both new and in-place twisted-pair cabling should be evaluated prior to use as LAN media. The HP 28687A Wire Test Instrument verifies the suitability of in-place twisted-pair cable for your Type 10Base-T application before you install your network.

Functional Specifications

Electrical Specifications

Voltage (ac) RMS	Maximum Current RMS	Maximum Power	Frequency Range
100–120 volts	0.5 amp	30 watts	50/60 Hz
200–240 volts	0.3 amp	30 watts	50/60 Hz

Maximum Input Voltage:

Common Mode: 500 volts

Differential Mode: 24 Volts @ f ≤ 60 Hz, 1.5 Volts @ f > 60 Hz

Measurement Specifications

	Measurement Range	Accuracy	Resolution
Signal Attenuation	0–15 dB	± 0.5 dB	0.1 dB
Crosstalk Attenuation	0–36 dB	± 1.0 dB	0.1 dB
Burst Noise	232 mV minimum	± 32 mV	

Measurement made through a 3-pole Butterworth low-pass filter with a 3-dB cut off at 15 MHz.

Accuracy specified at 100-ohm line impedance.

Source Characteristics:

Frequency Range	5-MHz sine wave, 10-MHz sine wave, 10-Mbit/s pseudo-random Manchester-encoded data
Output Level Range	1.25 volts peak ± 250 mV
Impedance	100 ohms ± 10 ohms
Output Connector	50-pin Telco connector

Receiver Characteristics:

Frequency Range	5 MHz to 15 MHz
Input Level Range	20 mV peak to 1.5 volts peak
Impedance	100 ohms ± 10 ohms
Input Connector	50-pin Telco connector

Physical Specifications

Dimensions:

Width:	27.9 cm (11.0 in.)
Depth:	34.3 cm (13.5 in.)
Height:	15.9 cm (6.3 in.)
Weight:	4.1 kg (9.0 lb)

Environmental Specifications

Environment Temperature

Operating: 0°C to +55°C (32°F to 131°F)

Nonoperating: -40°C to 70°C (-40°F to 158°F)

Relative Humidity
Operating: 5% to 95% at 40°C (104°F) noncondensing
Nonoperating: 5% to 90% at 65°C (149°F) noncondensing

Altitude
Operating: 0-4.6 km (15,000 ft)
Nonoperating: 0-15.3 km (50,000 ft)

Approvals

RFI (Radio Frequency Interference): FCC Class A, FTZ-1046/84 (level B), CISPR-22 Class A, VCCI Class 1

Safety: CSA C22.2-220 for ITE. Compliance with UL 478, UL 1244 and IEC 348.

Ordering Information

The HP 28687A Wire Test Instrument includes a Wire Test instrument, an operating manual, 12 loopback hoods, one 12-port modular adapter, one test results pad and a power cord.

Warranty

The HP 28687A Wire Test Instrument is warranted for 1 year against defects. Check with your local Hewlett-Packard Sales and Support Office for more information.

HEWLETT PACKARD

HP Wire Test Instrument

Product Note

Testing and Troubleshooting Twisted-Pair Cable

When to Test Cable

The purpose of the HP 28687A Wire Test Instrument is to verify that twisted-pair cable meets the key cable specifications of the Type 10Base-T addition to the IEEE 802.3 standard. This instrument measures crosstalk attenuation, signal attenuation, and burst noise, and detects continuity faults.

Twisted-pair cable should be tested when it is newly installed. Testing will verify that suitable cable has been properly installed. Sometimes poor-quality cable is substituted and installed; then, when the customer starts up his or her network for the first time there are problems. Testing the cable prior to starting up the network can save time, money, and frustration for the customer.

Twisted-pair cable should be tested when it is part of an existing cabling system. Taking advantage of cable that is already in place can be a major savings in the overall cost of the network. However, good records of the existing cabling system are rarely available. The cable type and length of installed cable is often unknown. Testing with the HP 28687A Wire Test Instrument will verify the suitability of the cable for a Type 10Base-T network and identify any opens, shorts, or miswires in the existing cabling system. Testing the cable with the wire test instrument assures you and your customer that the cable is good.

Twisted-pair cable should be tested as part of the troubleshooting procedure when isolating faults in a network. Being able to quickly identify or eliminate the cable as being faulty can greatly reduce network down time. Whenever you call Hewlett-Packard for assistance in troubleshooting a network failure, you may be asked to provide measurement information on key parameters of the twisted-pair cabling. The HP 28687A Wire Test Instrument will provide you with this information.

Tips for Testing Twisted-Pair Cable

Test twisted-pair cable using the HP 28687A Wire Test Instrument.

Test twisted-pair cable from **end to end**. Test cable from the end that attaches to the hub to the other end that attaches to the transceiver or interface card in the PC. Testing only portions of this entire length is an **incomplete** test of the cable and will provide inaccurate test results.

All pairs that will be used in a Type 10Base-T network must be tested in the configuration in which they will be used.

Run all of the tests—crosstalk, attenuation, burst noise, and continuity—on the twisted-pair cabling. Running a subset of these tests does not provide a complete test of the cable.

When running the attenuation and continuity tests, attach the "CONT, ATTEN, BURST" side of the loopback hood to the far end of the cable.

Run the crosstalk test from both ends of the cable. All other tests can be run from the telecommunications closet end (hub end) of the cable. If the crosstalk test is not run from both ends of the cable, some cable failures will go undetected.

When running crosstalk tests, do not place loopback connectors on the far end of the cable. Leave the cable open. (Note that an unconnected IBM data connector will short transmit to receive.)

Always run the pair crosstalk test from the work-area end of the cable. In addition, run the pair crosstalk test from the hub end any time there are **no** 25-pair cables in the path from hub to PC.

Run the bundle crosstalk test from the hub end whenever there are 25-pair cables anywhere in the path from hub to PC.

If it is not known whether or not there is a 25-pair cable in the path from hub to PC, run the pair crosstalk test.

When running the bundle crosstalk test, be sure to include all 24 pairs of a 25-pair bundle in the test. (The Wire Test Instrument can test up to 24 pairs at one time.)

Troubleshooting Twisted-Pair Cable Failures

Things to check that can cause crosstalk failures:

- **Untwisted cable.** Untwisted cable can be flat cable or round cable. Flat cable is easily identified by its appearance and is often found between the wall jack and PC. Round untwisted cable can be identified by stripping off about 2 feet of the outer sheath and checking the pairs for twists. There should be at least 2 twists per foot.
- **Split pairs.** A split pair is one conductor of one pair paired with one conductor of another pair.
- **Untwisted pairs close to cross-connect block connections.** Twisted-pair cable should be twisted all the way up to the connecting pins of the cross-connect block.
- **Transmit pair shorted to receive pair.** If a loopback connector (that connects transmit to receive) is attached to one end of the cable, the crosstalk test will fail. When testing an IBM cabling system, remember that an unconnected IBM data connector will short transmit to receive.

- **Retest crosstalk with pairs terminated.** Attach the XTALK side of the loopback connector to the far end of the cable. This side of the loopback connector terminates the transmit and receive pairs with 100 ohms. If the cable fails this test it cannot be used in the network. If the terminated cable passes the crosstalk test but fails the crosstalk test when not terminated, it can be used in the network. The crosstalk test on unterminated cable is a worst-case test.
- **Poor-quality cable.** Some cables are not designed to transmit high-speed data.

Things to check that can cause signal attenuation failures:

- **Conductors of a twisted pair separated.** Sometimes the pairs of unsheathed cable (used for connections between cross-connect blocks) separate too much (more than a centimeter). This separation will change the impedance of the pair and can cause the attenuation test to fail.
- **Too many cross-connect blocks in the path.** Four cross-connect blocks is the recommended maximum. Cross-connect blocks can induce signal reflections that can cause attenuation test failures.
- **Ambient temperature.** The attenuation of PVC-insulated cable is temperature dependent. At temperatures greater than 40°C (104°F) signal attenuation increases.
- **Cable length.** Cable that is too long will fail attenuation tests. Typical telephone cable can be 100 meters long. Some high-performance cables can run longer than 100 meters before the signal attenuation becomes too great.
- **Loading coils or RC filter networks attached to the cable.**
- **Poor-quality cable.** Some cable is not designed for high-speed data transmission.

Things to check that can cause burst noise failures:

- **Noisy environment.** When cable runs in electrically noisy environments (near big electric motors for example) burst noise will be detected. The noise source must be removed or the cable re-routed.
- **Any cables that fail the burst noise test should be monitored for several hours.** The HP 28687A Wire Test Instrument has the capability to monitor burst noise on a cable for up to 24 hours. Monitoring burst noise will show periods throughout the day where noise is present. If burst noise is high for a short time only once a day, it may be tolerable. If burst noise in a cable is present frequently throughout the day, that cable should not be used in the network.

Things to check when continuity failures are reported:

- **16-character display on the HP 28687A Wire Test Instrument.** When a cable fails continuity, the instrument's display will tell you exactly what the failure is. It will report which pins are shorted, opened, or miswired.
- **Fix the reported error and retest continuity.**

HEWLETT PACKARD

HP Wire Test Instrument

Product Note

Questions and Answers

Q. When using the HP 28687A instrument to test installed cable, must the crosstalk test be run from both ends of the cable?

A. Yes. If this test is not run from both ends, some cable faults may go undetected.

Q. When using the HP 28687A instrument to test installed cable, must all of the tests be run from both ends of the cable?

A. No, only the crosstalk test must be run from both ends.

Q. Must a loopback connector be attached to the other end of the cable when the burst noise test is run?

A. No. The burst noise test can be run with or without a loopback connector attached.

Q. What symptoms will be seen on the network if burst noise is present in a twisted-pair cable?

A. Data corruption, retransmissions, and collisions.

Q. How can I get an HP 28687A Wire Test Instrument?

A. Contact your local HP sales office for assistance in placing an order.

Q. What comes with the HP 28687A Wire Test Instrument?

A. The instrument is shipped with one 12-port modular adapter (HP 28638A), 12 loopback connectors (part number 28687-63003), an operating manual, a results table pad, and power cord.

Q. Does the HP 28687A Wire Test Instrument test for all of the Type 10Base-T cable specifications?

A. No, all the cable specifications are not tested. However, the specifications that are important in determining whether or not the cable will operate in a Type 10Base-T network are tested.

HEWLETT PACKARD

HP Wire Test Instrument

Product Note

HP 28687A
Quick Reference Guide

Part I. Run Tests in Telecommunications Closet:

1. Turn on the instrument.
2. Connect cable(s).
3. Push PAIR for X-TALK test or BUNDLE if testing 25-pair cable.
4. Push PORT SELECT button(s) (1 ... 12) or ALL PORTS.
5. Push RUN (push STOP to stop test).
6. Read results: PASS LEDs, MORE, or PRINT.
7. Connect loopback hood(s) (in work area).
8. Push CONT, ATTEN, BURST or ALL TESTS.
9. Push RUN (push STOP to stop test).
10. Read results: PASS LEDs, MORE, or PRINT.
11. Disconnect cable(s), loopback hood(s), turn off instrument.
12. To complete testing, go to work-area ends.

Part II. Run PAIR test at work-area ends:

13. Turn on the instrument.
14. Connect cable.
15. Push PAIR for X-TALK test.
16. Push PORT SELECT button(s) (1 ... 12).
17. Push RUN (push STOP to stop test).
18. Read results: PASS LEDs, MORE, PRINT.
19. Disconnect cable(s), connect next cables, and repeat steps 15 through 18 until all pairs are tested.

Technical Reference Guide

Site LANs

- **Introduction**
- **HP Hubs**
- **HP Bridges**
- **Site LAN Design**
- **Site LAN Cabling**

LAN Products

Introduction

Site LANs

A site LAN is a collection of several different workgroup LANs. The workgroup LANs that are joined in a site LAN are usually in the same geographical location (for example, the same building or campus). Within a site LAN, members of different workgroup LANs can communicate with each other. The workgroup LANs in a site LAN are joined by a backbone. The backbone can be housed within a single building or between several closely located buildings on a campus.

The recommended cabling for the site LAN is the fiber-optic backbone. Since fiber-optic cabling provides noise immunity and longer distances than thin coaxial cabling, it is the preferred cabling for the site LAN. Hewlett-Packard provides fiber-optic products that are compatible with the IEEE 802.3 FOIRL (FIber-Optic Inter-Repeater Link) extension.

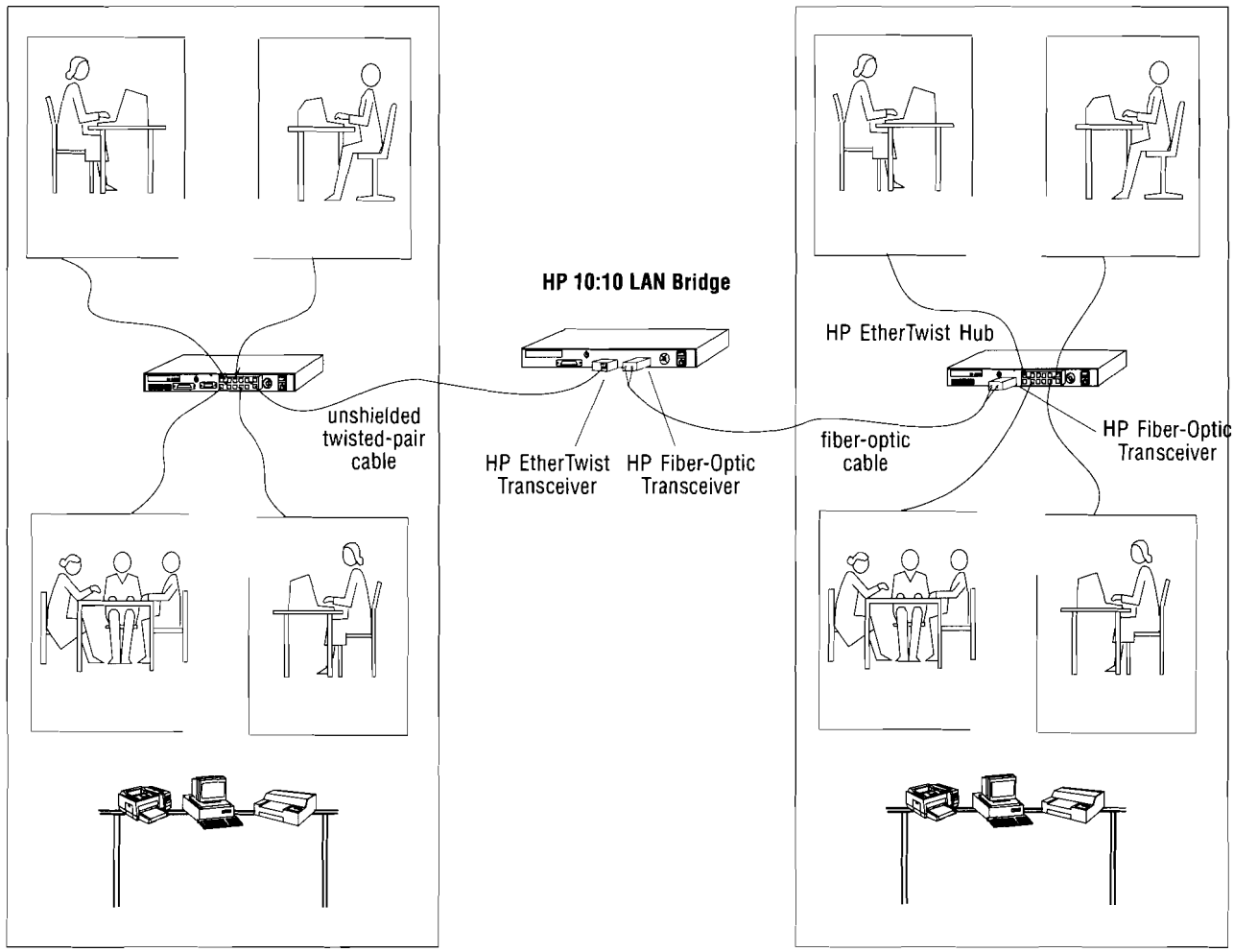
Smaller site LANs can use existing installed thin coaxial backbones. Since it is not permissible to run thin coaxial cable outdoors between unconnected buildings, a thin coaxial backbone should be confined within a building. If you need to connect thin coaxial backbones in two unconnected buildings, you can use a fiber-optic backbone for the outdoor cable run.

Routers may also be used in site LANs to connect subnetworks within a building or campus. For example, if you have subnetworks that use different media types and network layer protocols (such as TCP/IP, IPX, or DECnet), routers can be used in the site LAN. For information on HP routers, please refer to the Multisite LAN section of this document.

The HP EtherTwist products covered in the Site LAN section are:

Hubs. Hubs form the network by providing the physical connections for all nodes (such as computers, peripherals, other hubs, bridges and routers) connected on the LAN. The hub discussed in the Site LAN section is the HP Fiber-Optic Hub Plus.

Bridges. Bridges can isolate network traffic between workgroup LANs. That is, a bridge can forward and filter packets from users on the LANs it connects. This helps to improve overall network performance. Bridges also extend networks beyond their topological limits. For example, a bridge allows you to add hubs, and additional cable lengths to an existing network to extend it beyond its maximum (physical) topology. The two bridges discussed in this section are the HP 28681A 10:10 LAN Bridge LB and the HP 28673A 10:10 LAN Bridge MB. Both bridges are two-port bridges for connection (or isolation) of two separate networks. The "LB" bridge is a low-cost learning bridge. The "MB" bridge (also a learning bridge) includes support of the IEEE 802.1 Spanning Tree Protocol for redundant paths, and SNMP network management.



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HP Fiber-Optic Hub Plus

Technical Data

HP 28682A

Using the same form factor as the HP EtherTwist hubs, the HP 28682A Fiber-Optic Hub Plus adds more functionality to the HP modular, "rack-and-stack" family. The HP Fiber-Optic Hub Plus is a multiport, fiber-optic repeater for use in Ethernet and IEEE 802.3 local area networks. This "plug-and-play" 8-port hub gives you a fully manageable, scalable, and flexible networking solution for 10-Mbit/s fiber-optic connections. It provides backbone connections to other network devices as well as direct connections to computers. The HP Fiber-Optic Hub Plus complies with the IEEE 802.3 FOIRL standard for fiber-optic inter-repeater links.

The Fiber-Optic Hub Plus includes agent firmware to support network management via SNMP/IP and SNMP/IPX and a console (RS-232) port for out-of-band network management.

In addition, the agent firmware incorporates HP EASE (Embedded Advanced Sampling Environment), an embedded instrument technology that allows the hub to perform trend analysis functions. When used with HP OpenView Resource Manager/DOS (HP 27257D), the Fiber-Optic Hub can identify top talkers, heavy users, error sources, and communication pairs on your network.

Highlights

☆ **Full Management Control**
Configure, monitor, and control your HP hubs over the LAN with the graphical, full-featured HP OpenView Hub Manager/DOS (HP 28686D) or Interconnect Manager/DOS (HP 27256D). With its SNMP/IP and SNMP/IPX agent firmware, the HP Fiber-Optic Hub Plus can be controlled from a single DOS management station on the network or remotely controlled via out-of-band network management.

☆ **Industry-Standard Compatibility**
The HP Fiber-Optic Hub Plus supports the IEEE 802.3 FOIRL standard so it can be easily integrated into existing Ethernet and 802.3 networks.

☆ **Maximum Reliability through Diagnostics and Fault Isolation**
To ensure your network integrity for critical backbone applications, the HP Fiber-Optic Hub Plus automatically identifies any segment disturbing the network and disconnects it from the rest of the network. When the problem is resolved, the hub automatically reconnects the segment. Status LEDs help you troubleshoot your network.

☆ **Backup Links for Fault Tolerance**
HP Hub Pluses, including the HP 28688B EtherTwist Hub Plus, HP 28699A EtherTwist Hub Plus/48, HP 28692A ThinLAN Hub Plus, and the HP 28682A Fiber-Optic Hub Plus, can support a single backup link between any two hubs. This provides network fault tolerance at the hardware level. A backup link is a separate cable installed between two hubs. Using the hub's console port, simply configure the primary link and backup link to a single hub. The backup link automatically becomes enabled when the primary connection between the two hubs fails. See the "Backup Link on HP Hubs for Fault Tolerance" Product Note (located in the Advanced Topics section) for more information.

Features

- Provides eight fiber-optic ports using ST connectors, one BNC port, and one AUI port. The BNC and AUI ports allow simultaneous connection to thin coaxial cable and (via transceiver) thick coaxial, fiber-optic, or twisted-pair cable.
- Can operate as a nine-port fiber-optic hub when a fiber-optic transceiver (HP 28683A) is attached to the AUI port. For larger networks, multiple hubs can be multi-dropped from thin coaxial cable or cascaded via fiber-optic cable to easily increase the port count.
- Supports one redundant link per hub to provide backup connections.
- Is compatible with IEEE 802.3 FOIRL standard.
- Supports 10-Mbit/s link speed.
- Supports both 62.5/125-µm and 50/125-µm optical fiber.
- Supports 1 km of fiber-optic cable. Greater distances are possible depending on network configuration.
- Supports both IEEE 802.3 and Ethernet networks.
- Isolates network faults by automatically segmenting ports disturbing the network.
- Includes LEDs for a quick visual check of port status, collisions, activity, and power.
- Provides console (RS-232) port, which allows users to read network statistics and configure ports in the hub. This port connects to a terminal or terminal emulator either directly or via modem.
- Includes diagnostics for checking port functionality and loopback test for troubleshooting cable problems.
- Is transparent to network operating system software.
- Follows simple design rules for maximum topological flexibility.
- Supports SNMP/IP- and SNMP/IPX-based network management. Specifically, the hub can be managed from a centralized network management station on the LAN using HP OpenView Hub Manager/DOS (HP 28686D) or HP OpenView Interconnect Manager/DOS (HP 27256D).
- Mounts in a standard 19-inch rack (with cables facing front or back), on a wall (flat or on end), or on any horizontal surface like a shelf or table. Since the hub is only 1.75 inches high (one rack space), it takes up very little space in any mounting configuration.

Specifications

Optical Characteristics

Optical Characteristics	62.5/125-µm Fiber	50/125-µm Fiber
Wavelength:	820 nm	820 nm
Budget:	10 dB transmitter	6 dB transmitter
Power:	12 dBm typical 17 dBm minimum	16.5 dBm typical 21 dBm minimum
Receiver sensitivity:	30 dBm typical 27 dBm minimum	30 dBm typical 27 dBm minimum

Environmental Characteristics

Operating Temperature: 0°C to 55°C (32°F to 131°F)

Relative Humidity: 15% to 95% @ 40°C (104°F) noncondensing

Physical Characteristics

Dimensions: 42.6 cm by 23.5 cm by 4.4 cm (16.8 in. by 9.3 in by 1.7 in.)

Weight: 2.7 kg (6.0 lbs)

Electrical Characteristics

Voltage:	100-120 V ac	200-240 V ac
Current:	0.5 A max	0.4 A max
Frequency:	50/60 Hz	50/60 Hz

The HP Fiber-Optic Hub Plus automatically adjusts to any voltage from 90 to 240 volts.

Standards

Communications:
IEEE 802.3 FOIRL
IEEE 802.3 Type 10Base2

Safety:
UL 1950
CSA 220
CSA 950
Verified to IEC 950 / EN 60950

Emissions:
FCC Part 15 Class A
CISPR-22 (1985) Class A
EN 55022 (1988) Class A
VCCI Class 1
FTZ 1046/84 (VDE Level B)

Immunity:

ESD
IEC 801-2: 1991 3 kV CD, 8 kV AD
prEN 55101-2: 1990

Radiated Emissions:
IEC 801-3: 1984 3 V/m
prEN 55024-3: 1991

Warranty

The HP 28682A Fiber-Optic Hub Plus is warranted for one year against defects.

HP Fiber-Optic Hub Plus

Product Note

Questions and Answers

General

Q. When should I use the fiber-optic hub?

A. Since the HP Fiber-Optic Hub Plus provides eight fiber-optic connections, you can use it to create a large fiber-optic backbone. Use the fiber-optic hub to connect up to eight separate workgroup LANs between buildings in a campus setting or within a building. To get a ninth fiber-optic connection, attach a fiber-optic transceiver (HP 28683A) to the fiber-optic hub's AUI port.

Q. Can I use the fiber-optic hub to connect workstations using fiber-optic cable?

A. Yes. Your workstations or any computer system must have a network adapter card with an AUI connector. Attach the HP Fiber-Optic Transceiver (HP 28683A) to the AUI connector and run a fiber-optic cable from the transceiver to the hub.

Q. What is the low-light LED used for?

A. The low-light LED will turn on when light is being received by the fiber-optic hub's port(s). The LED is off if there is no connection (no light), or if there is a problem with the fiber-optic cable or fiber-optic port.

Q. How does the hub store configuration data?

A. The configuration data is stored in EEPROM. The network management code (software) is stored in flash EEPROM.

Console Port Configuration

Q. What is Thinwatch for and when should I use it?

A. The purpose of Thinwatch is to monitor the ThinLAN (BNC) port connection. Thinwatch causes the Fault LED and port LED to flash when the fiber-optic hub's ThinLAN port becomes segmented. If the ThinLAN port is to be unused, you should disable the Thinwatch function so that the Fault LED does not blink. The hubs are shipped (from the factory) with Thinwatch disabled. Thinwatch has no effect on the AUI port or the fiber-optic ports of the hub.

Q. Do I need to set the IP configuration parameters on my fiber-optic hub if I'm using Novell NetWare?

A. No. If you plan to use HP OpenView network management to manage your hubs and you are using Novell NetWare, it is not necessary for you to set the IP configuration parameters on your hubs. The HP OpenView Interconnect Manager/DOS (HP 27256D) and HP OpenView Hub Manager/DOS (HP 28686D) and the HP hubs (except the Hub/8) support IPX communications.

If you are not using Novell NetWare software, you must set the IP configuration parameters on your hubs if you wish to manage your hubs with HP OpenView network management software using IP communications.

Q. How do I set the IP configuration parameters on my Hub Plus?

A. To set the IP configuration parameters, you must attach a terminal or terminal emulator to the hub's console port. Once a console port session is established, then use the IP command to set the IP address for your hub.

Hub Ports

Q. Do I have to disable hub ports that are not in use?

A. No. You may leave unused fiber-optic ports enabled. The ports are automatically segmented if no fiber-optic connection is made. When a connection is made, the ports automatically become active with no need to use network management or the console port commands to enable them. However, if you are concerned with security and do not want anyone to attach to your backbone, you may disable unused fiber-optic ports.

Q. Is the AUI port compatible with AUI slide-latch connectors?

A. All HP hubs include an AUI retainer (part number 5062-3351) instead of an AUI slide-latch connector. The retainer replaces the slide-latch connector and is used to securely fasten any transceiver to the hub's AUI port.

Q. Can I use both the AUI and BNC connectors at the same time on the hub?

A. Yes, you can use all hub ports at the same time. Since the HP Fiber-Optic Hub Plus is a multiport repeater, all of its connections are active. Data signals coming into the hub from any of its ports are automatically repeated to all the other hub ports.

Q. If I don't plan to use the ThinLAN (BNC) port, what will happen if I don't terminate it?

A. The hub is shipped (by default) with all ports enabled. If you don't have anything connected to the ThinLAN port, then this port will auto-segment. If Thinwatch is on, then the Fault LED for the ThinLAN port will be flashing. Since this port is not terminated, it is auto-segmented because of excessive collisions. This does not affect the rest of the hub.

Auto-Segmentation

Q. Which ports will auto-segment?

A. All of the hub's ports (excluding the RS-232 console port) may be auto-segmented. This includes all fiber-optic ports, the AUI port, and the ThinLAN (BNC) port.

Q. What causes the hub to auto-segment a fiber-optic port?

A. When the hub detects excessive collisions (greater than 30 consecutive collisions), the hub will auto-segment the port. The corresponding port LED and Fault LED will flash when this happens.

Q. What causes the hub to auto-segment the AUI or ThinLAN (BNC) port?

A. Auto-segmentation of these ports is caused by excessive collisions (greater than 30 consecutive collisions). Auto-segmentation can be caused by improper termination of the thin coaxial cabling, or if nothing is attached to the ThinLAN port and the port is enabled.

Connecting Hubs in the Network

Q. How can I connect fiber-optic hubs together?

A. Here are five different ways to connect fiber-optic hubs:

1. Use fiber-optic cable between any fiber-optic ports.
2. Connect two or more hubs to the same thin coaxial backbone using the BNC port on each hub. Use at least 0.5 meters of coaxial cable between adjacent hubs.
3. Connect fiber-optic cabling between two hubs, via a fiber-optic transceiver (HP 28683A) attached to the AUI port on each hub.
4. Connect thin coaxial cabling between two hubs, via a thin coaxial transceiver (HP 28641B) attached to the AUI port on each hub.
5. Connect twisted-pair cabling between two hubs, via a twisted-pair transceiver (HP 28685B) attached to the AUI port on each hub.

Q. How can I connect EtherTwist hubs to my fiber-optic hubs using fiber-optic cabling?

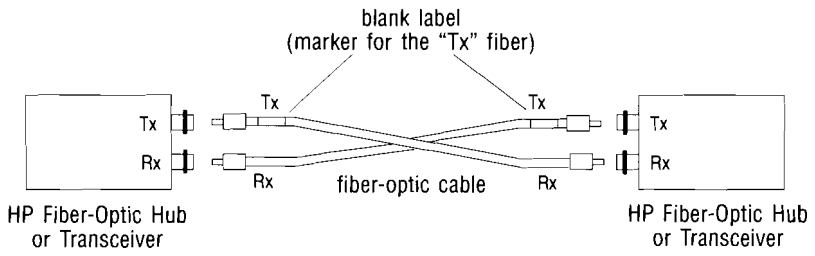
A. Attach a fiber-optic transceiver (HP 28683A) to the EtherTwist hub's AUI port. Connect the EtherTwist hub to a fiber-optic hub via fiber-optic cable.

Q. Do I need to reverse "Tx" and "Rx" with fiber-optic cables?

A. Fiber-optic cabling may be labeled "Tx" and "Rx" at both ends of the cable. If there's a blank label on just one of the two fibers, as shown on the next page, this is a marker for the "Tx" fiber. The "Tx" fiber is connected to the "Tx"port (of the fiber-optic hub or transceiver). Similarly the "Rx" fiber is connected to the "Rx" port (of a hub or transceiver). Use this convention at both ends of the cable.

Q. What happens if I accidentally connect the "Tx" port of one hub to the "Tx" port of another hub?

A. No damage will occur. However, the Port LED will be off. This indicates that no communication is occurring on this port.



HP Fiber-Optic Hub Plus

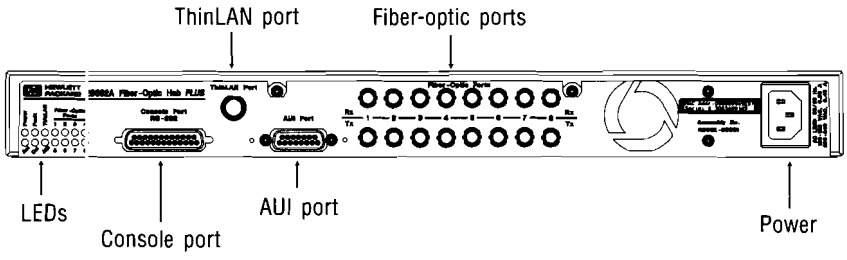
Installation Steps

HP 28682A Fiber-Optic Hub Plus

Mount and plug in.

1. Make sure the hub's power cord is correct for your country's power receptacle.
2. Mount the hub on a wall or table, or in a rack.
3. Attach the power cord to hub and plug it into an electrical outlet.
4. Check LEDs on the back:
   - All the LEDs should go ON momentarily.
   - The Power LED should stay ON.
   - The Fault LED should go OFF.
   - Disregard the other LEDs for now.

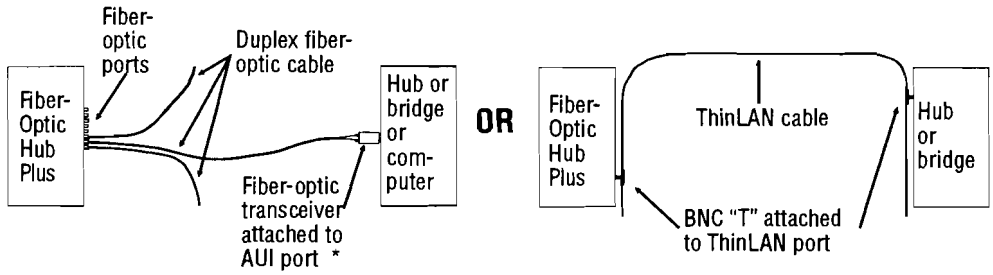
   If the LEDs are different, the hub may be faulty.



Back of the Hub

For more installation details, see the *HP Fiber-Optic Hub Plus Installation and Reference Guide*, part number 28682-90001.

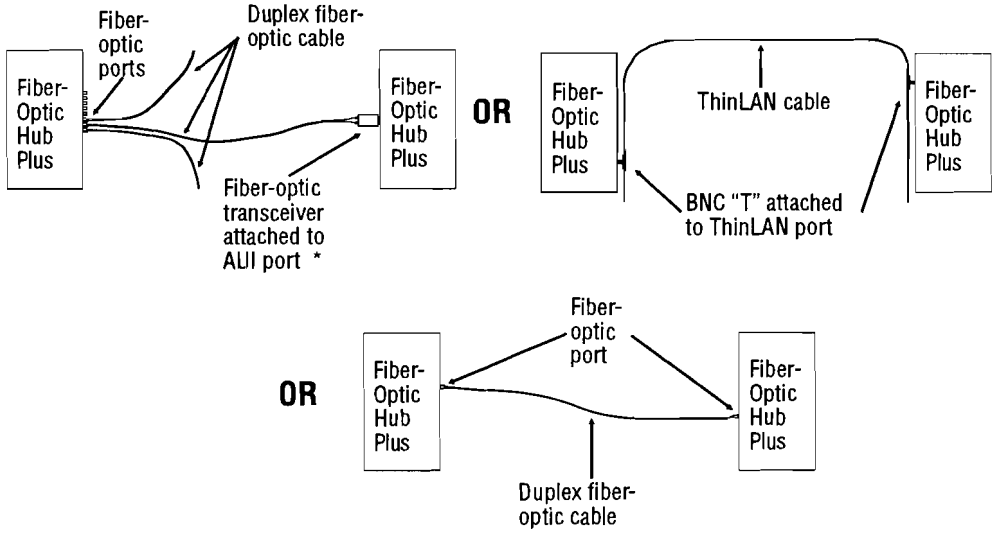
Connect each hub, bridge, or computer.



* Make sure the SQE test is disabled on the attached transceiver.

If the connected device is another HP Fiber-Optic Hub Plus, then see the step below instead.

Connect another HP Fiber-Optic Hub Plus if required.



* Make sure the SQE test is disabled on the attached transceiver.

HP 10:10 LAN Bridge MB

Technical Data

HP 28673A

The HP 28673A 10:10 LAN Bridge MB is a "learning" bridge that connects two separate LANs or extends a single LAN beyond its topological limitations. It provides "media speed" data transfer, and it performs address filtering to eliminate unnecessary traffic on the network. The bridge can be managed using HP's OpenView Interconnect Manager/DOS software (HP 27256D).

The HP 10:10 LAN Bridge MB includes agent firmware to support network management via SNMP/IP and SNMP/IPX and a console (RS-232) port for out-of-band network management.

In addition, the agent firmware incorporates HP EASE (Embedded Advanced Sampling Environment), an embedded instrument technology that allows the bridge to perform trend analysis functions. When used with HP OpenView Resource Manager/DOS (HP 27257D), the HP 10:10 LAN Bridge MB can identify top talkers, heavy users, error sources, and communication pairs on your network.

Yet with all its features, the bridge offers easy, "plug-and-play" operation. It comes preconfigured with a default configuration that works optimally in most installations—all you do is attach the network cables and plug in the power, and the bridge starts functioning automatically.

Highlights

☆ **High Performance**
The HP 10:10 LAN Bridge MB can filter and forward data packets as fast as the network can operate; this is called "media-speed" operation. This allows you to divide a large LAN into logical subnets without creating bottlenecks in the network. In addition, the bridge conserves network capacity (bandwidth) by isolating local traffic and forwarding only those packets with destinations on the other side of the bridge.

☆ **Fault Tolerance**
The HP 10:10 LAN Bridge MB uses the Spanning Tree Protocol developed by the IEEE 802.1 committee. This permits IEEE 802.3/Ethernet LANs to be bridged in an arbitrary topology that includes alternative or redundant paths. In the event of a primary link failure, a backup link takes over automatically, thereby ensuring continued data transmission between networks.

☆ **Network Management**
HP OpenView Interconnect Manager/DOS software (HP 27256D) can centrally monitor and control HP 10:10 LAN Bridge MBs in an extended IEEE 802.3 or Ethernet LAN environment. Bridges are typically located in excellent positions for providing information about the network and its operation, and the HP OpenView Interconnect Manager/DOS use this information to identify and diagnose network problems, enhance network security, and increase network reliability by controlling bridges serving as redundant data paths. In addition, the bridge's console port provides for out-of-band management of several bridge parameters from a terminal or a PC, through either a direct connection or a remote connection using a modem.

Features

- Connects adjacent LANs, or allows expansion of an existing LAN that has reached its topological limits.
- Operates at "media speed", filtering and forwarding packets as fast as the network can operate.
- Automatically learns addresses of stations on the attached LANs by examining network traffic (in learning mode), and uses address filtering to eliminate unnecessary traffic on the network.
- Allows filtering based on combinations of stations configured into the address table (in secure mode), to provide greater security for individual stations.
- Allows "wildcard filtering" of packets based on source or destination address or on data fields in the packets.
- Does not propagate corrupt packets from one network to another. End-to-end data integrity is maintained.
- Provides one port with AUI connector and one port with choice of AUI or BNC connector. This allows direct connection to thin coaxial cable, and connection via transceiver to thick coaxial, thin coaxial, twisted-pair, or fiber-optic cable.
- Includes LEDs for a quick visual check of power, activity, self-test status, and network and bridge failure.
- Supports the IEEE 802.1 Spanning Tree Protocol, allowing a network topology that contains redundant bridges. If an active bridge fails, a backup bridge can automatically take over and continue transmitting data.
- Supports SNMP/IP- and SNMP/IPX-based network management. The bridge can be managed from a central network management station on the LAN using the HP OpenView Interconnect Manager/DOS software (HP 27256D).
- Provides console (RS-232) port for out-of-band bridge management from a terminal or PC. The console port also allows downloading of product updates to the bridge firmware. Connection to this port can be made directly or remotely via modem.
- Comes preconfigured to provide easy, "plug-and-play" installation and operation for most network applications.
- Mounts in a standard 19-inch rack (with cables facing front or back), on a wall (flat or on end), or on any horizontal surface like a shelf or table. Since the bridge is only 1.75 inches high (one rack space), it takes up very little space in any mounting configuration.

Specifications

Environmental Characteristics

Operating Temperature: 0°C to 55°C (32°F to 131°F)

Relative Humidity: 15% to 95% @ 40°C (104°F) noncondensing

Physical Characteristics

Dimensions:	42.6 cm by 23.5 cm by 4.4 cm (16.8 in. by 9.3 in. by 1.7 in.)
Weight:	2.7 kg (6.0 lbs)

Electrical Characteristics

Voltage:	100-120 V ac	200-240 V ac
Current:	0.5 A max	0.25 A max
Frequency:	50/60 Hz	50/60 Hz

The HP 10:10 LAN Bridge MB automatically adjusts to any voltage between 90 and 240 volts.

Standards

Communications:	IEEE 802.3 IEEE 802.3 Type 10Base2 IEEE 802.1 Spanning Tree Protocol
Safety:	UL 1950 CSA 220 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class A EN 55022 (1988) Class A VCCI Class 1 VDE-0871 Level A
Immunity:	
ESD	IEC 801-2: 1991 3 kV CD, 8 kV AD prEN 55101-2: 1990
Radiated Emissions:	IEC 801-3: 1984 3 V/m prEN 55024-3: 1991

Warranty

The HP 28673A 10:10 LAN Bridge MB is warranted for one year against defects

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HP 10:10 LAN Bridge LB

Technical Data

HP 28681A

The HP 28681A 10:10 LAN Bridge LB is the low-cost LAN extender for any Ethernet/IEEE 802.3 network. For nearly the same price as a repeater, the HP 10:10 Bridge LB provides the additional benefits of a high-performance, filtering bridge. By connecting multiple local networks into a single integrated communications system, these bridges will improve the performance of a LAN by reducing traffic. Since all the HP bridges are protocol independent, they can be used in conjunction with any other vendor's Ethernet/IEEE 802.3 devices.

Highlights

☆ **Low Cost and High Performance**
The HP 10:10 LAN Bridge LB offers "near media-speed" performance, processing arriving data at a rate close to the theoretical maximum speed at which the LAN can operate. "Real-world" LAN environments typically exhibit steady-state traffic levels below 50% of the maximum (media) speed, with occasional bursts of traffic up to 85%. With performance levels that are approximately 90% of the maximum (media) speed of an Ethernet LAN, the HP 10:10 LAN Bridge LB can easily handle such loads. The HP 10:10 LAN Bridge LB offers this performance for half the price of some competitive products.

☆ **Increased Network Performance**
The HP 10:10 LAN Bridge LB is a data-link layer device which, unlike a repeater, is intelligent about forwarding data from one LAN to another. Data that must travel between nodes on opposite sides of the bridge is forwarded; packets that are transmitted between nodes on the same network segment are discarded. In other words, the HP 10:10 LAN Bridge LB prevents unnecessary traffic from being repeated on opposite sides of the bridge, which conserves bandwidth on both LANs.

☆ **Network Extension beyond Maximum Cable Distances**
When maximum cable lengths are reached, bridges permit extension of a LAN beyond the maximum cable lengths specified for various media. Additionally, bridges are excellent at connecting LANs of different media types. For example, the corporate backbone may use fiber-optic or thick coaxial cable, and the smaller workstation subnet may use thin coaxial or twisted-pair cable. The HP bridge can connect these different media through its AUI and ThinLAN ports (using the appropriate transceivers as necessary).

Features

- Installs easily—simply connect it to the networks and to a power source and the bridging function begins immediately and automatically. No configuration is needed; the bridge is a "plug-and-play" device that is self-configuring.
- Forwards 13,373 packets per second and filters 26,700 packets per second. This is approximately 90% of the maximum (media) speed of an Ethernet LAN, allowing the bridge to easily handle maximum network traffic loads for a normally operating network.
- Saves network capacity by isolating local traffic and only forwarding packets intended for stations on the other side of the bridge.
- Automatically learns station addresses by examining network traffic.
- Provides one port with AUI connector and one port with choice of AUI or BNC connector. This allows direct connection to thin coaxial cable, and connection via transceiver to thick coaxial, thin coaxial, twisted-pair, or fiber-optic cable.
- Maintains an address table of the last 256 active stations. (Only a fraction of the stations on a typical network are active at any one time, so it is *not* necessary to have excessively large table sizes.)
- Allows extension of a LAN beyond the maximum cable lengths specified for various media. Additionally, the bridges can connect LANs of different media types through its AUI and ThinLAN ports.
- Maintains end-to-end data integrity. The HP 10:10 LAN Bridge LB does not propagate corrupt packets from one network to another. The bridge performs a check (CRC/FCS) of the packet to determine the packet's integrity.
- Can be used in multivendor Ethernet/802.3 environments. The HP bridge operates at the data link layer of the IEEE ISO model, so it is transparent to higher-level protocols. The HP bridge can thus be used with any other vendor's products.
- Mounts in a standard 19-inch rack (with cables facing front or back), on a wall (flat or on end), or on any horizontal surface like a shelf or table. Since the bridge is only $1\frac{3}{4}$ inches high (one rack space), it takes up very little space in any mounting configuration.
- Provides LEDs for easy recognition of the bridge's operating condition and for troubleshooting. LEDs indicate power, self-test status, faults, collisions, and activity.
- Does not support the IEEE Spanning Tree Protocol, nor does it include network management or a console port. For these features, order the HP 28673A 10:10 LAN Bridge MB.

Specifications

Environmental Characteristics

Operating Temperature: 0°C to 55°C (32°F to 131°F)

Relative Humidity: 15% to 95% @ 40°C (104°F) noncondensing

Physical Characteristics

Dimensions: 42.6 cm by 23.5 cm by 4.4 cm
(16.8 in. by 9.3 in. by 1.7 in.)
Weight: 2.7 kg (6.0 lbs)

Electrical Characteristics

Voltage:	100-120 V ac	200-240 V ac
Current:	0.5 A max	0.4 A max
Frequency:	50/60 Hz	50/60 Hz

The HP 10:10 LAN Bridge LB automatically adjusts to any voltage between 90 and 240 volts.

Standards

Communications:	IEEE 802.3 IEEE 802.3 Type 10Base2
Safety:	UL 1950 CSA 220 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class B EN 55022 (1988) Class B VCCI Class 1 FTZ 1046/84 (VDE Level B)
Immunity:	
ESD	IEC 801-2: 1991 3 kV CD, 8 kV AD prEN 55101-2: 1990
Radiated Emissions:	IEC 801-3: 1984 3 V/m prEN 55024-3: 1991

Warranty

The HP 28681A 10:10 LAN Bridge LB is warranted for one year against defects.

HP Bridges

Product Note

Questions and Answers

General

Q. Why would I use a bridge in my network?

A. Use a bridge in your network for the following reasons:
- To join two LANs or to extend a LAN beyond the physical configuration limits for a single LAN.
- To provide security at the data link layer using the secure mode or static and wildcard filters. (HP 28673A 10:10 LAN Bridge MB only.)
- To reduce excess traffic, resulting in optimized network performance.
- To provide fault tolerance with backup bridges (or links) using the Spanning Tree Protocol. (HP 28673A 10:10 LAN Bridge MB only.)

Q. Why is a bridge called a learning bridge?

A. Both the HP 28673A 10:10 LAN Bridge MB and the HP 28681A 10:10 LAN Bridge LB will automatically learn the addresses of the nodes communicating through the bridge and which side of the bridge each node is on. The bridge learns the node addresses from the source address fields in the packets it receives. It learns which side the node is on by noting which port receives the packet. The bridge adds entries to the address table for each new address it sees. Based on the information from the address table, the bridge discards packets when it sees that the source and destination are on the same side of the bridge. In this way, a bridge (or learning bridge) selectively restricts the flow of packets that cross to the other side and helps control network traffic levels.

For more information on the bridge address table, refer to the "Bridge Operating State and Address Table" Product Note located in the Advanced Topics section of this document.

Q. When should I use an HP 28681A 10:10 LAN Bridge LB versus an HP 28673A 10:10 LAN Bridge MB in my network?

A. The "LB" bridge is a low-cost bridge suitable for small, uncomplicated networks. If you only need to add more hubs or longer cable lengths to your network, the "LB" bridge is an inexpensive way to improve overall network performance for a growing LAN.

The "MB" bridge is a full-featured bridge suitable for larger networks that need:

- network management (SNMP and console port for out-of-band management)
- media-speed performance
- redundancy (Spanning Tree Protocol)
- security (secure mode, static and wildcard filters, etc.)

Q. What does "media-speed" bridge mean?

A. Media-speed operation is defined as the ability for a network device to transmit and forward data packets as fast as the physical layer rate. For example, the physical layer rate for IEEE 802.3 networks is 10 Mbit/second. When data frames appear (at the fastest rate possible) on the networks attached to the HP bridges, the bridge is fast enough to process each frame before receiving the next one. This ensures that the bridge does not become a traffic bottleneck during times of peak network loading.

Q. What is the Spanning Tree Protocol used for?

A. The IEEE 802.1 Spanning Tree Protocol (STP) uses an algorithm to calculate a transmission path through primary and backup bridges on the network. The Ethernet and IEEE 802.3 standards allow only one active path between any two nodes on the network at any given time. Without Spanning Tree Protocol support, networks with physical loops would cause packets to flood and circulate all over the network. Bridges and routers (functioning as bridges) that support Spanning Tree Protocol can communicate with each other to ensure that only one path at a time is active between any two nodes on the network. For more information on the Spanning Tree Protocol, see the "Spanning Tree Protocol" Product Note located in the Advanced Topics section of this document.

Q. How does the bridge store configuration data?

A. Configuration data for the HP 28673A 10:10 LAN Bridge MB is stored in battery-backed RAM. All parameters that you set or any enhancements that you download to the bridge's firmware are stored in the battery-backed RAM. Note that the HP 28681A 10:10 LAN Bridge LB does not use battery-backed RAM. The HP 28681A 10:10 LAN Bridge LB is pre-configured and is not user-configurable.

Console Port

Q. How can I establish a console session on the bridge?

A. First attach your terminal or modem to the console (RS-232) port. To start a bridge console session, the bridge must have successfully completed self-test and initialization. During the self-test, the bridge tests to see that both ports are properly terminated and have functional LANs attached. If the ports are not terminated, the bridge will fail its self-test with a net fail indication (the Self-test, Net Fail, and Fault LEDs are all on.) *Make sure that both of the bridge ports are either attached to viable networks or are terminated with loopback connectors before the bridge is powered on.* The bridge will then complete its self-test and initialization and the console session can be started by pressing the Enter key a few times.

Q. Do I need to set the password on my bridge?

A. By default, the HP 10:10 LAN Bridge MB is shipped with no password set. You can set the password by using the console port or HP OpenView network management.

Once your password is set, the bridge will always prompt you to enter the password in these three instances:

1. When you initiate a console session.
2. When you change the bridge password.
3. When you change bridge parameters with HP OpenView network management.

Q. What can I do if the bridge password is lost/forgotten?

A. To delete the password, press the button labeled "Password Clear" on the bridge (located to the left of port 1) Hold the button for approximately one second to erase the password. The "Password Clear" button is recessed (to prevent accidental pressing). To press it, use a non-conducting pointed implement like a toothpick.

For older HP 28673A bridge products, make sure that the firmware revision is C.01.xx or D.01.xx. (The password clear function is provided in both the C.01.xx and D.01.xx revisions.) Also, on older bridges, the label for the button may be "Config-Clear".

Q. What is the difference between the Password Clear function and the Config-Clear Reset function?

A. The Password Clear function is used to clear your bridge password only. The Config-Clear Reset function resets the firmware code and the configuration parameters in the bridge to the factory-set values. You should use the Config-Clear Reset function as a last resort. Note that the Password Clear and Config-Clear Reset functions apply only to the HP 28673A 10:10 LAN Bridge MB and the HP 28674B Remote Bridge RB.

For more information, see the "Saving your Hub and Bridge Configurations" Product Note located in the Advanced Topics section of this document.

Q. Do I need to set the IP configuration parameters on my bridge if I'm using Novell NetWare software?

A. No. If you plan to use HP OpenView network management to manage your bridges and you are using Novell NetWare, it is not necessary for you to set the IP configuration parameters on your bridges. HP OpenView Interconnect Manager/DOS (HP 27256D) and the HP bridges support IPX communications.

If you are not using Novell NetWare software, you must set the IP configuration parameters on your bridges if you wish to manage your bridges with HP OpenView network management software using IP communications.

Q. How do I set the IP configuration parameters on my bridge?

A. To set the IP configuration parameters on your bridge, you must attach a terminal or terminal emulator to the bridge's console port. Once a console port session is established, go to the Config Mode menu. Use the IP command to set the parameters for your bridge. Note that there is no console port on the HP 28691A 10:10 LAN Bridge LB, nor can it be managed by SNMP-based network management products.

Bridge Ports

Q. Can I use both connectors on port 1 at the same time on the bridge?

A. No. On port 1, choose only one connector by attaching an AUI cable or a transceiver to the AUI connector or attaching a BNC "T" and thin coaxial cable to the BNC connector. Each connector on port 1 has a Port LED. When the bridge is powered on, the hardware circuitry will automatically sense which connector on port 1 you are using and its Port LED will turn on. Once you have chosen one of the connectors on port 1, it cannot be changed without going through self-test again.

Q. If I choose to use the AUI connector of port 1, do I need to terminate the ThinLAN (BNC) connector?

A. No. The hardware interface at port 1 automatically knows that you are using the AUI connector. The unused and unterminated BNC connector does not affect the bridge operation.

Q. Is the AUI port compatible with AUI slide-latch connectors?

A. All HP bridges include an AUI retainer (part number 5062-3351) instead of an AUI slide-latch connector. The retainer replaces the slide-latch connector and is used to securely fasten any transceiver to the bridge's AUI port.

Status LEDs

Q. What does the Fault LED indicate?

A. The Fault LED (yellow) is ON if the bridge or network has failed during the self-test or normal operation. (The Fault LED is located on the back as well as the front of the bridge.) If the Fault and Self-test LEDs are both ON during a self-test, the bridge is at fault. If only the Fault LED is ON, it indicates bridge failure during normal operation. You should reset the bridge to run its self-test.

See the bridge's manual for details of the LED pattern interpretations.

Q. What does it means if the Fault and the LAN port's Net Fail LEDs are ON?

A. If these LEDs are ON during a self-test, this most likely indicates that the LAN cable or transceiver is bad or is improperly connected, or the LAN cable is unterminated.

HP 10:10 LAN Bridge MB

Installation Steps

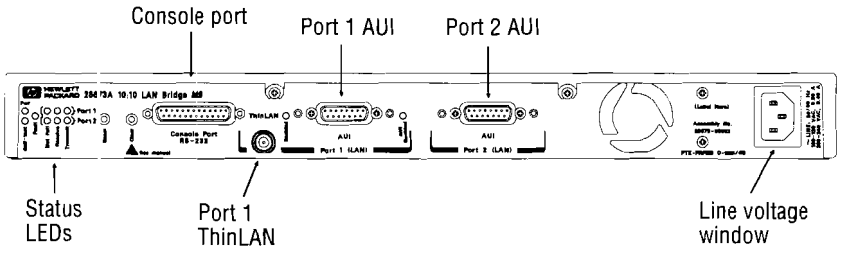
HP 28673A

The HP 10:10 LAN Bridge MB (HP 28673A) is designed to connect two 10-Mbit's IEEE 802.3/Ethernet networks together.

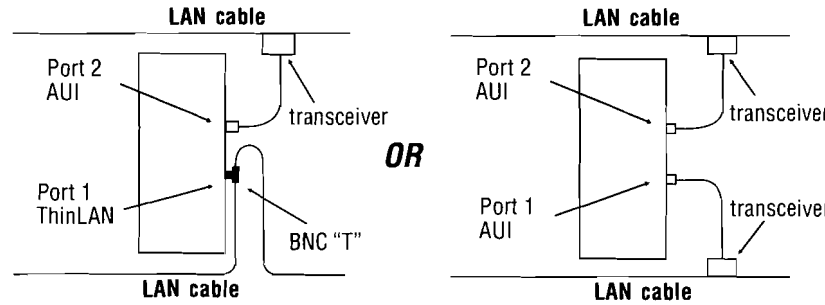
Installation details are provided in the bridge's installation and reference manual.

Mount the bridge.

1. Make sure the bridge's line voltage setting and power cord are correct for your area.
2. Mount the bridge in a rack or on a wall by using the mounting brackets, or place it on a table.
3. Attach the power cord to the bridge but do not plug it into a power source yet.



Connect the bridge to the networks.



Use only one of the Port 1 connectors (BNC or AUI).

To attach the cable to an AUI port, (1) slide the AUI retainer onto the cable connector, (2) attach the cable connector to the bridge's AUI port with the screws.

Connect a console if needed.

If you intend to customize the bridge configuration, connect a terminal or modem to the console port. (The console port can also be used to view bridge statistics and to run bridge diagnostics.) Plug in the terminal and switch its power on.

Plug in the bridge and verify.

1. Plug the bridge power cord into a power source.
   Note that the bridge does not have a power switch; the bridge is powered on when the power cord is plugged in.
2. Check the back of the bridge for the following LED pattern when initialization ends:
   - The Self-Test LED is OFF; it stays ON only while self-test is running (about 20 seconds).
   - The Pwr LED is ON
   - The Receive and Transmit LEDs will begin flashing if there is any traffic on the network.
   - The Fault and Net Fail LEDs are OFF.

   If the bridge LED pattern does not match the above states, then refer to the bridge's manual for troubleshooting information.

Customize bridge configuration if needed.

The bridge is pre-configured with a default configuration that will work in most installations. With the default configuration, the bridge functions as a learning bridge.

HP 10:10 LAN Bridge LB

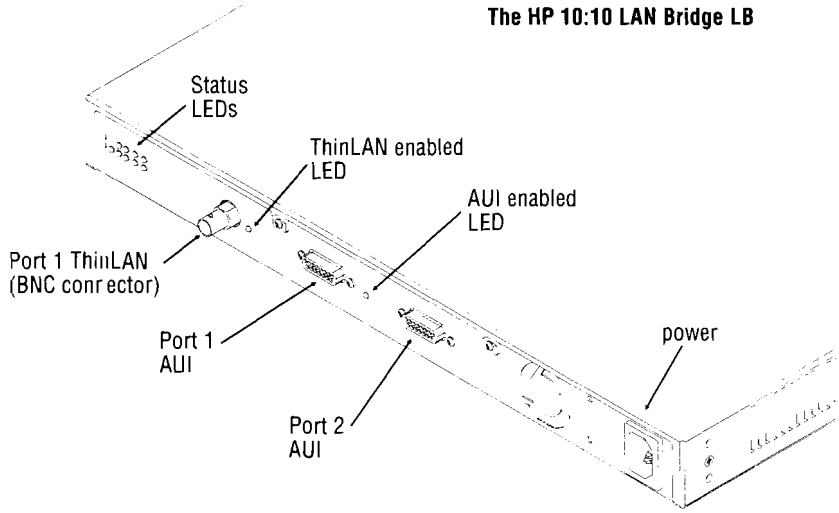
Installation Steps

HP 28681A

The HP 10:10 LAN Bridge LB (HP 28681A) is a learning bridge designed to connect two 10-Mbit/s IEEE 802.3/Ethernet networks together.

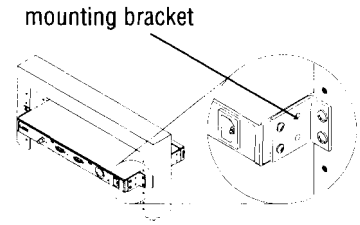
Installation details and a complete description of the bridge are provided in the bridge's installation and reference manual.

The HP 10:10 LAN Bridge LB



Mount the bridge.

1. Make sure the bridge's power cord is correct for your country's ac power supply. Note that the bridge does not have a power switch; the bridge is powered on when it is plugged in.
2. Mount the bridge in a rack or on a wall by using the mounting brackets and screws supplied, or attach the rubber feet to the bottom and place the bridge on a table near a power supply.

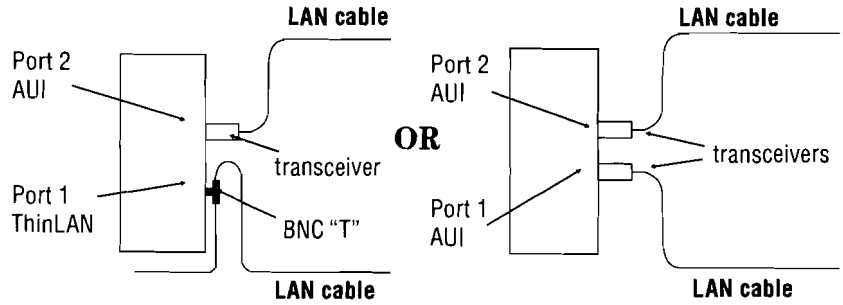


example rack mounting

Connect the bridge to the networks.

Use only one of the Port 1 connectors (BNC or AUI), as shown.

To attach an AUI cable or transceiver to a bridge AUI port, (1) slide the AUI retainer (included with the product) onto the cable or transceiver connector, (2) plug the connector into the bridge's AUI port and secure with the retainer's screws.



Plug in the bridge and verify.

1. Plug the power cord into a power source.
   Note that the bridge does not have a power switch; the bridge is powered on when the power cord is plugged in.
2. Check the back of the bridge for the following LED pattern when initialization ends:
   - The Self-Test LED is OFF; it stays ON only while self-test is running (about 10 seconds).
   - The Pwr LED is ON
   - The Receive and Transmit LEDs will begin flashing if there is any traffic on the network. (The Tx ABORT LED may also flash occasionally if the bridge is transmitting onto a very busy LAN.)
   - The Fault and Net Fail LEDs are OFF.

   If the bridge LED pattern does not match the above states, then refer to the bridge's manual for troubleshooting information.

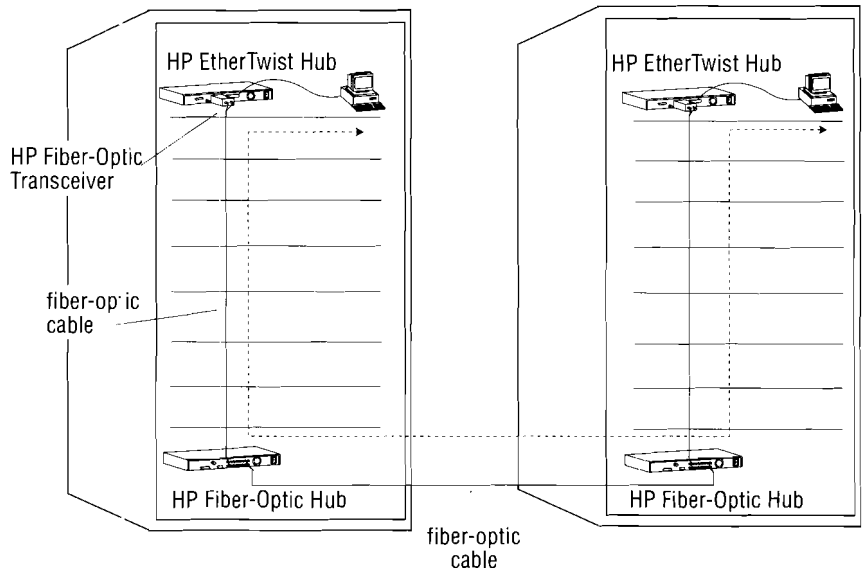
Site LAN Design

Product Note

General Rules

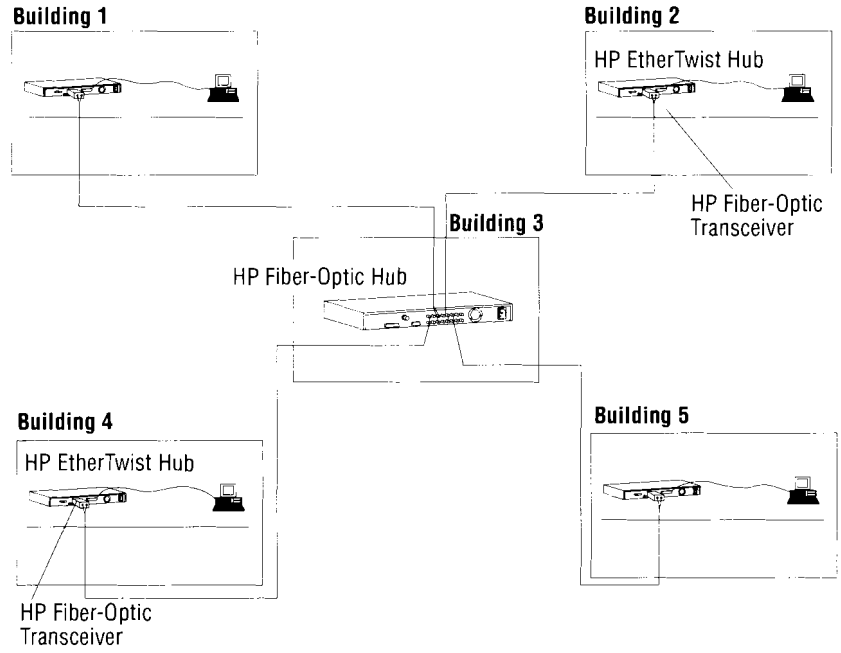
The IEEE 802.3 standard provides general rules for cable lengths and network connections on single segments of cable or on point-to-point links. Maximum topologies for 802.3 networks are largely a function of media attenuation and signal propagation delay. Limitations are placed on cable lengths, the number of cable segments and repeaters (hubs), etc. The rules help to ensure that the communication path between the two farthest nodes on the network are trouble-free.

Communication path between the two farthest nodes.

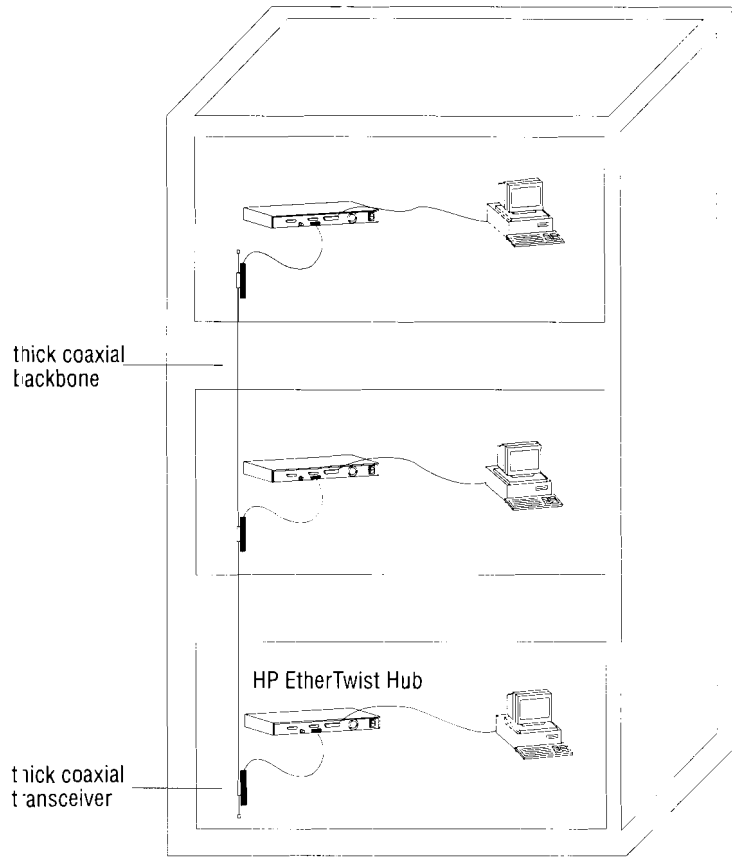


Typically, fiber-optic or thick coaxial cabling is used to create the site backbone LAN. In some cases where long cable distances are not a concern, thin coaxial cabling can also be used to create a building backbone LAN.

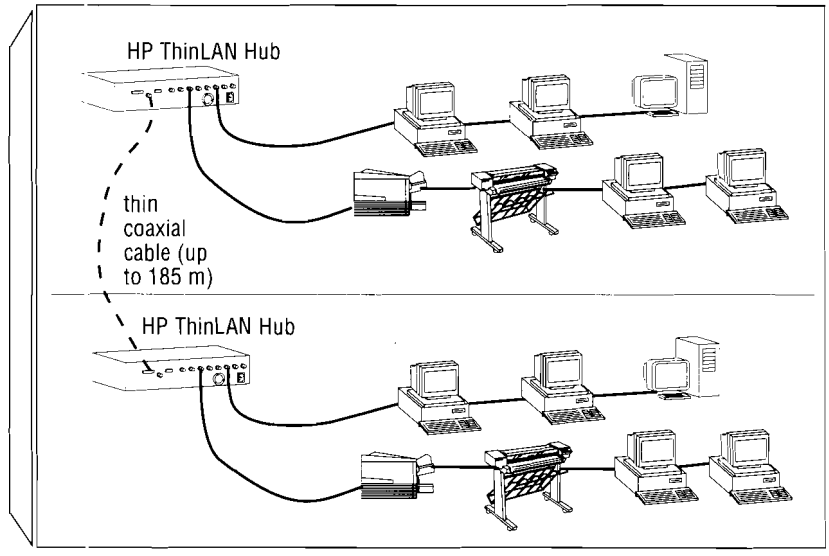
Campus backbone using fiber-optic cable.



Building backbone using thick coaxial cable.



Building backbone using thin coaxial cable



The following topology rules and guidelines will help you easily design site LANs that interconnect various workgroup LANs for proper network operation. It is possible that some network designs will not simply fit within the rules and guidelines. In such cases, you should consult your HP authorized dealer or local HP sales representative for further assistance.

Maximum Number of Repeaters

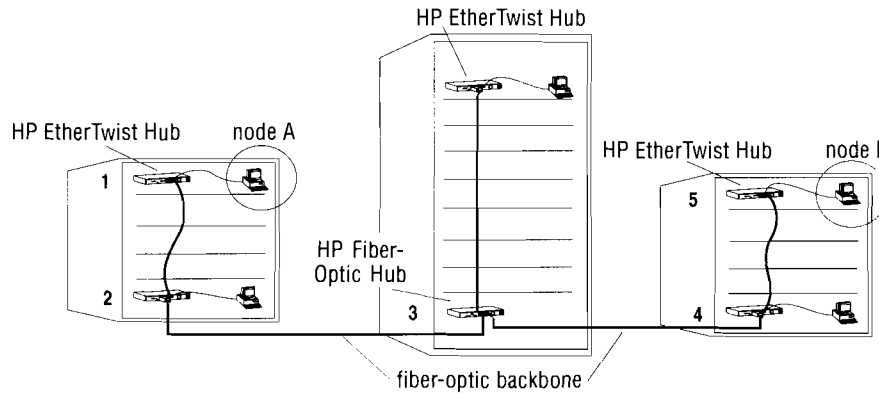
For any network that does not include bridges, the maximum number of repeaters (hubs) in the data path between any two nodes is:

- Four EtherTwist hubs.
- Four ThinLAN hubs.
- Four Fiber-Optic hubs.
- Four (total) any combination of hubs (with one exception).

Exception to Four-Repeater Rule

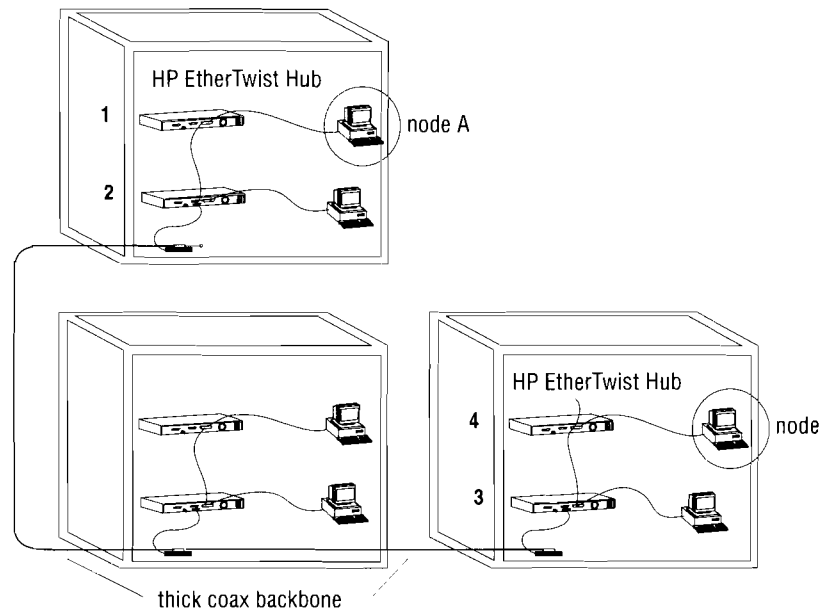
There is only one exception to the four-repeater rule. A fifth repeater is allowed when a Fiber-Optic hub is used in a site backbone for interconnecting twisted-pair and thin coaxial workgroup LANs.

Five hubs (repeaters) in the communication path between node A and node B.



By contrast, when creating a site backbone with thick coaxial cable, up to four repeaters can exist in the communication path between any two nodes. By substituting the thick coaxial backbone with a fiber-optic backbone using an HP Fiber-Optic Hub Plus, you are allowed up to five repeaters in the communication path between any two nodes.

Four hubs (repeaters) in the communication path between node A and node B.



Explanation

The reason that five repeaters are allowed in the fiber-optic backbone is that a fiber-optic hub introduces less propagation delay than a thick coaxial backbone segment with up to 100 network connections. Therefore, the propagation delay was tested for a fiber-optic backbone configuration using one fiber-optic hub and four repeaters (EtherTwist hubs and/or ThinLAN hubs). The testing has verified that this topology will provide trouble-free communication between the two farthest nodes on the network.

Maximum Number of Cable Segments

For any network that does not include bridges, the maximum number of cable segments in the data path between any two nodes is:

- The maximum is five segments with four repeaters. (No more than 3 segments can be coaxial cable.)
- The maximum is six segments with five repeaters. (No more than 3 segments can be coaxial cable.)

Maximum Cable Lengths

The maximum lengths for each cable type is:

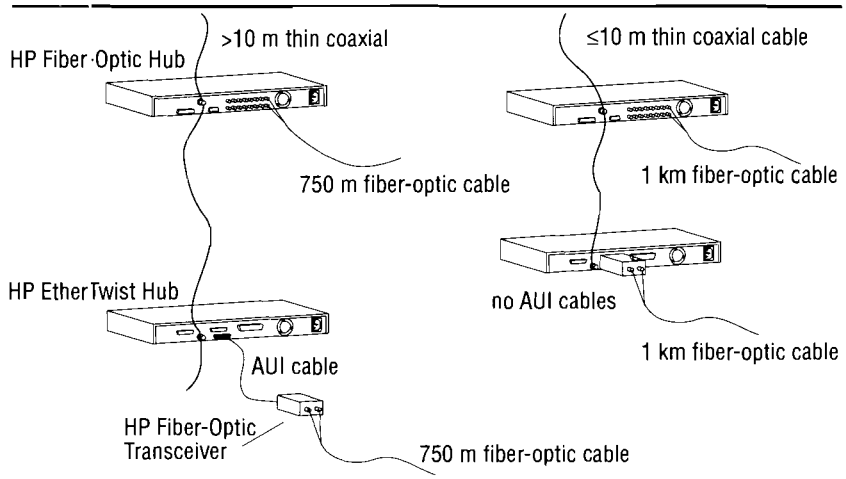
Twisted-pair:	100 m
Thin coaxial:	185 m
Thick coaxial:	500 m
Fiber-Optic single segment:	1 km **
Fiber-Optic sum total between any two nodes:	2 km *

* When a fiber-optic cable connects two bridges or one bridge and one repeater, the maximum distance is 2 km.

**Typically, the maximum length for a single fiber-optic segment is 1 km in a point-to-point fiber-optic link. However, if a mix of optical fiber and one (or more) of the following cable media types is present in the data path between any two nodes on the network, then shorten the fiber-optic segment length to 750 meters.

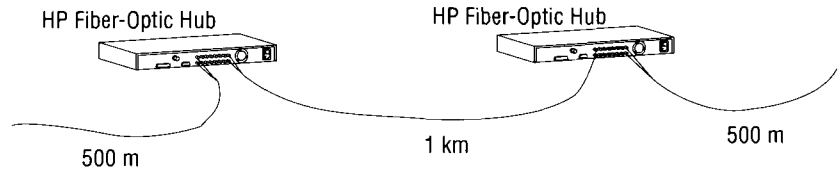
Cable Type	Cable Length	Optical fiber segment length (62.5/125 µm and 50/125 µm)
Thin AUI:	>5 m (up to 15 m)	
Thick AUI:	>5 m (up to 50 m)	
Thin coaxial:	>10 m (up to 185 m)	750 m
Thick coaxial:	>10 m (up to 500 m)	

A trade-off between fiber-optic cable lengths and coaxial or AUI cable lengths.

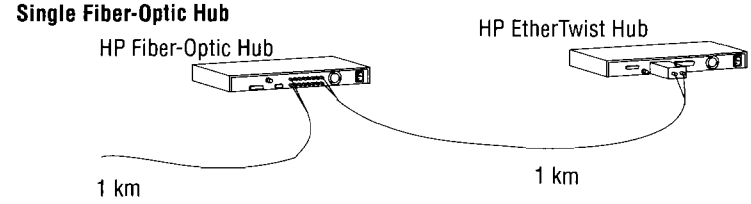


The sum of all fiber-optic segments must be ≤2 km.

Multiple Fiber-Optic Hubs



Single Fiber-Optic Hub



Explanation

The reason that there are limitations to the fiber-optic and coaxial cable lengths is that if you were to use the maximum length (allowed) for fiber-optic cable plus the maximum length for coaxial cable in the communication path between two nodes, the total propagation delay would exceed the IEEE 802.3 specifications. In order to stay within the specifications, a trade-off is made for the cable lengths used in any combination.

To extend maximum cable distances, you can introduce a bridge into the network topology.

Maximum Number of Bridges

The maximum number of bridges (or routers functioning as bridges) in the data path between any two nodes on the network is seven. This is an IEEE 802.1 Spanning Tree Protocol recommendation.

With regard to the maximum repeater and segment numbers stated above, when a bridge is crossed in the communication path, the count for repeaters and cable segments resets to zero.

A bridge isolates local traffic by not forwarding packets with destinations on the same side of the bridge as the source. The bridge does not forward collision packets. Collisions are resolved locally on each LAN the bridge connects.

Maximum Number of LAN Connections per Cable Segment

A LAN connection means that an electrical load exists at the point of (physical) connection on the cable. A transceiver and a BNC "T" connection is an example of an electrical connection on a cable segment.

Cable Type	Data Rate	Cable Connection	Maximum Connections	IEEE 802.3 Standard
Twisted-pair	10 Mbit/s	pt-to-pt*	2	Type 10Base-T
Fiber-optic	10 Mbit/s	pt-to-pt*	2	FOIRL
Thin coax	10 Mbit/s	segment*	30	Type 10Base2
Thick coax	10 Mbit/s	segment*	100	Type 10Base5

* A point-to-point (pt-to-pt) cable attachment means that there can be only two devices connected on the ends of the cable. A segment cable attachment means that multiple devices can be attached along the length of the cable.

Site LAN Design

Product Note

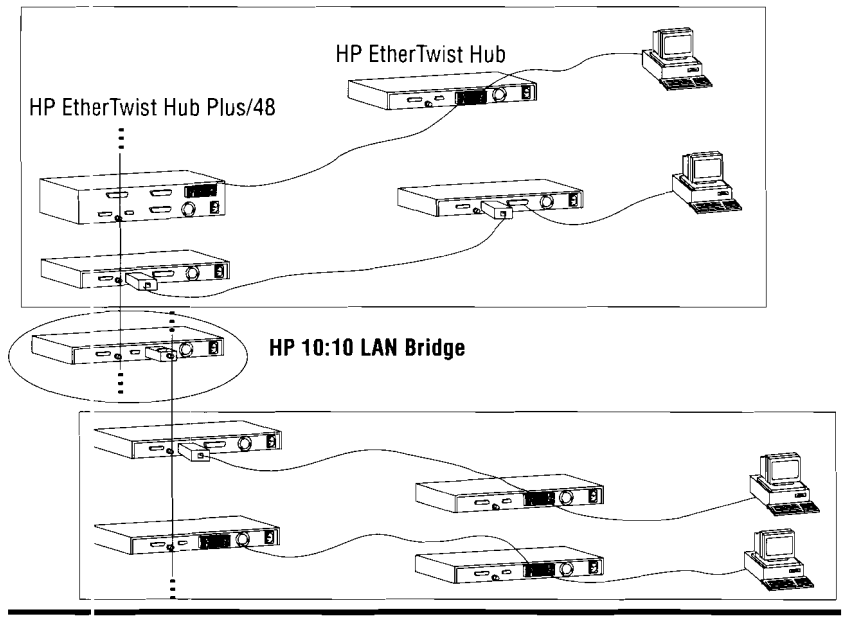
Tips for Designing Site LANs

The following are a few helpful tips and common network practices to consider when designing site LANs using HP bridges, fiber-optic hubs, and ThinLAN hubs.

1. A 62.5/125-µm fiber-optic cable is the recommended cable type for new fiber-optic backbone installations. The fiber-optic hub and transceiver support both 62.5/125-µm and 50/125-µm fiber-optic cable, and there may be many existing installations, particularly in Europe, where 50/125-µm cable is installed. For new installations, 62.5/125-µm cable is recommended because it allows for a higher optical budget and can also be used for FDDI-based network products.

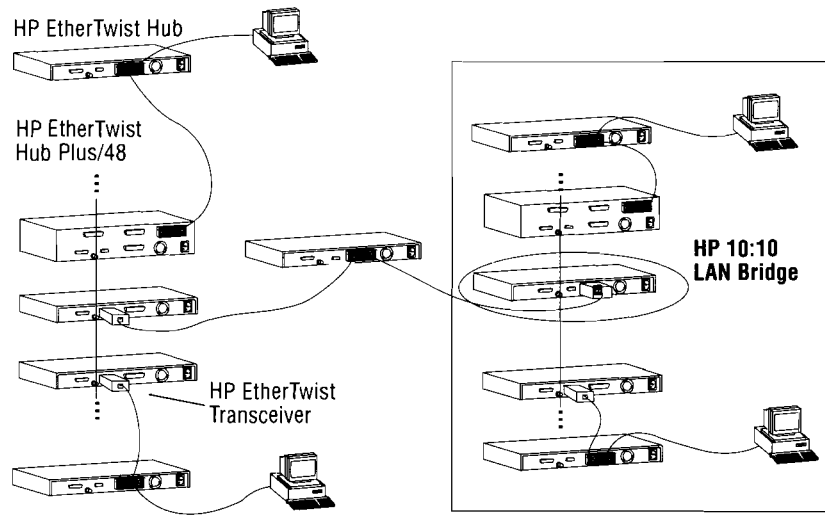
   For more information, refer to the "Product Note—Fiber-Optic Cable Specifications".

2. Use the HP 28681A 10:10 LAN Bridge LB or the HP 28673A 10:10 LAN Bridge MB to expand networks that have reached topological limits or to help isolate traffic from the site backbone.



HP 10:10 LAN Bridge isolates traffic between two LANs.

HP 10:10 LAN Bridge extends the existing LAN so that additional HP EtherTwist hubs may be added.



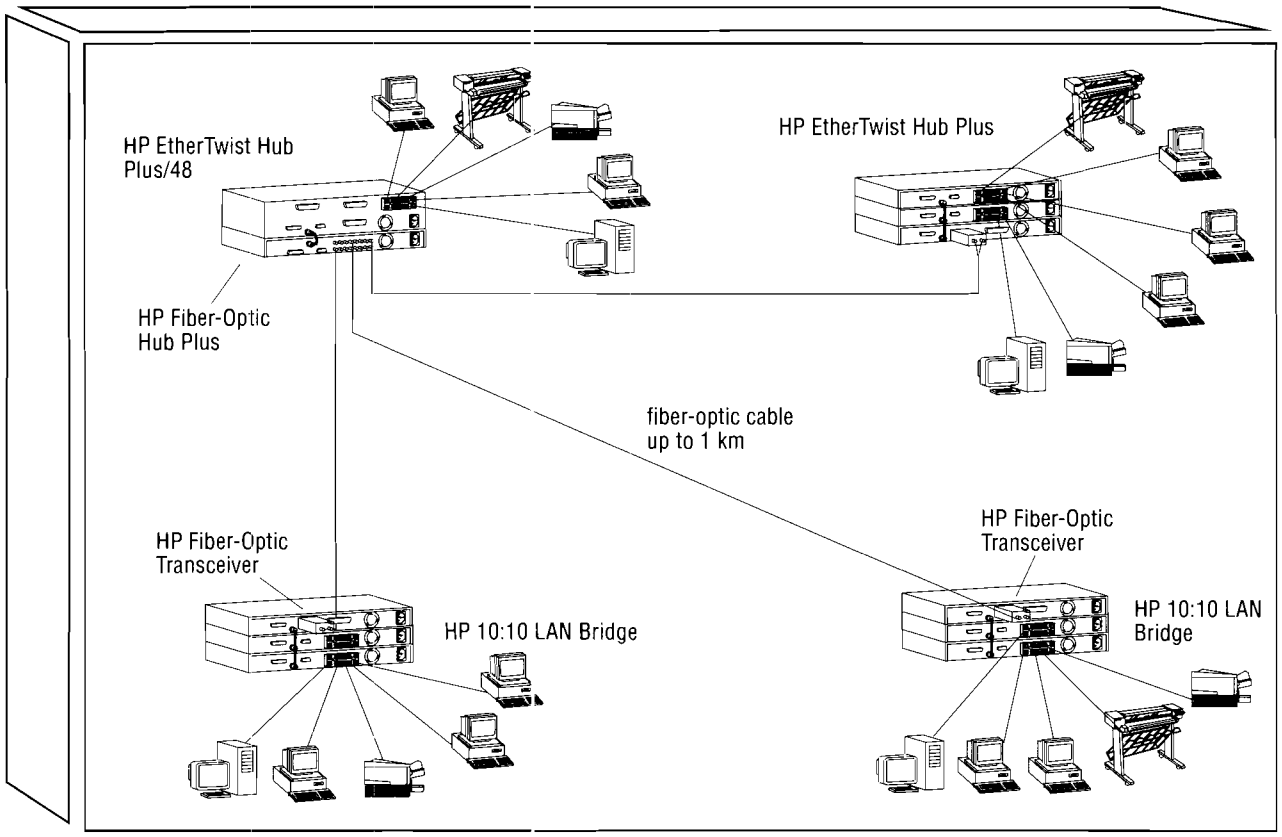
3. Organize your network such that servers and network peripherals shared by a group of clients are placed on the same side of the bridge as the group of clients.
4. Use at least 0.5 meters of thin coaxial cable between neighboring network devices. This 802.3 requirement is to prevent electrical reflections on the coaxial cable from occurring between neighboring devices.
5. HP fiber-optic hubs, ThinLAN hubs, EtherTwist hubs, and bridges can be stacked (or mounted in racks) and connected with thin coaxial cable. This is the preferred method to organize your network products. This keeps your network equipment in controlled locations and reduces the risks of any interruptions to the network connections.
6. Use the fiber-optic backbone to reach different floors within a building or to reach adjacent buildings. Unlike thin or thick coaxial cabling, fiber-optic cabling provides immunity from noise, eliminates grounding problems, and provides security from unauthorized taps into the cable system.
7. Use thin coaxial cabling to reach workgroup LANs located on the same floor or on different floors within a building. Thin coaxial cabling is not recommended for interconnecting building LANs.
8. Minimize the use of AUI cables whenever possible. HP's family of transceivers are compact in size and can connect directly to the AUI port of any 802.3/Ethernet device. Not using AUI cables eliminates failure points in your cable system.

Site LAN Design

Product Note

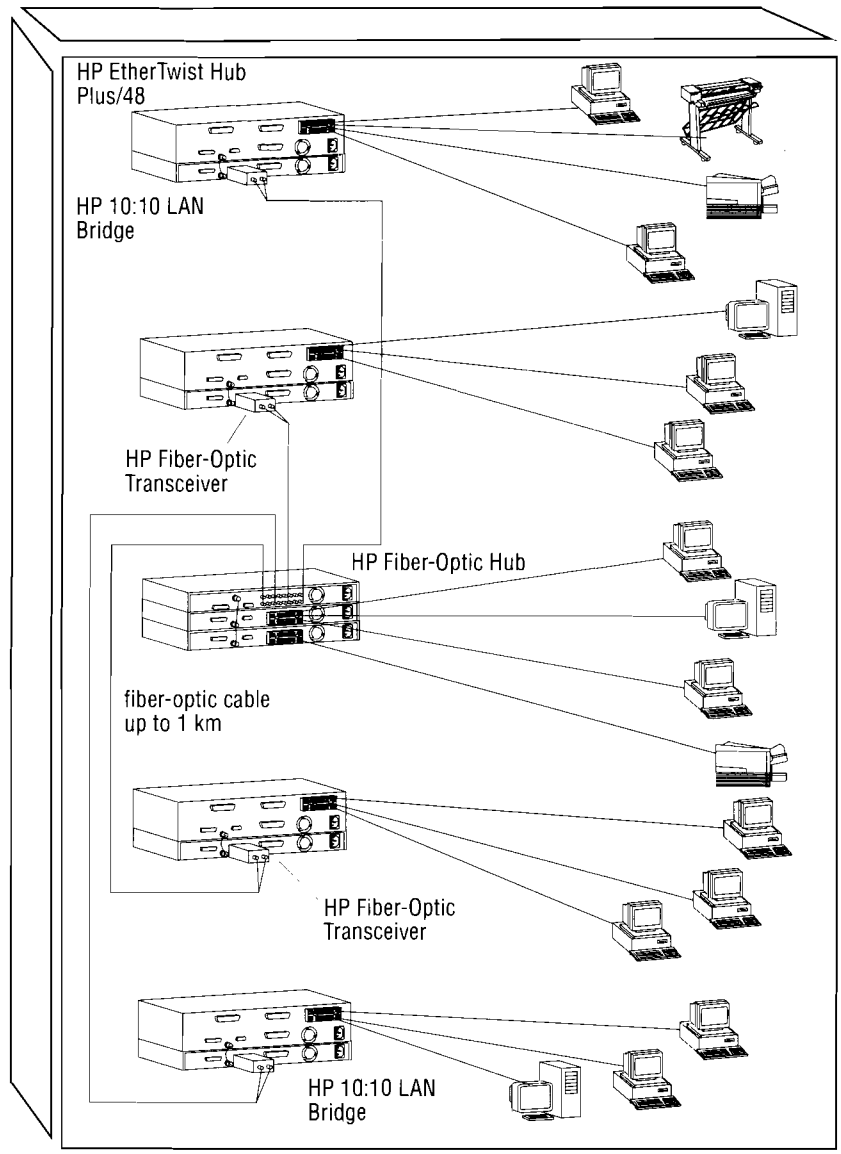
Examples of Site LAN Topologies

Example 1. Horizontal Building



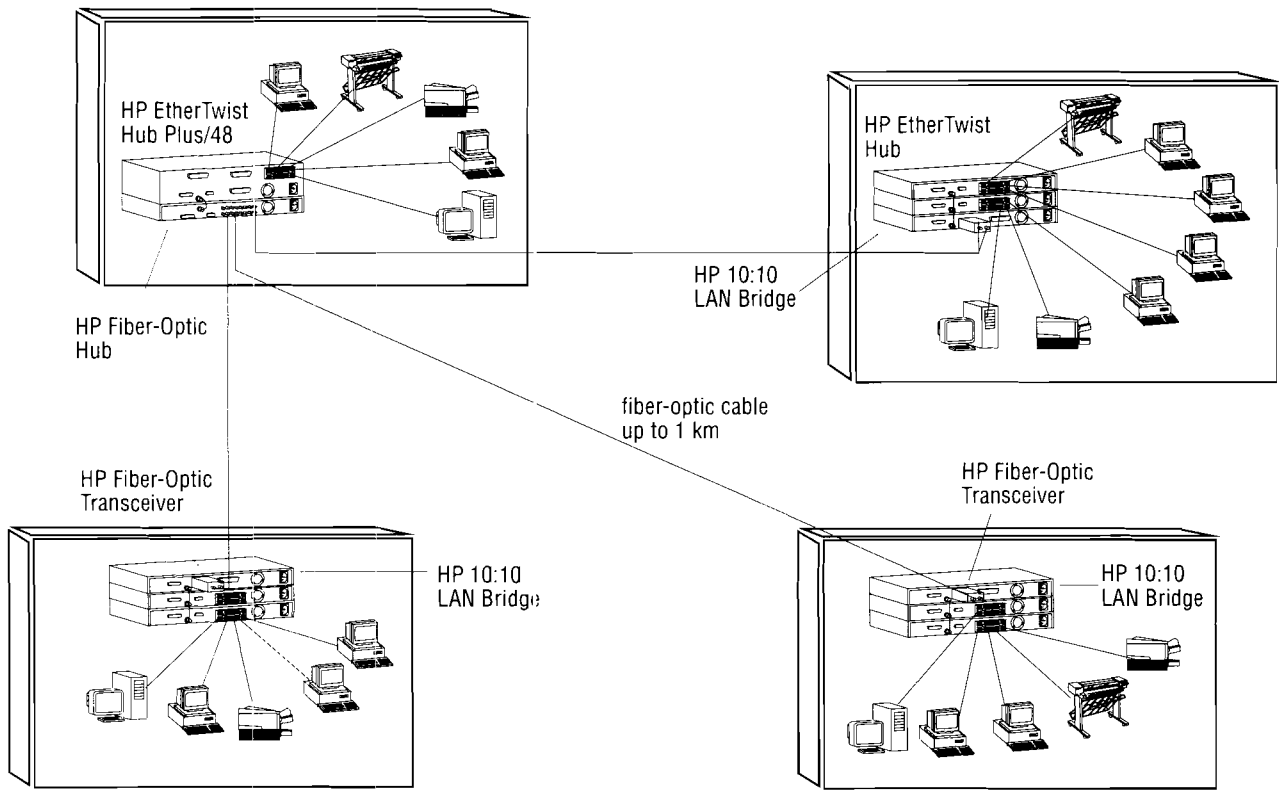
A single fiber-optic hub provides eight fiber-optic connections. (Attach a fiber-optic transceiver, HP 28683A, to the hub's AUI port to get a ninth fiber-optic connection.) The fiber-optic backbone can reach different workgroup LANs located on the same floor.

Example 2. Vertical Building



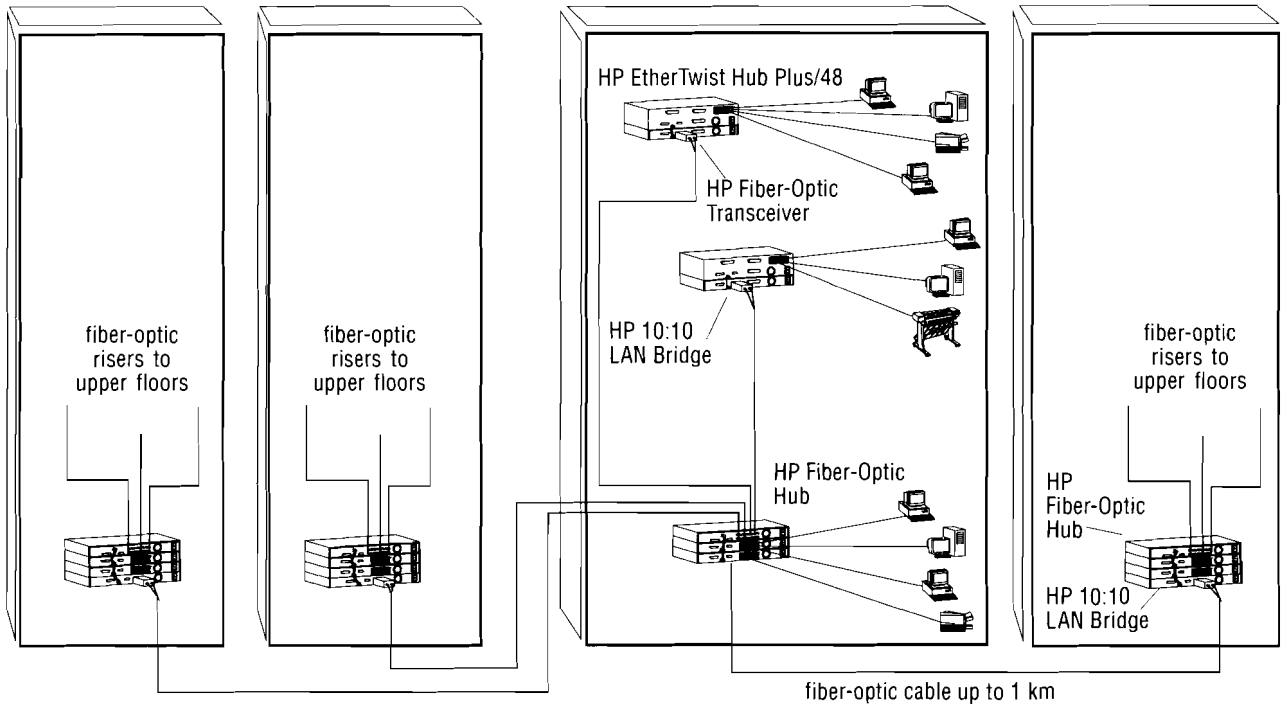
The fiber-optic backbone can span a high-rise building to reach work-group LANs located on different floors.

Example 3. Horizontal Campus



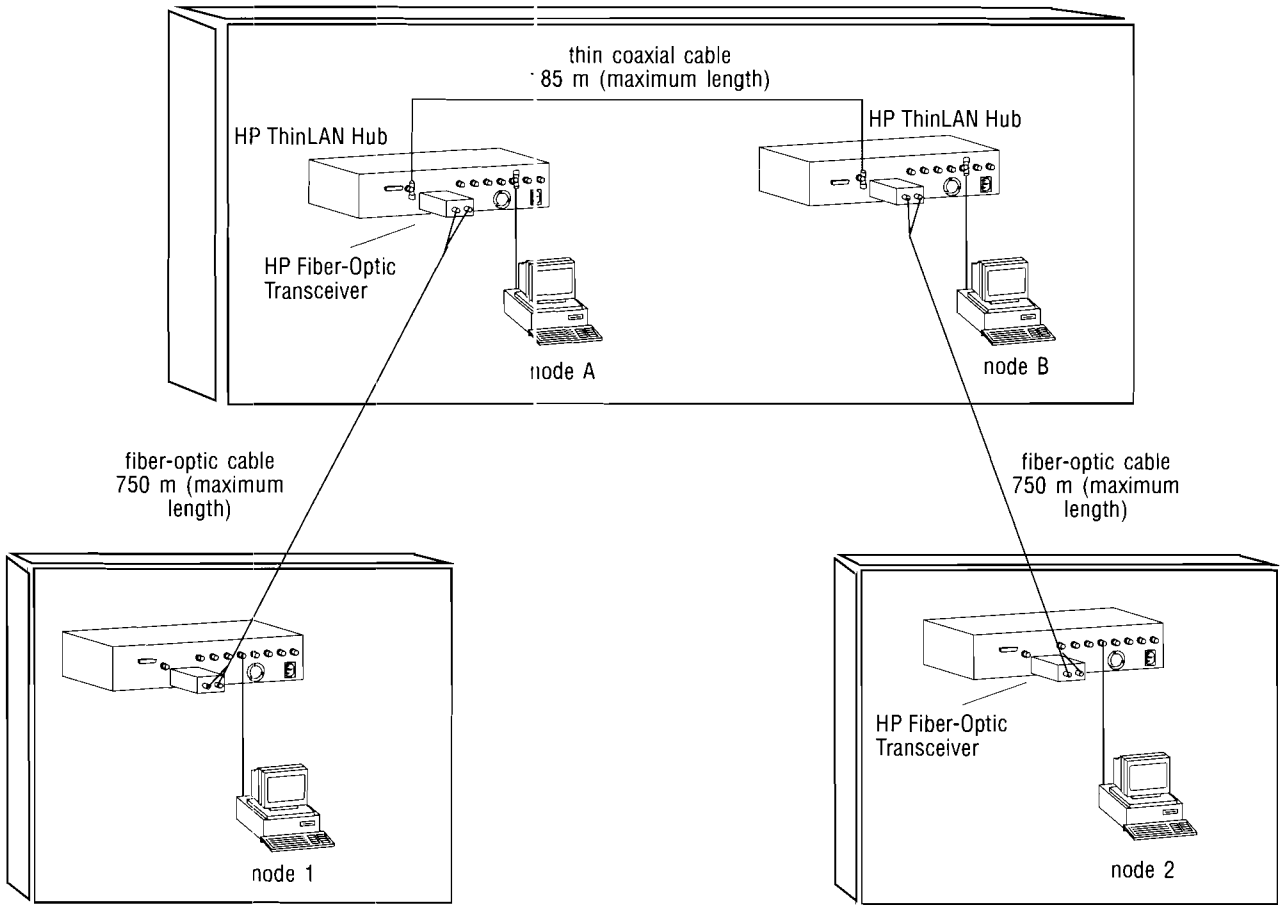
A group of horizontal buildings are connected through fiber-optic cable and 10 10 LAN bridges. The bridges allow extension of the maximum topologies that exist in each building, and at the same time provide intra-building traffic isolation.

Example 4. Vertical Campus



A group of vertical buildings are connected through fiber-optic cable and 10:10 LAN bridges. The bridges allow extension of the maximum topologies that exist in each building, and at the same time provide intra-building traffic isolation.

Example 5. Campus Using ThinLAN Hubs and Fiber-Optic Cable

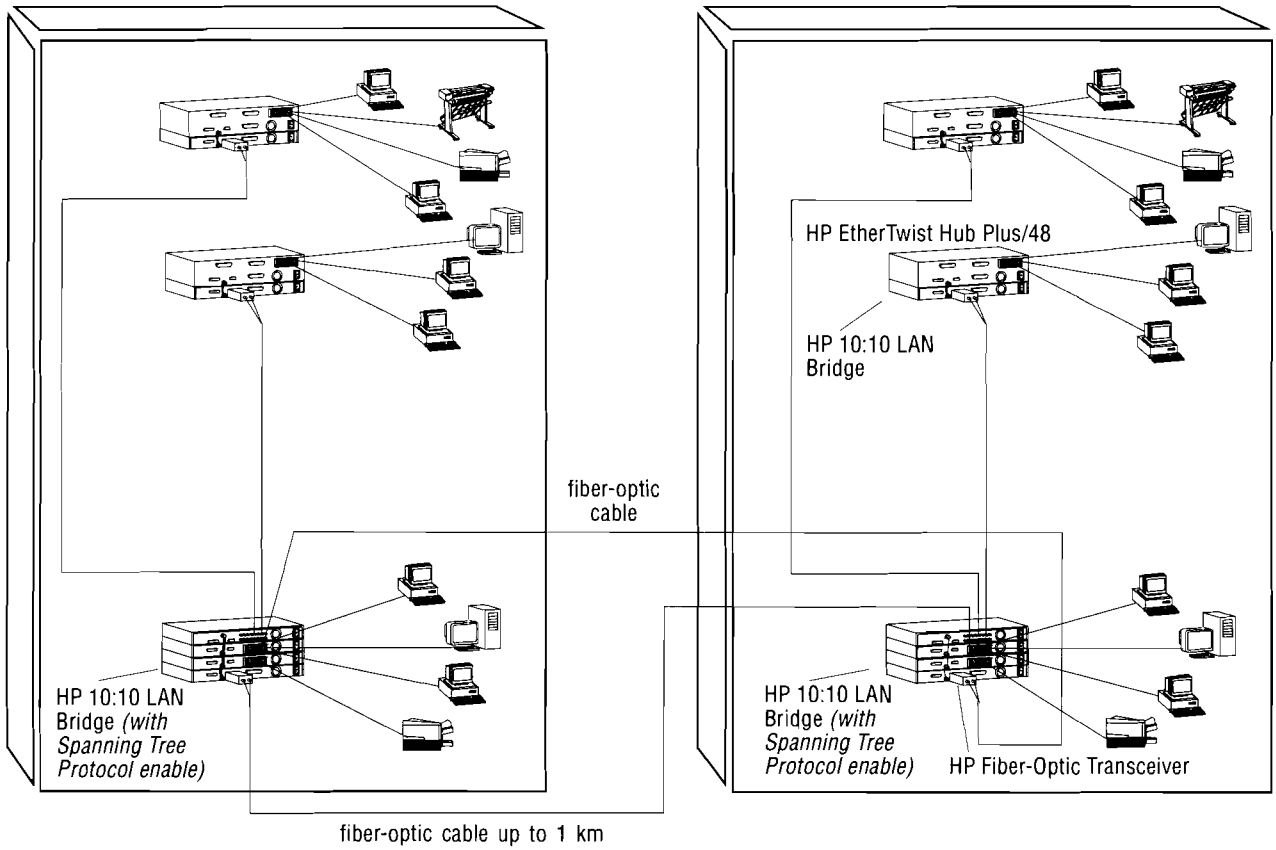


Four ThinLAN hubs are used in the communication path between node 1 and node 2. This site LAN uses thin coaxial cable and fiber-optic cable. Note that of the five segments between nodes 1 and 2, up to three segments can be coaxial segments. The other two segments are fiber-optic segments.

There are two ThinLAN hubs and three coaxial segments in the communication path between node A and node B.

This example shows that the fiber-optic cable segment is limited to 750 meters when thin coaxial cable lengths of greater than 10 meters (up to 185 meters) are used in the communication path between any two nodes on the network.

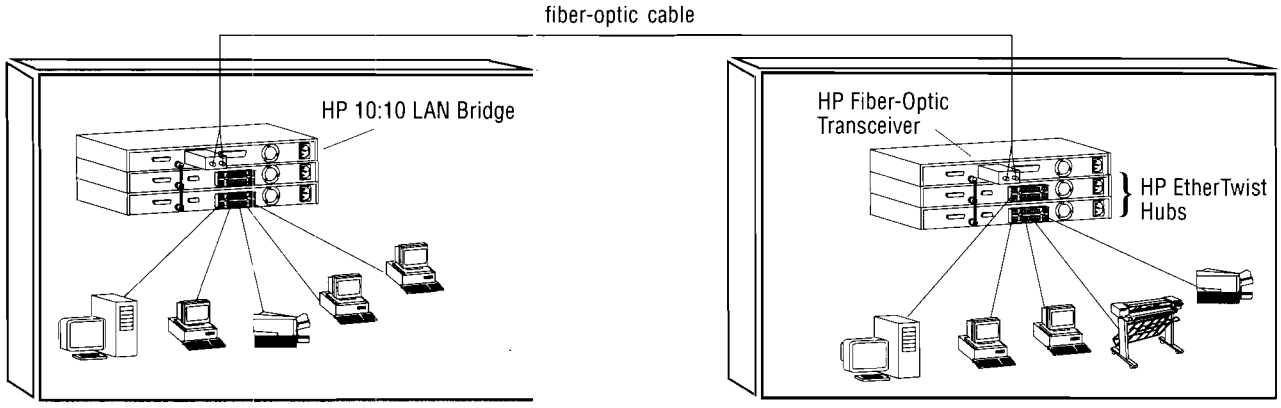
Example 6. Redundant Bridges



One of the benefits of the HP 10:10 LAN Bridge MB is that it supports the IEEE Spanning Tree Protocol (STP). You can use bridges in your network to provide a redundant path in case a failure occurs in the network's active path.

If interbuilding conduits permit, the two fiber-optic cables should be run via separate routes to prevent a single accident from damaging both the active and the backup link.

Example 7. Point-to-Point Configuration



If you wish to connect only two networks (without using a fiber-optic hub), you can use the fiber-optic transceivers (HP 28683A) and the 10:10 LAN bridges in a point-to-point configuration.

In this configuration, the 2-km length for the 62.5/125-µm optical fiber is an exception to the 1-km maximum segment rule.

Please refer to "Product Note—Fiber-Optic Cabling" section of this document for a discussion on optical budget and cable attenuation.

Site LAN Design

Product Note

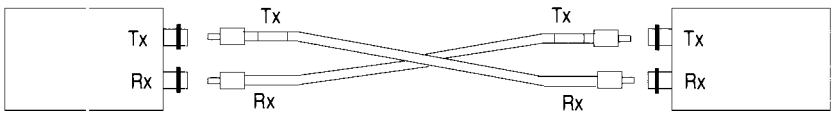
Equipment Layout

The Network Map and Floorplan

The network topology should be drawn in the form of a network map and should show the devices that will be included in the network, the basic layout of their connections, and the types of cable that will be used to connect them.

End-to-End Continuity

A fiber-optic cable consists of two fibers (transmit and receive), both of which connect to the network device or station. The two fibers may be labeled "Tx" and "Rx" at both ends of the cable. If there's a blank label on just one of the two fibers, as shown below, this is a marker for the "Tx" fiber. The "Tx" fiber connects to the "Tx" port (of a fiber-optic hub or transceiver). Therefore, the second fiber (the "Rx" fiber) connects to the "Rx" port of a hub or transceiver. Use this convention at both ends of the fiber-optic cable.



Sometimes fiber-optic cables are routed through fiber-optic patch panels. Make sure that end-to-end continuity is maintained throughout the wiring path.

Mounting HP EtherTwist Devices

Before beginning the planning steps, you should have a general idea of the device mounting strategy you will be using. You may decide on one of the following or on a combination .

Rack Mounting. Rack mounting your HP EtherTwist devices will help keep them neat and organized. Thin coaxial cable connections between the devices provide a virtual backplane that is easy to install and modify. The modular design of the devices makes it easy to make changes to the network design as need arises.

Wall and Table Mounting. If you do not use racks for mounting your devices, you can mount them on a wall or table. In a small network (one or two hubs/bridges at each location), table mounting may be the easiest option. Otherwise, you will probably need to wall mount the devices to keep them neat and organized.

Planning Steps

1. Make sure you have a good network map and floorplan. Keep the following general guidelines in mind.
   - Make sure maximum cable distances between devices are not exceeded. Try to minimize cable runs when possible.
   - Consider ease of access to network devices. Centralized locations (such as wiring closets) make it easier to manage and maintain the network.
   - Consider the logical organization of the network. Keeping logical groups together makes record keeping and maintenance easier. It also allows you to install and verify your network in stages, one logical group at a time.
2. If you are using cross-connect blocks or patch panels, be sure you have the specific wiring layouts planned for each.
3. Plan the specifics of your device mounting strategy. This will be used to make your equipment list. Keep the following general guidelines in mind:
   - For HP EtherTwist devices, direct the cabling to the right-hand side (away from the device's LEDs) when possible.
   - Place cable guide units between devices as needed to provide neat cable management. You can also attach individual cable guide rings to the sides of the rack.
   - Remember that, if you connect network devices with thin coaxial cable, you need at least 0.5 meters of thin coaxial cable between devices. You can keep this cable coiled between devices.
   - Consider possible future changes. You may want to keep devices that might be moved later near the top or bottom of the rack.

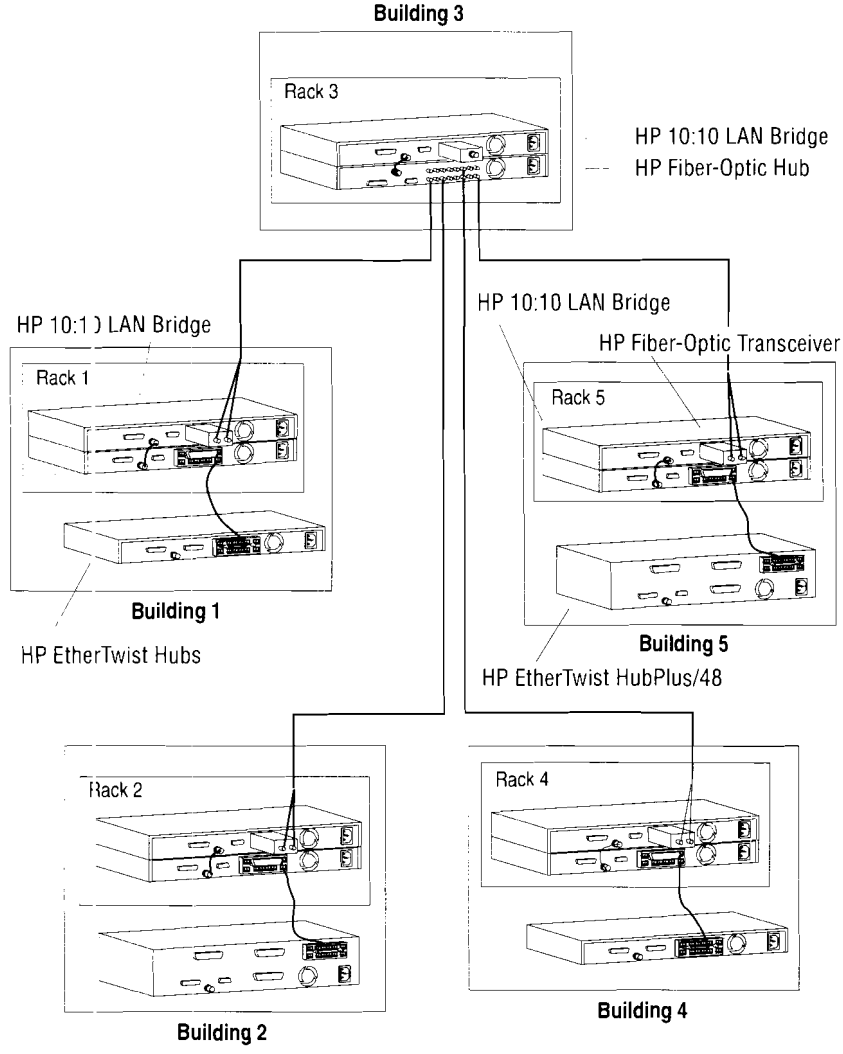
Examples

The following examples show equipment layouts for a fiber-optic backbone topology and a thin coaxial backbone topology. You will need to adapt your layout plans to the constraints of your particular network environment.

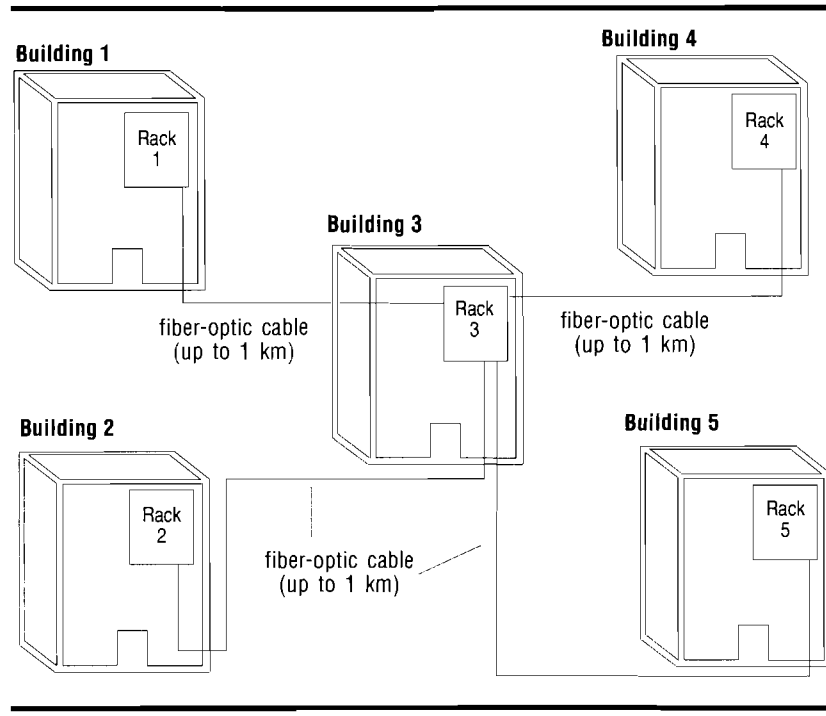
Example 1: Fiber-Optic Backbone Topology

A fiber-optic hub is used to connect multiple building LANs within a campus. Bridges are used to isolate each building's LAN from the fiber-optic backbone.

Network map of campus backbone using fiber-optic cabling.



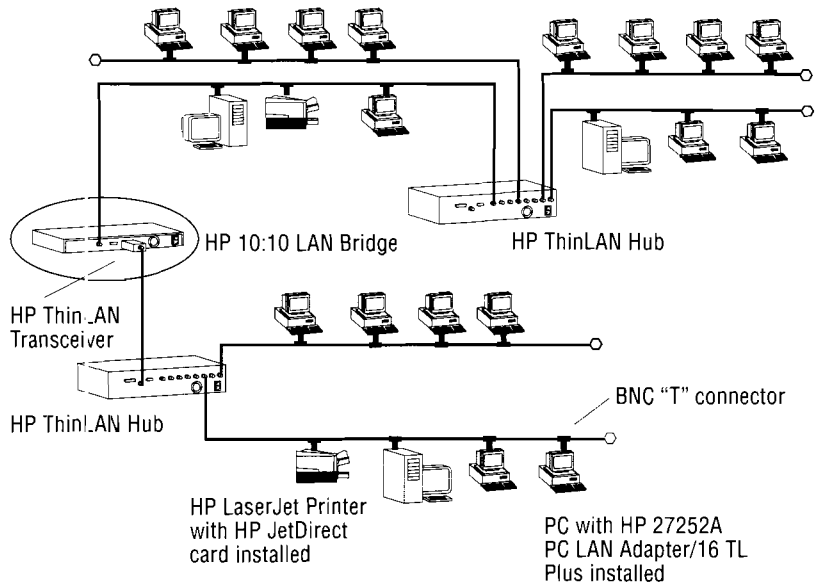
Campus Layout Plan.

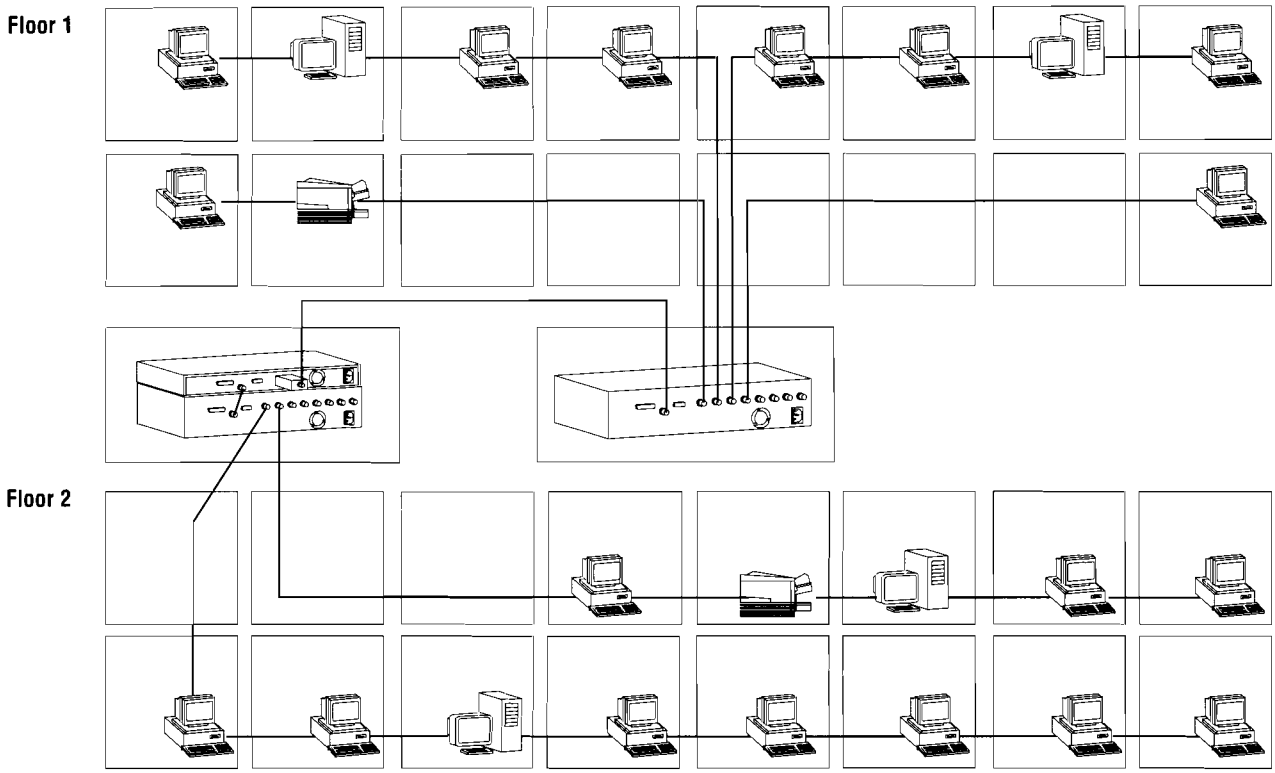


Example 2: Thin Coaxial Backbone Topology

ThinLAN hubs are used to connect multiple workgroup LANs within a building. A bridge is used to isolate the workgroup LANs.

Network map of a building backbone using thin coaxial cable.



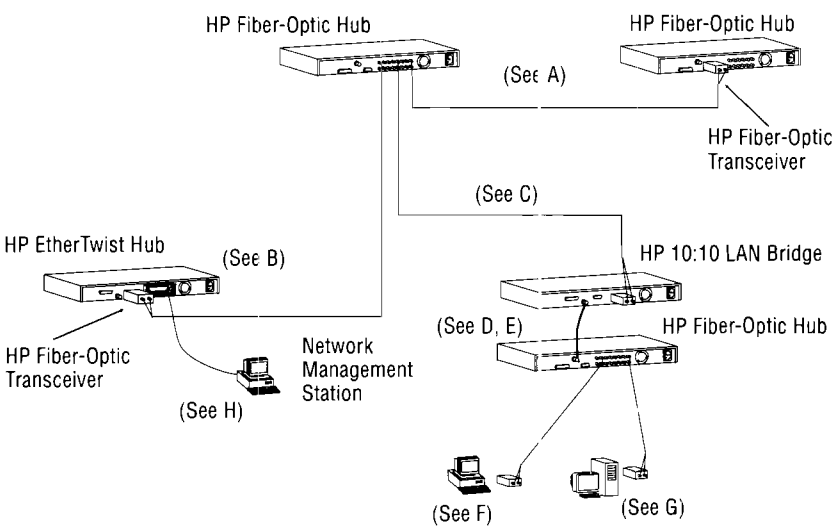


Building Floorplan

HP EtherTwist Family of Network Products

Ordering Guide

Site LAN



To create this simple site LAN using fiber-optic hubs and a 10:10 LAN bridge, the following items are needed:

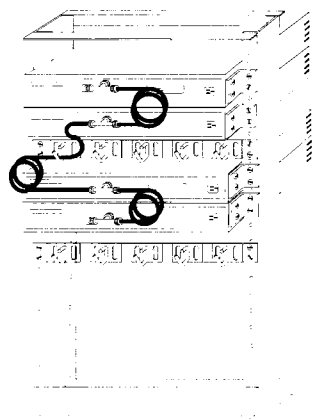
- three fiber-optic hubs
- one 10:10 LAN bridge
- fiber-optic cabling, 62.5/125 µm with ST connectors recommended. (See the "Product Note—Fiber-Optic Cable Specifications" of this document.)
- thin coaxial cable.

The letters shown on the illustration correspond to the ordering sections below.

Network devices from the HP EtherTwist family fit neatly and securely in a 19-inch equipment rack. The illustration shows a configuration with:

- 19-inch equipment rack
- cable guide
- mounting brackets

The illustration also shows thin coaxial connections between hubs or bridges creating a virtual extended backplane.
See section J for ordering details.



Product Number	Description
A. What you need to order for a two fiber-optic hub backbone.	
28682A*	(2) Fiber-Optic Hub Plus. Includes hub and documentation.
28683A	Fiber-Optic Transceiver. Includes transceiver and installation steps.
—	Fiber-optic cable (see "Product Note—Fiber-Optic Cable Specification" of this document).
B. What you need to order to connect an EtherTwist hub to a fiber-optic backbone.	
28683A	Fiber-Optic Transceiver. Includes transceiver and installation steps.
—	The HP transceiver generally attaches directly to an AUI port of the hub. For installations where there is not enough clearance for the transceiver, or where additional cable length is needed between the transceiver and the hub, an AUI cable (HP 92254A to H) of the appropriate length can be inserted between the transceiver and the hub.
—	Fiber-optic cable (see "Product Note—Fiber-Optic Cable Specification " of this document).
C. What you need to order for a fiber-optic hub and a 10:10 LAN bridge connection.	
28683A	Fiber-Optic Transceiver. Includes transceiver and installation steps.
28673A* or 28681A	10:10 LAN Bridge MB. Includes bridge and documentation. 10:10 LAN Bridge LB. Includes bridge and documentation.
—	The HP transceiver generally attaches directly to an AUI port of the bridge. For installations where there is not enough clearance for the transceiver, or where additional cable length is needed between the transceiver and the bridge, an AUI cable (HP 92254A to H) of the appropriate length can be inserted between the transceiver and the bridge.
—	Fiber-optic cable (see "Product Note—Fiber-Optic Cable Specification " of this document).
D. What you need to order to connect a fiber-optic hub or 10:10 LAN bridge to thin coaxial cable via ThinLAN (BNC) port.	
92227N	"T" connector.
92227P	50-ohm terminator pair.
—	Thin coaxial cable.
E. What you need to order to connect a fiber-optic hub, a 10:10 LAN bridge, or other network devices to thin coaxial cable via AUI port.	
28641B	ThinLAN Transceiver.
—	The HP transceiver generally attaches directly to an AUI port of the hub, bridge, or router. For installations where there is not enough clearance for the transceiver, or where additional cable length is needed between the transceiver and the hub, bridge, or router, an AUI cable (HP 92254A to H) of the appropriate length can be inserted between the transceiver and the hub, bridge, or router.
92227N	"T" connector.
—	Thin coaxial cable.

* Order the appropriate language and line cord option if applicable (see item M).

Product Number	Description
F. What you need to order to connect a PC directly to a fiber-optic hub.	
28683A	Fiber-Optic Transceiver. Includes transceiver and installation steps.
—	The HP transceiver generally attaches directly to an AUI port of the card. For installations where there is not enough clearance for the transceiver, or where additional cable length is needed between the transceiver and the card, an AUI cable (HP 92254A to H) of the appropriate length can be inserted between the transceiver and the card.
27248A*	EISA Adapter Card/32. Includes adapter, Support Disk with LAN drivers and diagnostic tool, and documentation.
or	
27247B*	PC LAN Adapter/16 TP Plus. Includes adapter, Support Disk with LAN drivers, HP LANSet configuration tool, and documentation.
or	
27252A*	PC LAN Adapter/16 TL Plus. Includes adapter, Support Disk with LAN drivers, HP LANSet configuration tool, and documentation.
	(Or other vendor PC network adapter card with an 802.3 AUI connector.)
—	Fiber-optic cable (see "Product Note—Fiber-Optic Cable Specification" of this document).
G. What you need to order to connect a computer system directly to a fiber-optic hub.	
28683A	Fiber-Optic Transceiver. Includes transceiver and installation steps.
—	The HP transceiver generally attaches directly to an AUI port of the computer system. For installations where there is not enough clearance for the transceiver, or where additional cable length is needed between the transceiver and the system, an AUI cable (HP 92254A to H) of the appropriate length can be inserted between the transceiver and the system.
—	Appropriate LAN adapter card for the computer system. Must have an 802.3 AUI connector.
—	Fiber-optic cable (see "Product Note—Fiber-Optic Cable Specification" of this document).
H. What you need to order for one PC-based network management station (connected to EtherTwist hub).	
27245A, 27246A, 27247B, 27248A	EtherTwist PC LAN Adapter. Includes adapter, Support Disk with LAN drivers and diagnostic tool (or HP LANSet configuration tool), documentation.
or	
3rd party LAN adapter card	See list of tested 3rd party LAN adapter cards in the "Network Management Question and Answer" section of this technical reference guide.
28686D	HP OpenView Hub Manager/DOS software. Includes Hub Manager disk, HP OpenView Windows disks, training disks, HP IP software, documentation.
or	
27256D	HP OpenView Interconnect Manager/DOS software. Includes Interconnect Manager disks, HP OpenView Windows disks, training disks, HP IP software, documentation.

* Order the appropriate language and line cord option if applicable (see item M).

Product Number	Description
H. What you need to order for one PC-based network management station (connected to EtherTwist hub) *(continued)*.	
—	MS-DOS 3.2, 3.3, 4.01, 5.0 or later.
—	MS Windows 3.00a or 3.1.
—	Personal computer (with at least 2 Mbyte of RAM), color monitor, and mouse.
—	RS-232 cable for console port connection to a hub (see section I). Used to configure the IP address of the hub(s) to be managed.
I. What you need to order for a console port connection to HP hubs or bridges.	
For direct terminal connections:	
13242G, 40242G	25-pin male to 25-pin male cable.
13242H	25-pin male to 25-pin female cable.
24542G	25-pin male to 9-pin female cable.
92221P	9-pin male to 25-pin male cable (for use with HP 110 portable computer).
BlackBox # EVNBPC	25-pin male to 9-pin female cable.
Tandy # 26-1496	25-pin male to 25-pin female null modem adapter. Use with a straight through modem cable.
For modem connections:	
13242M, 13242N, 17355M	25-pin male to 25-pin male straight-through modem cable.
31391A	25-pin male to 25-pin female straight-through modem cable.
J. What you need to order for "racking and stacking" your HP hubs or bridges.	
46298D	19-inch free-standing equipment rack. Can accommodate up to 48 fiber-optic hub pluses and bridges.
35199D *optional*	19-inch cable guide (height=1.75 inches). Includes 5 metal rings for keeping cables organized. Order 1 cable guide for every 2 or 3 hubs/bridges in the rack.
—	Hub/bridge brackets (shipped with hubs/bridges). Used for hanging hubs/bridges in 19-inch rack.
92214U	Thin coaxial cable assembly. Includes 0.5 meter thin coax, 1 "T" connector, 1 50-ohm terminator. Order 1 cable for each hub in the rack.
92227P	Thin coaxial 50-ohm terminator pair. Order 1 pair for one thin coaxial backbone (not needed if 92214U cables ordered).

* Order the appropriate language and line cord option if applicable (see item M).

Product Number	Description
J. What you need to order for "racking and stacking" your HP hubs or bridges. ***(continued)***	
5062-3350	Mounting kit and accessories for HP EtherTwist hubs, bridges, and routers. (The mounting kit ships with every product. Order this part number if you need extras.)
5062-9325	Mounting kit and accessories for HP ThinLAN Hub Plus, HP EtherTwist Hub/8 and the HP EtherTwist Hub Plus/48. (The mounting kit ships with every product. Order this part number if you need extras.)
5062-3351	AUI screw-down retainer.
1400-1497	Velcro strap bracket for 50-pin connector.
5957-8469	Floor bolt set for rack.
K. Additional support and ancillary products for use with HP EtherTwist networks.	
28687A	Wire Test Instrument. Includes 12 loopback hoods, one 12-port modular adapter, documentation.
28689B	EtherTwist Troubleshooting Kit *(order one per installation or order individual parts listed below)*. Includes 50-pin loopback connector, AUI loopback connector, RS-232 loopback connector, 8-pin loopback connector, BNC loopback connector, and V.35 loopback connector.
28663-63001	AUI loopback connector.
28606-63067	RS-232 loopback connector.
28663-63002	50-pin loopback connector.
28606-63037	V.35 loopback connector.
28606-63007	WAN (DB-62) loopback connector.
5061-2550	Token-ring loopback connector.
5041-3738	Fiber-optic loopback connector.
5181-6181	ST-SMA Fiber Adapter. Includes ST connectors on one end of the adapter and SMA connectors on the other end.
92268P	RJ-45 modular plugs (box of 25).
92268T	RJ-45 hand crimp tool.
92227L	BNC connectors (2), crimp-or type.
92227M	BNC connector hand crimp tool.
92227N	BNC "T" connector with cover.
92227P	50-ohm terminators (2).
92227Q	ThinLAN loopback (BNC "T" with terminators).
92227R	Insulation cover for the BNC "T" connector.
92268J	Wallplate (duplex RJ-45/RJ-11).
92224F	RS-232-C female gender converter.
92224M	RS-232-C male gender converter.

* Order the appropriate language and line cord option if applicable (see item M).

Product Number	Description
K. Additional support and ancillary products for use with HP EtherTwist networks. *(continued)*	
Twisted-Pair Cables:	
92268A	4-meter twisted-pair cable. Includes 8-pin modular plugs on each end.
92268B	8-meter twisted-pair cable. Includes 8-pin modular plugs on each end.
92268C	16-meter twisted-pair cable. Includes 8-pin modular plugs on each end.
92268D	32-meter twisted-pair cable. Includes 8-pin modular plugs on each end.
92268N	300-meter twisted-pair cable (no connector, cut to length).
92268P	8-pin modular plugs (package of 25).
92268J	8-pin modular wall jack (package of 12).
92268S	6-pin to 8-pin adapter cable (5 meters long).
92268T	8-pin modular plug crimp tool. Includes 25 8-pin modular plugs.
92214W	Crossover cable with coupler. Includes 8-pin modular plugs on each end (20 cm long).
Note:	*For other suitable twisted-pair cables, see the "Cabling" section of this guide.*
AUI Cables:	
92264D	1-meter thin AUI cable, with connectors attached. Includes 1 male and 1 female connector. Outer jacket material made of PVC.
92254J	5-meter thin AUI cable, with connectors attached. Includes 1 male and 1 female connector. Outer jacket material made of PVC.
92254A–D	6-, 12-, 24-, 48-meter thick AUI cables, with connectors attached. Includes 1 male and 1 female connector. Outer jacket material made of FEP Teflon.
92254E–H	6-, 12-, 24-, 48-meter thick AUI cables, with connectors attached. Includes 1 male and 1 female connector. Outer jacket material made of PVC.
Thin Coaxial Cables:	
92227A–H	1-, 2-, 4-, 8- 16- 32- 64-, 128 meter thin coaxial cables, with connectors attached. Outer jacket material made of PVC.
92227S	300-meter thin coaxial cable, with no connectors. Outer jacket material made of PVC.
92227T	100-meter thin coaxial cable, with no connectors. Outer jacket material made of FEP (Teflon).
92227U	300-meter thin coaxial cable, with no connectors. Outer jacket material made of FEP (Teflon).

* Order the appropriate language and line cord option if applicable (see item M).

Product Number	Description
K. Additional support and ancillary products for use with HP EtherTwist networks. ***(continued)***	
Thick Coaxial Cables:	
92253A	23.4-meter thick coaxial cable, with no connectors. Outer jacket material made of FEP (Teflon).
92253B	23.4-meter thick coaxial cable, with connectors attached. Outer jacket material made of FEP (Teflon).
92253C	117-meter thick coaxial cable, with no connectors. Outer jacket material made of FEP (Teflon).
92253D	500-meter thick coaxial cable, with no connectors. Outer jacket material made of FEP (Teflon).
92253E	23.4-meter thick coaxial cable, with no connectors. Outer jacket material made of PVC.
92253F	23.4-meter thick coaxial cable, with connectors attached. Outer jacket material made of PVC.
92253G	117-meter thick coaxial cable, with no connectors. Outer jacket material made of PVC.
92253H	500-meter thick coaxial cable, with no connectors. Outer jacket material made of PVC.
Coaxial Connectors:	
30241B	Thick coaxial cable tap.
92253J	Package of 4 "N" connectors.
92253K	Package of 2 barrel connectors and 2 barrel insulators.
92253L	Package of 1 non-grounded 50-ohm terminator, 1 grounded 50-ohm terminator, and 1 insulator. Used with thick coaxial cable.
92256E	Thick coaxial cable surge protector.
92229B	Crimp tool for "N" connectors. Requires die found in 92256A product.
92256A	Thick coaxial cable installation tool kit. Includes coaxial cable stripper and hex crimp die for 92229B crimp tool.
92227L	Package of 2 crimp-on BNC connectors.
92227M	Thin coaxial cable installation tool kit. Includes cable stripper and crimp tool.
92227N	"T" connector with insulating cover. Includes 1 connector.
92227P	Thin coaxial 50-ohm terminator pair.
92227Q	Thin coaxial loopback connector. Includes 1 "T" connector, 1 50-ohm terminator pair, and insulating cover.
92227R	Insulating cover for "T" connector.

* Order the appropriate language and line cord option if applicable (see item M).

Product Number	Description
L. What you need to order for ThickLAN backbone connections to HP hubs, bridges and other network devices.	
30241A	HP Thick MAU (transceiver). Includes coaxial cable tap. Note that an HP 30241A Thick MAU with date code D-3017 or earlier cannot be used with the HP Fiber-Optic Hub Plus. (The date code is found on a small white sticker on the body of the device. Lesser numbers indicate an earlier manufacturing date.) Instead, use an HP 30241A with date code F-3105 or later, and follow the included product instructions for disabling SQE test.
—	Thick coaxial cable.
—	AUI cable.

M. Language and Line Cord Options.

HP Fiber-Optic Hub/HP 10:10 LAN Bridge/HP Remote Bridge

Option	*Language*	*Line Cord*
ABA	English	U.S.
ABB	English	Europe
ABC	English	U.S.
ABD	English	Europe
ABE	English	Europe
ABF	English	Europe
ABM	English	Latin America
ABP	English	Switzerland
ABQ	English	Switzerland
ABU	English	United Kingdom
ACE	English	Denmark
ABZ	English	Europe
ABG	English	Australia
ACF	English	Japan

HP 28687A Wire Test Instrument

Option	*Language*	*Line Cord*
none	English	appropriate line cord ships automatically

Site LAN Cabling

Product Note

Fiber-Optic Cable Specifications

Fiber Specifications

The HP Fiber-Optic Hub Plus and HP Fiber-Optic Transceiver support two different fiber core and cladding sizes, 62.5/125 µm and 50/125 µm. Both HP products use ST connectors.

Fiber Core/Cladding Size:	62.5/125 µm	50/125 µm
Fiber Type:	Multimode	Multimode
Attenuation Grade:	≤4.0 dB/km	≤4.0 dB/km
Numerical Aperture:	0.275	0.20
Modal Bandwidth:	≥150 MHz*km	≥150 MHz*km

Note: Attenuation and modal bandwidth values are at 850 nm wavelength for both fiber sizes.

IEEE FOIRL Recommendation

The IEEE FOIRL (fiber-optic inter-repeater link) standard limits a fiber segment length to 1 km. That is, the fiber-optic cable that connects two repeaters is limited to 1 km. In most network configurations, use the 1-km length maximum as a rule of thumb. The only exception to this rule is that the maximum cable length between two HP 10:10 LAN Bridges connected via 62.5/125-µm cable and HP Fiber-Optic Transceivers is 2 km.

What limits the length of the fiber-optic cable segment?

A common assumption is that what limits the length of a fiber-optic link is the attenuation of light as it travels from one end of the fiber to the other. This assumption is true for some applications of fiber optics such as video or voice. However, for IEEE 802.3 or Ethernet fiber-optic LAN applications, the limiting factor on the cable segment length is mostly a combination of propagation delay and cable attenuation. In most fiber-optic network configurations, or in a mix of fiber-optic, coaxial, and twisted-pair network configurations, propagation delay is the main factor in determining the fiber-optic segment length.

The Propagation Delay Factor

To determine how far apart two nodes can be (without bridges and routers between them), it is important that the round trip propagation delay between the two nodes be less than or equal to 51.2 microseconds (or within 512 bit times). That is, 51.2 microseconds is the total time limit for a signal to travel from one node to the other node and for a collision indication to return. In general, point-to-point links can propagate collisions faster than coaxial cable segments. Therefore, when there is a mix of point-to-point links and coaxial cable segments in your network, there will be a trade-off in lengths that you can use for the various types of cables.

Even though propagation delay is a factor that limits fiber-optic cable lengths for most network configurations, you should also be careful about using too many patch panels and splices (and the resulting attenuation) in the cable path. Having a lot of patch panels and splices in your cable path can quickly become the primary factor (over propagation delay) of limiting your cable length.

Attenuation

Attenuation across a fiber-optic link is the decrease in optical power (loss) as light travels through the fiber. Attenuation is usually measured in decibels per kilometer (dB/km) at a specified wavelength. The lower the numerical value for attenuation grade, the better the fiber. For example, if a fiber's attenuation grade is 3.0 dB/km, then it provides less loss in the optical budget than a fiber with an attenuation grade of 4.0 dB/km.

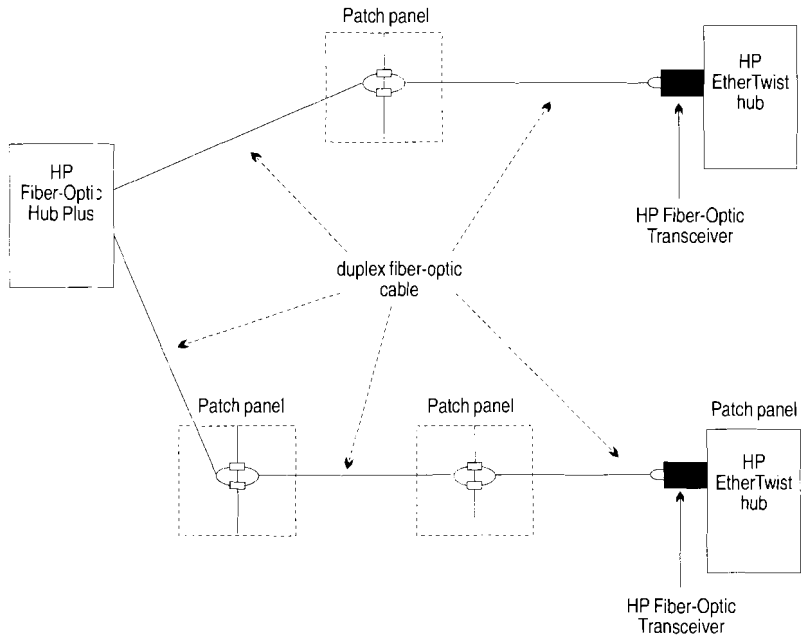
Optical Budget

Optical budget refers to the maximum amount of signal that can be lost in the fiber-optic link and still maintain data integrity. (You can think of it as the amount of signal attenuation that you can "spend" in making the connection between two fiber-optic devices.) Two major factors that can contribute to light loss are connections along the fiber-optic link and cable attenuation.

HP recommends the use of 62.5/125-µm fiber whenever possible because it allows for a higher optical budget. With 62.5/125-µm fiber the optical budget is 10 dB; with 50/125-µm fiber it is 6 dB.

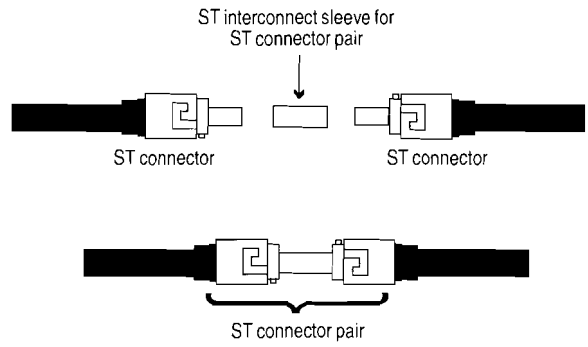
Configuration Examples

Example A. Cablir.g systems using patch panels.



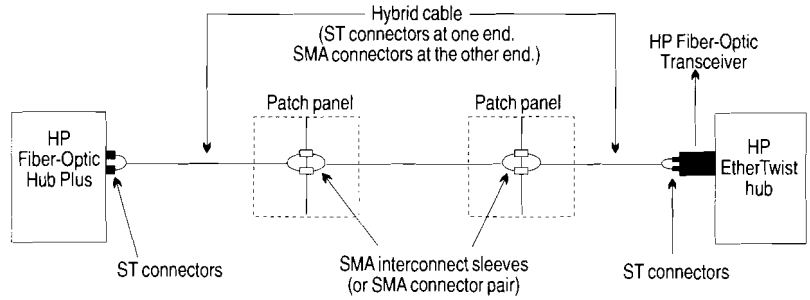
The HP Fiber-Optic Hub Plus and HP Fiber-Optic Transceiver use duplex fiber-optic cable. (Duplex fiber refers to two fibers. One is used for transmitting data, the other is used for receiving data.)

Like unshielded-twisted-pair cabling systems, fiber-optic cabling systems also use patch panels to facilitate the ongoing management of fiber-optic cabling systems. Fiber-optic patch panels come in various sizes and styles. There are wall-mount and rack-mount versions. The patch panels contain interconnect sleeves (small tubes) that join two fiber-optic connectors. The union of two connectors is commonly called a connector pair. The typical signal loss across an ST connector pair is 0.5 dB.



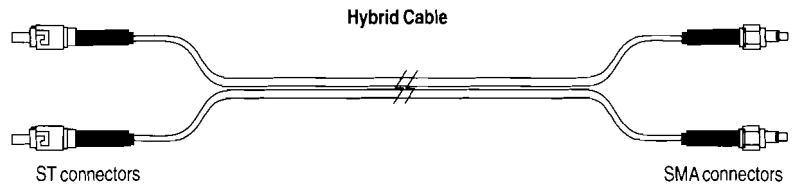
Example B.

Cabling systems containing SMA connectors.



The HP Fiber-Optic Hub Plus and HP Fiber-Optic Transceiver use ST connectors because these are becoming the industry standard for fiber-optic networking products. However, a situation may arise where the hub and transceiver are being installed in a fiber-optic cabling system that contains SMA or Biconic connectors. (SMA and Biconic connectors are not compatible with ST connectors.)

A hybrid cable can be used to connect the hub and transceiver to existing cabling systems (with SMA or Biconic connectors). A hybrid cable has ST connectors at the product end and SMA or Biconic connectors at the patch panel end. Hybrid cables are available from many cable vendors. An example of an ST-SMA hybrid cable is shown below.

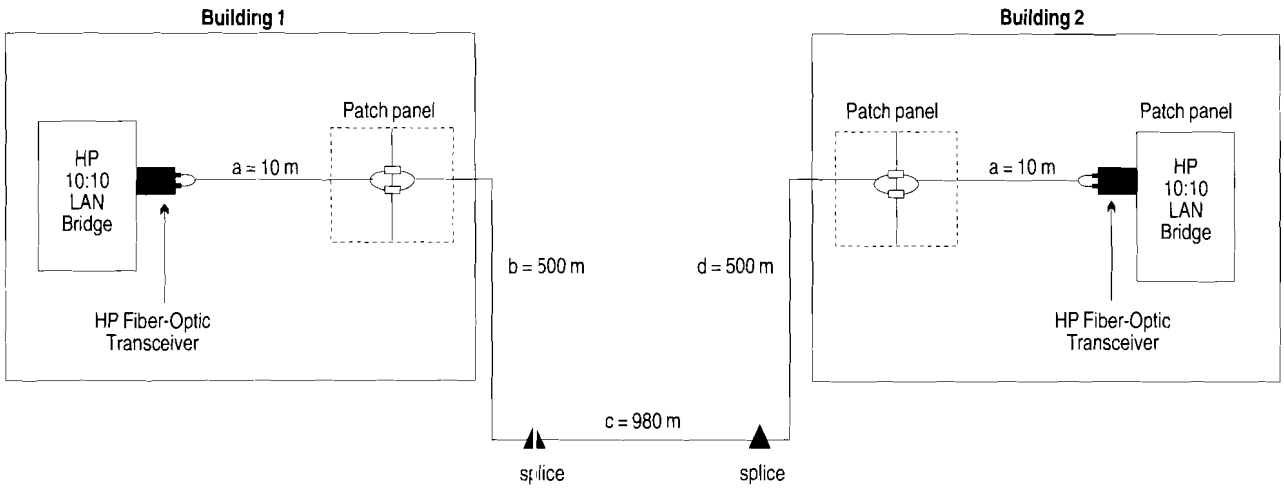


A 1-meter duplex fiber-optic cable with ST connectors on one end and SMA connectors on the other end is available by ordering HP part number 5181-6181.

Example C.

Point-to-point configuration with transceivers and bridges.

Transceivers can be used in a point-to-point configuration when two separate LANs are being connected by two HP 10:10 LAN Bridges. The chart below lists the lengths for both 62.5/125-µm and 50/125-µm fiber for each portion of the cable illustrated in example C. (Example C shows the lengths for 62.5/125-µm fiber.)



	62.5/125 µm	50/125 µm
a	10 m	10 m
b	500 m	300 m
c	980 m	380 m
d	500 m	300 m
e	10 m	10 m
total	2000 m	1000 m

The Attenuation Factor

Note that in this point-to-point configuration with HP bridges, the total fiber-optic cable length (end-to-end) is 2 km for 62.5/125-µm fiber. (With 50/125-µm fiber the total cable length is 1 km.) The point-to-point configuration (with HP bridges) for 62.5/125-µm fiber is an exception to the 1-km maximum segment rule.

In this case, it is cable attenuation (or link loss) that determines the maximum segment length, not propagation delay.

Example C also shows two patch panels and two splices, which are sources of attenuation in the fiber-optic link. That is, loss of light occurs through these connections. Typical ST connector pair (patch panel) loss is 0.5 dB (and can be as high as 1.2 dB per connector pair). This range in connector pair loss is attributed to the quality of the ST connector itself and the workmanship of making the ST connector pair for the patch panel. (A discussion on splices follows the optical budget calculation.)

Optical Budget Calculation

For example, calculating the fiber-optic link loss for example C would be as follows. First assume that you are using 62.5/125-µm fiber with attenuation grade of 4 dB/km. (A calculation is also provided for 50/125-µm fiber with attenuation grade of 4 dB/km.)

Fiber attenuation (62.5/125 µm):	2 km x 4.0 dB/km	=	8.0 dB
Connector pair (patch panel) loss:	2 connector pairs x 0.5 dB/pair	=	1.0 dB
Total Link Loss (62.5/125 µm):			9.0 dB
Fiber attenuation (50/125 µm):	1 km x 4.0 dB/km	=	4.0 dB
Connector pair (patch panel) loss:	2 connector pairs x 0.5 dB/pair	=	1.0 dB
Total Link Loss (50/125 µm):			5.0 dB

Both cable types for this point-to-point configuration are within their respective optical budgets. (That is, the optical budget for 62.5/125-µm fiber is 10 dB and 6 dB for 50/125-µm fiber.)

Even though both are within their respective optical budgets, it does not take many additional losses to the fiber-optic link to exceed their optical budgets.

Link Loss through Splices

Additional link losses (from cable splices) can affect the optical budget of your fiber-optic cabling system. To help illustrate this, we will continue to use the optical budget calculation for example C. A fusion splice, for example, is a technique used by cable installers to fuse bare fiber cores together. A fusion splice can be used to repair a fiber-optic cable. Typically, the loss through a fusion splice is 0.3 dB per splice.

In example C, adding the loss from 2 fusion splices (2 x 0.3 dB/splice = 0.6 dB) to the total link loss of both fiber types is 9.6 dB for 62.5/125 µm and 5.6 dB for 50/125 µm. These total values are very close to their optical budgets. Therefore, it is a good idea to keep a "buffer" between the optical budget and your link's actual total loss (in case you need to add splices to the cable in the future). One way to minimize going beyond the optical budget is to limit the fiber segment distance whenever possible.

The optical budget calculation for example C shows that you also need to minimize the number of patch panels and splices in the fiber path. Keep in mind that these calculations apply to the configuration of using HP Fiber-Optic Transceivers in a point-to-point configuration with HP 10:10 LAN bridges. The numbers used for the connector pair (patch panel) loss and splice loss are typical values and you should verify the exact values with your cable installer for your specific installation.

Typical cable attenuation for a good grade of fiber is about 3.5 dB/km for 62.5/125-µm fiber and about 3.0 dB/km for 50/125-µm fiber.

Choosing the Appropriate Cable Construction

Like coaxial and twisted-pair cabling, fiber-optic cabling is available in different constructions for specific installation environments. There are five different cable constructions available for fiber optics.

Outside plant. These cables are constructed for outdoor installations in or outside conduit and contain a steel-tape armor. In outdoor cables, the fibers are loosely placed in a jell-like compound that allows for thermal expansion and contraction of the fibers due to wide temperature variations.

Indoor/Outdoor. These cables can be used between buildings when there is a relatively short distance between the buildings. They are designed to be rugged enough for the outdoors while still passing intrabuilding fire codes.

Riser. These cables are designed for a building's riser shaft (or elevator shaft) and are designed to fan out at the patch panel.

Plenum. A plenum-rated cable is designed to meet the National Electric Code's flammability requirements for indoor cable.

Interconnect. In most cases, you will only be handling the interconnect cables that will go between an HP Fiber-Optic Hub Plus (or HP Fiber-Optic Transceiver) and a patch panel. The most common interconnect cable is a zip-cord design that comes pre-connectorized and is available through most cable supply vendors.

If your site requires a complete cable plant design and installation, contact your HP Sales Representative and request the HP CableSite Service or contact your preferred cable installation company.

Other Fiber-Optic Cabling Considerations

FDDI

If you are planning to use the same fiber-optic cabling with the HP Fiber-Optic Hub Plus and HP Fiber-Optic Transceiver and with FDDI (Fiber Distributed Data Interface) products, HP recommends that you install fiber-optic cabling that meets the FDDI specifications:

Fiber Core/Cladding Size:	62.5/125 µm
Fiber Type:	Multimode
Attenuation Grade:	≤2.5 dB/km (at 1300 nm)
Numerical Aperture:	0.275
Modal Bandwidth:	≥500 MHz*km (at 1300 nm)

Many fiber-optic cable vendors are now supplying a dual-window fiber. (Dual-window fiber refers to fiber-optic cabling that is designed for operation at both 850 nm and 1300 nm wavelengths.) Dual-window fiber can be used to meet your current cabling needs for IEEE 802.3/Ethernet applications and future FDDI applications.

In addition to the above FDDI fiber-optic cable specifications, there are other (physical) FDDI cabling requirements. You should consult your preferred cable installation company for details.

Handling of Fiber-Optic Cables

When handling fiber-optic cables, do not bend the cables tighter than a 50 mm (2 inches) bend radius. While the glass fiber in the cable is quite flexible, the glass can be fractured by keeping it in a position tighter than the minimum bend radius. A cable failure may not occur immediately, but over time, the cable may be rendered useless.

The cable must be free of kinks, twists, and jacket irregularities. When installing the HP Fiber-Optic Hub Plus in a 19-inch rack, be careful when organizing fiber-optic cables around the rack and other equipment.

When you are not using all of the fiber-optic ports on the hub, it is helpful to keep the dust-cover caps on both the HP fiber-optic hub and transceiver ST connectors as well as on the connectors at the ends of the cables. This will prevent dust particles from blocking the light flow to the products and cables.

Site LAN Cabling

Product Note

Fiber-Optic Cables with ST Connectors

Normally, the fiber-optic cables needed to complete an installation are supplied by the cable installation contractor. In the event that you are not using a cable installer, or do not have a local source of pre-connectorized fiber-optic cable, or do not have a cable distributor that you normally work with, the following companies can be contacted for pre-connectorized, custom-length fiber-optic cables. This list is not exhaustive and you should consult other cable vendors in your area.

While pre-connectorized cables can minimize time, labor and equipment in the installation (particularly a small installation), special considerations may be necessary during installation to protect the connectors as the cable gets pulled. Also, determine the cable length that is required to route the cable in the path you desire. That is, to connect two network devices, take into account the distance to get around desk areas or any objects in the path. Keep in mind that if a connector on the cable is damaged during installation, the skills and equipment to repair it may not be readily available.

Dupont Corporation
489 Siecor Park
Hickory, NC 28603-0489 **(704) 327-5000**

Cables through Dupont for use with the HP Fiber-Optic Hub Plus or HP Fiber-Optic Transceiver would be ordered as:

Connector at End 1:	ST
Connector at End 2:	ST
Cable Type:	2-fiber zipcord, 62.5/125 μm* multimode plenum or non-plenum**
Performance:	≤4 dB/km attenuation @ 850 nm ≥160 MHz bandwith @ 850 nm
Length:	Length of cable needed

* 50/125-μm cable can be specified instead, but is not recommended for new cable installations.

** Cables that will be routed through an air plenum must be plenum rated in order to meet fire codes.

Red Hawk
1411 S. Milpitas Blvd.
Milpitas, CA 95035 **(408) 945-1800**

Specify the part number:

(P)Y221313-xxxM

where: P specifies a plenum-rated cable and is optional. Cables that will be routed through an air plenum must be plenum rated in order to meet fire codes.

xxx is the length of the cable in meters.

The above part number will provide a duplex zipcord 62.5/125-µm multimode cable with ≤4 dB/km attenuation, ≥160-MHz bandwidth @ 850 nm, ST connectors at both ends.

A 50/125-µm fiber-optic cable (not recommended for new cable installations) can be specified instead of 62.5/125-µm cable via the following part number:

(P)Y211313-xxxM

where: P specifies a plenum-rated cable and is optional. Cables that will be routed through an air plenum must be plenum rated in order to meet fire codes.

xxx is the length of the cable in meters.

Site LAN Cabling

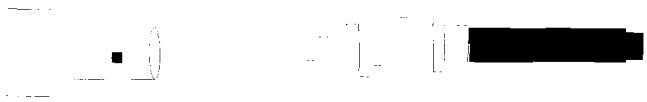
Product Note

Cable Connections for Site LAN and Multisite LAN Products

Product	Available Connections (Ports)
HP 2868 2A Fiber-Optic Hub Plus	1 BNC, 1 female AUI, 1 female 25-pin RS-232 (console port), 8 fiber-optic ST connector pairs (female)
HP 28683A Fiber-Optic Transceiver	1 fiber-optic ST connector pair (female), 1 male AUI
HP 28641B ThinLAN Transceiver	1 BNC, 1 male AUI
HP 2867 3A 10:10 LAN Bridge	1 BNC, 2 female AUI, 1 female 25-pin RS-232 (console port)
HP 28681A 10:10 LAN Bridge LB	1 BNC, 2 female AUI,

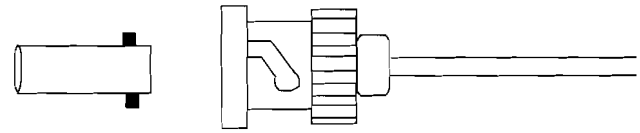
Connectors

ST Connectors

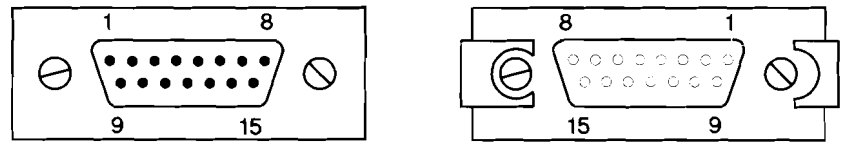


female male

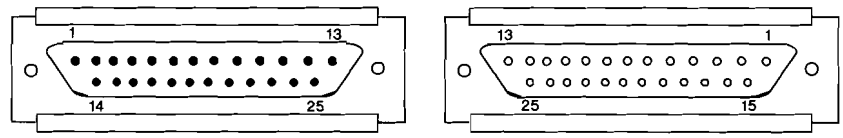
BNC Connectors



15-Pin D (AUI) Connector



Standard 25-Pin RS-232-C Connector



15-Pin to 15-Pin AUI Cable

(minimum pin-out)

15-pin female		15-pin male	
2	———	2	CI A
3	———	3	DO A
4	———	4	DI shield
5	———	5	DI A
6	———	6	voltage common
9	———	9	CI B
10	———	10	DO B
12	———	12	DI B
13	———	13	voltage plus

Available HP cables: 92254A/.../H, 92254J, 92264D

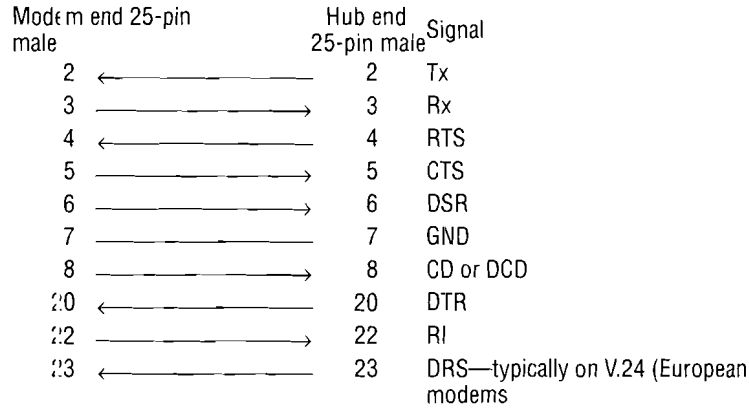
RS-232 Cable and Connector Pin-Outs

Hub 25-Pin Female Connector

Pin	US	CCITT	DIN
1	CHS GND	101	
2	TX	103	D1
3	RX	104	D2
4	RTS	105	S2
5	CTS	106	M2
6	DSR	107	M1
7	GND	102	
8	CD	109	M5
20	DTR	108	S1
22	RI	125	M3
23	SR	111	

RS-232-C Modem Cable

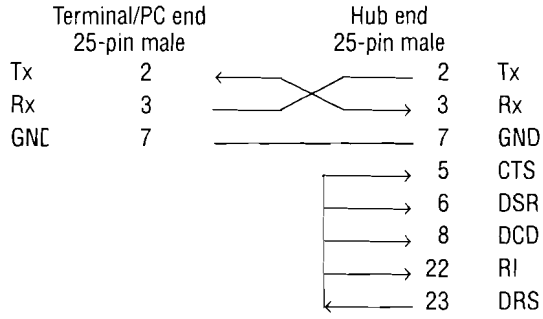
(minimum pin-out)



Available HP Cables: 13242M/N, 17355M

RS-232-C Cable for Terminal or 25-Pin HP Vectra PC

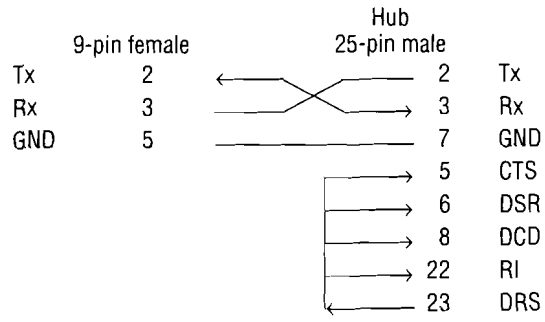
(minimum pin-out)



Available HP Cables: 13242G, 40242G

RS-232-C Cable for 9-Pin HP Vectra PC

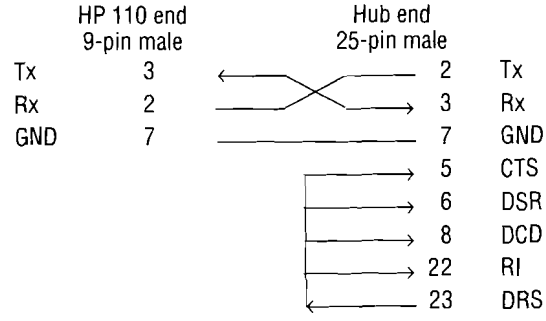
(minimum pin-out)



Available HP Cable: 24542G

RS-232-C Cable for HP 110

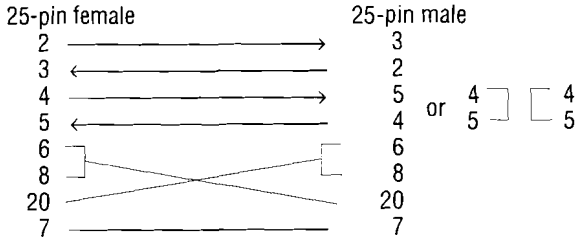
(minimum pin-out)



Available HP Cable: 92221P

Null Modem Adapter for use with Modem Cable

(minimum pin-out)



DTR (pin 20) and RTS (pin 4) must be on, or high, on your terminal or in your terminal emulation program.

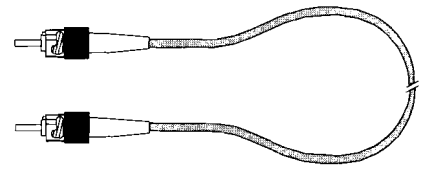
Available HP Cable: 92221P

Loopback Connectors

The four loopback connectors shown below are useful for troubleshooting your HP Fiber-Optic Hub Plus, HP ThinLAN Hub Plus, and HP bridges. The connectors for the AUI, ThinLAN, and console ports are included in the HP Extended LAN Troubleshooting Kit, product number HP 28689B, or all four can be purchased separately. Contact your HP-authorized LAN dealer or your local HP sales office for assistance.

For Fiber-Optic Ports

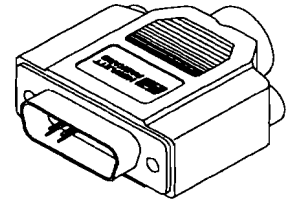
HP Fiber-Optic Loopback Cable,
HP part number 5041-3738.



For AUI Port

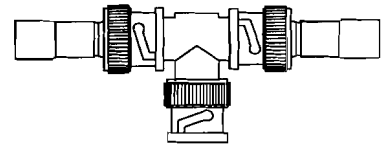
HP part number 28663-63001.
The following pins are connected:

- pin 3 to pin 5
- pin 10 to pin 12



For ThinLAN Port

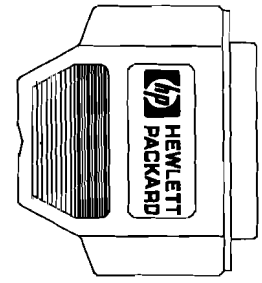
HP part number 5061-4990.
BNC "T" with two 50-ohm terminators attached.



For Console Port

HP part number 5062-3355.
The following pins are connected:

- pin 2 to pin 3
- pin 4 to pin 5 to pin 8
- pin 6 to pin 20 to pin 22
- pin 7 to pin 23



Technical Reference Guide

Multisite LANs

- **Introduction**
- **HP Bridges**
- **HP Routers**
- **Multisite LAN Design**
- **Multisite LAN and WAN Connections**

LAN Products

Introduction

Multisite LANs

A multisite LAN connects site LANs. A multisite LAN does not have geographical limitations. It can connect several geographically dispersed site LANs located in different cities, states, or countries.

The connectivity hardware used to build a multisite LAN includes:

- Wide area network (WAN) link. This may be a leased line, satellite link, or public/private X.25 packet-switched network, etc.
- WAN link terminating equipment to access the WAN link (such as DSU/CSUs, and various modems including a T-carrier modem or V.35 modem).
- HP Remote Bridge RB to connect an 802.3/Ethernet LAN to a wide area link.
- HP Router ER to connect two 802.3/Ethernet LANs to one or two wide area links.
- HP Router TR to connect one 802.3/Ethernet LAN and one 802.5/token ring LAN to one or two wide area links.

The organization and placement of HP EtherTwist network products discussed in this reference guide is not rigid. For instance, HP routers may be used to interconnect multiprotocol networks within a site LAN. That is, you don't always have to use WAN links and WAN link terminating equipment in order to use HP routers. HP routers can be used to administratively divide a large site LAN and to help optimize overall network performance. Even though HP routers are presented in the Multisite LAN section of this document, routers may be used in site LANs as well.

Bridge and Router Differences

Bridges operate at the data link layer (layer 2) of the OSI model, which makes them independent of (invisible to) higher layer protocols. Because of this, HP bridges operate in any Ethernet/802.3 environment regardless of the network layer (layer 3) protocol.

Routers operate at the network layer (layer 3) of the OSI model. Routers route packets using the network layer addresses of the packets. These are assigned by a network administrator and always configured with software. Routers can support different network layer protocols such as:

- TCP/IP
- IPX
- XNS
- DECnet Phase IV
- AppleTalk Phase 2

Routers communicate with other routers on the network that support the same set (or a subset) of network layer protocols. HP routers support all of the above network protocols, as well as bridging (with Spanning Tree Protocol). Any network protocols that cannot be routed are bridged by HP routers.

As with bridges (using the Spanning Tree protocol), if one path in a network fails, a router can select another available path. This helps improve network fault tolerance. Unlike bridges, a router can also keep all available network paths active at the same time to increase the effective bandwidth.

Routers provide greater LAN isolation capabilities than bridges. This helps with network administration, problem isolation, and trouble-shooting. For example, a bridge will filter out some packets, but generally will not filter out broadcast packets or packets with addresses it does not recognize. A router can provide greater isolation of broadcast traffic and can filter out packets addressed to unreachable destinations.

Routers allow greater control over network traffic than a bridge. For example, static routes let you direct certain packets along pre-determined paths. This allows you to restrict the paths of sensitive information. You can also define sophisticated traffic filters (providing more control than bridge filters) that restrict traffic of certain types to or from specific areas of the network.

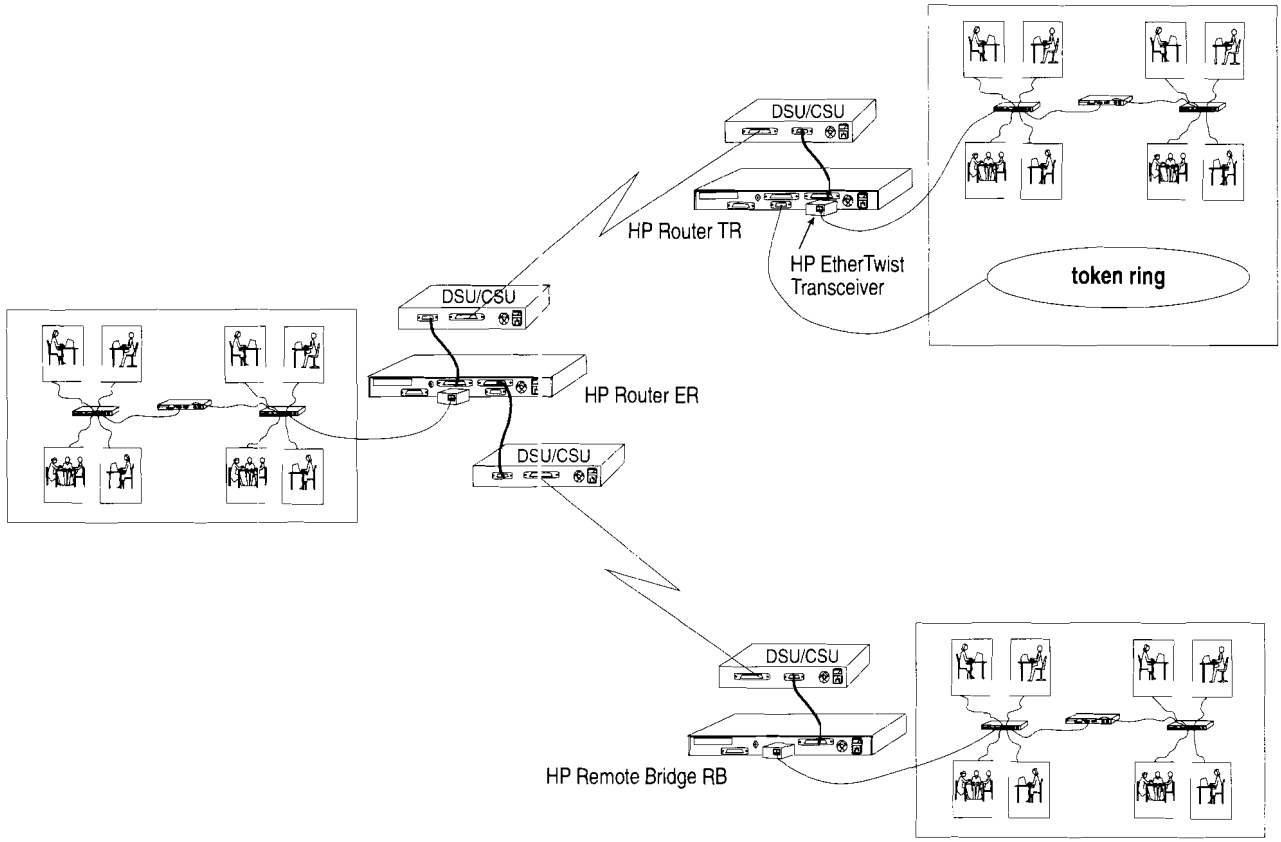
An important feature of routers is the ability to handle parallel active links. With bridges, only one parallel link is allowed to be active at one time (via Spanning Tree Protocol). Routers can make use of the combined bandwidth of multiple links. This makes routers a good choice for use in complex network topologies.

Use bridges for:

- low-cost, plug-and-play installation
- backbone connections (LAN or WAN) using a single layer 2 protocol (Ethernet/IEEE 802.3)
- backup links
- traffic management for security or performance reasons
- network expansion past hub limitations (for example, maximum number of hubs between nodes, maximum cable lengths, maximum number of nodes)

Use routers for:

- complex network topologies
- networks that use different media types and network layer protocols
- active parallel links and redundancy
- mixed layer 2 protocols (for example Ethernet and token ring)
- powerful security and administrative control based on subnetwork IDs (rather than station addresses only)
- networks using X.25



HP Remote Bridge RB

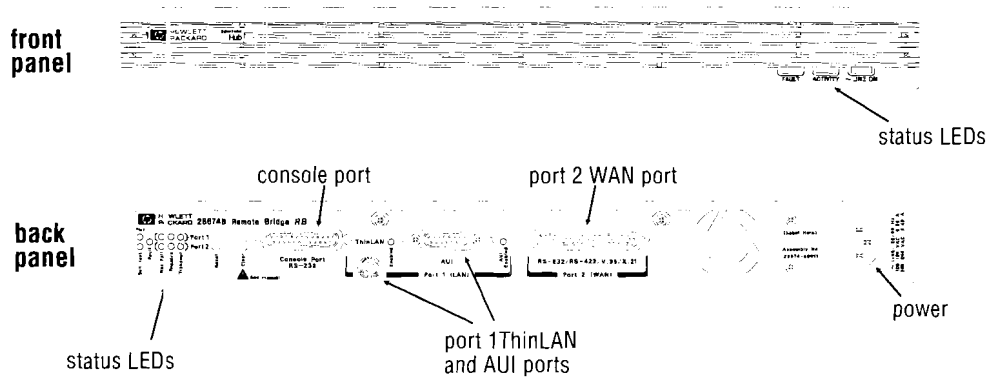
Technical Data

Product Number
HP 28674B

The HP 28674B Remote Bridge RB is a "learning" bridge that can connect one local and one remote 802.3 Ethernet LAN to form a single, integrated communications network between geographically distant sites. Since the HP bridges are protocol-independent and operate at "media speed", they can be used in a multivendor network without causing a bottleneck.

An HP universal interface with appropriate 5-meter interface cable to an external DSU/CSU provides access to digital leased lines. The HP Remote Bridge RB supports speeds from 19.2 Kbit/s to 2.048 Mbit/s (E-1). Each remote connection requires two HP Remote Bridge RBs, one at each end of the wide area link, or one HP Remote Bridge RB and one HP or Wellfleet router.

The HP Remote Bridge RB includes agent firmware to support network management via SNMP/IP and SNMP/IPX. In addition, the firmware incorporates HP EASE (Embedded Advanced Sampling Environment), an embedded instrument technology that allows the bridge to perform trend analysis functions. When used with HP OpenView Resource Manager/DOS, the Remote Bridge RB can identify top talkers, heavy users, error sources, and communication pairs, thus providing a new level of capability that complements dedicated instrumentation.



The HP Remote Bridge RB can be used in any multivendor 802.3/ Ethernet environment because it is protocol independent. The bridge operates at the media access control (MAC) sublayer of the data link layer (layer 2) of the OSI model. From the perspective of the end nodes that are exchanging data, the bridge is invisible to higher layer protocols.

The remote bridge uses the Spanning Tree Protocol developed by the IEEE 802.1 committee. The Spanning Tree Protocol (STP) allows IEEE 802.3/Ethernet LANs to have redundant paths. In the event of a primary link failure, a backup link takes over, thereby ensuring continued data transmission between the networks.

The HP Remote Bridge RB has one LAN port. Port 1 has two connectors, an AUI and a ThinLAN (BNC). Choose one by simply attaching the appropriate cable. When the bridge is powered on, the hardware circuitry will automatically sense which connector you are using. You don't need to select a switch for this. Each connector has an LED located next to it. (The LED will turn on to show which connector is being used on port 1.)

Port 2 of the bridge has a 62-pin (female) HP universal interface connector. Use one of four interface cable options (that you can order with the bridge) to connect the remote bridge to the DSU/CSU. The four interface cable options are: RS-232-C, RS-422/449, V.35, and X.21.

The bridge identifies nodes on a network using the station address (also known as the MAC address, Ethernet address, or physical address). When the bridge receives a data packet (on either of its two network ports), it examines the source and destination station addresses and uses its address table to determine how to process the packet. The address table keeps track of where each node is located on the two connected LANs.

If the address table shows that the source and destination nodes are on the same LAN, then the bridge discards the packet. The packet doesn't need to be forwarded to the other LAN to reach its destination. By discarding packets that don't need to be forwarded, the bridge keeps the network and the WAN link from being clogged by unnecessary traffic.

The bridge's forwarding decision is determined by:

- the bridge operating state
- static entries in the bridge's address table
- wildcard filters configured for the bridge
- the bridge state under the Spanning Tree Protocol (STP)

These factors all interact to influence the bridge's forwarding function, but do not affect media speed performance.

More information on wildcard filters and on the Spanning Tree Protocol can be found in "Product Note—Setting Network Security with HP Bridges" and "Product Note—Spanning Tree Protocol Support on HP Bridges", respectively.

Highlights

☆ **High Performance**
The HP Remote Bridge RB can filter and forward data packets as fast as the wide area link can operate; this is called "media-speed"operation. In addition, the bridge conserves network capacity (bandwidth) by isolating local traffic and forwarding only those packets with destinations on the other side of the bridge.

☆ **Fault Tolerance**
The Spanning Tree Protocol, developed by the IEEE 802.1 committee, permits IEEE 802.3/Ethernet LANs to be bridged in an arbitrary topology that includes alternative or redundant paths. In the event of a primary link failure, a backup link takes over automatically, ensuring continued data transmission between networks.

☆ **Network Management**
The HP Remote Bridge RB supports both SNMP/IP and SNMP/IPX network management communications over the network with HP OpenView Interconnect Manager/DOS (HP 27256D). HP OpenView Interconnect Manager/DOS is a Windows and DOS-based application program that runs on a network management station. From a network management station, a network administrator can monitor and control HP bridges (HP Remote Bridge RB and HP 10:10 LAN Bridge MB) on the network. HP OpenView Interconnect Manager/DOS provides facilities to monitor network traffic, set alarm conditions, help identify and diagnose network problems, enhance network security, and increase network reliability by controlling bridges serving as redundant data paths.

HP OpenView network management continuously updates HP OpenView Window's graphical network map to display the current state of the network, and notify the network administrator of network events. Configuring, monitoring, and controlling the entire network are made easy with HP OpenView network management. For more information on HP OpenView Interconnect Manager/DOS or HP OpenView Hub Manager/DOS, refer to the HP OpenView Network Management section of this document.

☆ **Console (RS-232) Port**
Basic bridge management features are also available through the bridge's RS-232 console port. Simply connect an ASCII terminal or a PC emulating an ASCII terminal to the console port directly or via modem. You can check bridge status, the spanning tree configuration, and network traffic statistics and collisions, and you can perform basic diagnostic tests. You can also configure several bridge parameters such as the IP configuration, the WAN configuration, the bridge operating state, and wildcard filters. New firmware enhancements can also be downloaded through the console port for low-cost updates.

Features

- Forwards and filters data packets as fast as the network can operate (media-speed operation).
- Conserves network capacity (bandwidth) by isolating local traffic and only forwarding packets that need to be forwarded.
- Does do not propagate collisions or corrupt packets from one network to another. Data integrity is maintained through CRC checks.
- Automatically learns station addresses by examining the network traffic.
- Uses the IEEE 802.1 Spanning Tree Protocol to support backup links between LANs in case of link failure.
- Is invisible to network operating systems and higher level protocols because the bridge operates at the MAC sublayer of the data link layer of the OSI network model.
- Connects geographically distant LANs to form one extended network.
- Comes pre-configured with an optimal configuration for operation in most installations. An external DSU/CSU is required for each bridge.
- Is easy to install; attach it to the DSU/CSU (WAN link equipment), and plug it in. The bridging function starts automatically.
- Is compatible with IEEE 802.3 and Ethernet LANs.
- Provides a console (RS-232) port (access by modem or direct connection) for bridge configuration, statistics, diagnostics and troubleshooting when the network link is down.
- The console port also allows downloading of product updates to the bridge firmware.
- Can connect to LANs of different media types through the built-in AUI and ThinLAN (BNC) ports.
- Has an automatic choice of two LAN connections on Port 1 via BNC connector or an AUI connector. (No need to select by switch.)
- Provides a WAN connection via the HP universal interface port with the appropriate 5-meter interface cable (RS-232, RS-442/449, V.35, X.21). The HP Remote Bridge RB automatically senses which specific interface is connected. Wide area link speeds between 9.6 Kbits/second and 2.048 Mbits/second are possible.
- Has LEDs located on the front and back of the HP bridge for easy recognition of the bridge's operating condition.
- Provides two 32-bit wildcard filters that allow address filtering on any two 32-bit blocks in the data packet.
- Allows filtering based on combinations of stations configured into the address table (in secure mode), to provide greater security for individual stations.
- Supports SNMP/IP- and SNMP/IPX-based network management. The bridge can be managed from a centralized network management station on the LAN using the HP OpenView Interconnect Manager/DOS software (HP 27256D).
- Mounts in a standard 19-inch rack (with cables facing front or back), on a wall (flat or on end), or on any horizontal surface like a shelf or table. Since the bridge is only 1.75 inches high (one rack space), it takes up very little space in any mounting configuration.

Specifications

Environmental Characteristics

Operating Temperature: 0°C to 55°C (32°F to 131°F)

Relative Humidity: 15% to 95% @ 40°C (104°F) noncondensing

Physical Characteristics

Dimensions:	42.6 cm by 23.5 cm by 4.4 cm (16.8 in. by 9.3 in. by 1.7 in.)
Weight:	2.7 kg (6.0 lbs)

Electrical Characteristics

Voltage:	100-120 V ac	200-240 V ac
Current:	0.5 A max	0.25 A max
Frequency:	50/60 Hz	50/60 Hz

The HP Remote Bridge RB automatically adjusts to any voltage between 90 and 240 volts.

Standards

Communications:	CCITT V.35 IEEE 802.3 Type 10Base2 IEEE 802.1 Spanning Tree Protocol
Safety:	UL 1950 CSA 220 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class B EN 55022 (1988) Class B VCCI Class 2
Immunity:	
ESD	IEC 801-2: 1991 3 kV CD, 8 kV AD prEN 55101-2: 1990
Radiated Emissions:	IEC 801-3: 1984 3 V/m prEN 55024-3: 1991

WAN Interface Cables

The HP 28674B includes a WAN (synchronous) interface cable. Select the cable type by ordering the appropriate option.

Option	*Cable Type*
001	V.35
002	RS-232
003	X.21
004	RS-422

Warranty

HP 28674B Remote Bridge RB is warranted for one year against defects.

HP Remote Bridge RB

Product Note

Questions and Answers

General

Q. When should I use remote bridges in my network?

A. Remote bridges are best used in a point-point configuration between two geographically dispersed sites. The HP Remote Bridge RB provides bridging services and has one LAN and one WAN port. For example, a main office site LAN located in San Francisco can connect to a branch office site LAN located across the bay in Oakland.

HP Remote Bridge RBs provide many benefits such as:

- Connecting a LAN at one site to a remote 802.3/Ethernet LAN via wide area link.
- Providing security between the networks it connects.
- Providing redundancy (or fault tolerance) by using the Spanning Tree Protocol.

Q. What does "media-speed" bridge mean?

A. Media speed is defined as the ability for a network device to receive and forward data packets as fast as the physical layer rate. For example, the physical layer rate for 802.3 LANs is 10 Mbit/second. When data frames appear (at the fastest rate possible) on the network attached to the HP Remote Bridge RB, the bridge is fast enough to process each frame before receiving the next one. The HP 28674B Remote Bridge RB uses a queuing algorithm for buffering packets to ensure that the bridge does not become the traffic bottleneck during times of peak network loading.

Q. What is the difference between the HP 28674A Remote Bridge and the HP 28674B Remote Bridge RB?

A. The "B" version remote bridge has a 62-pin universal connector on its WAN port (port 2). The 62-pin connector can be used with 4 different types of interface cables to provide connections to V.35, X.21, RS-232-C, and RS-449/422 devices, such as DSU/CSUs. A queuing algorithm has also been added to the "B" version to support WAN link connections via 9600-baud modems.

The "A" version has a V.35 connector on its WAN port and supports WAN link speeds ranging from 56 Kbit/s to 2.048 Mbit/s.

Q. How can I obtain a WAN link?

A. A WAN link (wide area network link) requires an arrangement for a leased line through the local phone company (if the ends of the WAN link are in one phone company's service area—if not, it is necessary to work through a common carrier for your region or country). For example, common carriers in the U.S. such as Sprint, MCI, or AT&T can arrange line services for you. WAN link speeds can range from 9.6 Kbit/s to 2.048 Mbit/s.

Q. What is a DSU/CSU used for?

A. The DSU/CSU (data service unit/channel service unit) provides each HP Remote Bridge RB access to the WAN link. DSU/CSUs provide access to common line services such as T-1 (1.544 Mbit/s), E-1 (2.048 Mbit/s), fractional T-1 (64 Kbit/s) and 56-Kbit/s digital data services (DDS).

Q. Which DSU/CSUs can be used with the HP Remote Bridge RB?

A. The following DSU/CSUs have been tested with the HP Remote Bridge RB:

Vendor	Product	DTE I/F	DTE Data Rate	WAN I/F
Scitec	Integrator 1544	- V.35 - RS-449	56 or 64 Kbit/s x n (n = 1 to 24)	RJ-45C T1
Scitec	SAT D4	- V.35 - RS-449	1.344 to 1.544 Mbit/s	DB15 T1
Digital Link	DL551VII	- V.35 - RS-449	1.344 to 1.544 Mbit/s	RJ4-8 T1
Digital Link	DL2048V	- V.35 - RS-449 - X.21	1.984 or 2.048 Mbit/s	G.703 E1
Digital Link	DL551VX	- V.35 - RS-449	56 or 64 Kbit/s x n (n = 1 to 24)	RJ-48 T1
Digital Link	DL551VX-FT	- V.35 - RS-449	56 or 64 Kbit/s x n (n = 1 to 24)	RJ-48 T1 Fractional
Larse	Split-T	- V.35 - RS-449	56 or 64 Kbit/s x n (n = 1 to 24)	DB15 T1 Fractional
Codex	3500	- V.35	2.4 to 56 Kbit/s	DDS
AT&T Paradyne	Comsphere 3610	- V.35	2.4 to 64 Kbit/s	DDS, ASDS

Q. Does the HP Remote Bridge RB support dial-up capability?

A. No.

Q. What processor does the HP Remote Bridge RB use?

A. The HP Remote Bridge RB uses an AMD 29000 32-bit RISC (16.6 MIPS) processor.

Q. What kind of framing does the HP Remote Bridge RB require—D4 or ESF?

A. It does not require either. D4 or ESF is a requirement of the T1 network connection. In order to connect to the T1 network, DSU/CSUs need to know what kind of framing to use. The DSU/CSU communicates to the remote bridge via V.35, RS-232, RS-422/449, or X.21 standards. Therefore the remote bridge does not really care what kind of framing the DSU/CSU uses.

Q. Can the HP Remote Bridge RB work with modems that operate at 9.6 Kbit/s? At 19.2 Kbit/s?

A. Yes. The HP 28674B Remote Bridge RB uses a queuing algorithm to make sure that packets sent or received on a 9600 bit/s or 19.2 Kbit/s line connection are buffered and not lost.

The "A" version remote bridge does not support WAN link speeds lower than 56 Kbit/s.

Q. Does the HP Remote Bridge RB support data compression across the WAN link?

A. No, it does not currently support data compression.

Q. Can I connect the HP Remote Bridge RB to an X.25 network?

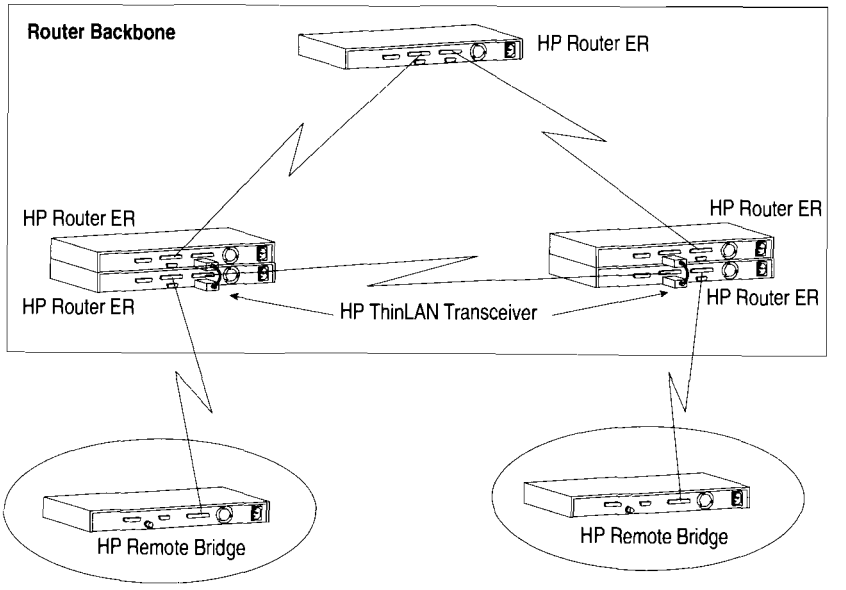
A. No, the HP Remote Bridge RB does not support X.25 connections to PSNs (packet switching networks). If you need X.25 connectivity, use HP routers.

Q. How does the bridge store configuration data?

A. Configuration data for the HP 28674B Remote Bridge RB is stored in battery-backed RAM. All parameters that you set or any enhancements that you download to the bridge's firmware are stored in the battery-backed RAM.

Q. Can I connect the HP Remote Bridge RB to a router?

A. Yes. The HP Remote Bridge RB can be connected to the HP 27285A Router ER, the HP 27286A Router TR, or the HP 27270A Router CR. Routers can connect multiple site LANs in a mesh topology. (Routers organized in this manner can be thought of as a router backbone.) Note that when connecting routers to the HP Remote Bridge RB over the WAN port, the router must be configured for LLC Type II. The HP Remote Bridge RB provides a low cost "end-node" connection to an HP Router backbone (as illustrated below).



Q. What is the difference between a router and a remote bridge?

A. Routers operate at the network layer (layer 3) of the OSI model. They route packets using the network layer addresses assigned by a network administrator. Routers can support different network layer protocols such as:

- TCP/IP
- DECnet Phase IV
- IPX/SPX
- XNS
- AppleTalk Phase 2

Routers communicate with other routers on the network that support the same set (or a subset) of network layer protocols. HP routers support all of the above network protocols, as well as bridging (with Spanning Tree Protocol). Any network protocols that cannot be routed are bridged by HP routers.

In general, routers can:

- Connect networks that use different media types and network layer protocols.
- Support both local (LAN) and wide area (WAN) links to the network.

The HP Remote Bridge RB operates at the MAC (media access control) sublayer of the data link layer (layer 2) of the OSI model. It is invisible to network operating systems and higher level protocols.

Q. When should I use an HP Remote Bridge RB or HP router?

A. Use the HP Remote Bridge RB to connect two remote site LANs. Since bridge operation is invisible to network operating systems and higher level protocols, it can bridge packets that cannot be routed. The remote bridge also requires very little software configuration. The remote bridge provides an easy-to-use, low-cost solution for connecting two remote sites.

For more complex network situations, routers are usually the preferred solution. Routers are designed to meet various network needs such as:

- the need to support medium-to-large networks consisting of many workgroup LANs and site LANs
- the need for redundant active WAN links to enhance network reliability
- the use of X.25 links for WAN transport
- the desire to create administratively separate subnets
- the need to control access to different parts of the network for security
- the desire to stop the propagation of broadcast packets and other unnecessary network traffic

Remote Bridge RB Ports

Q. What are the different ways to connect the HP Remote Bridge RB to a local 802.3/Ethernet network?

A. You can connect a transceiver (fiber-optic, twisted-pair, thin or thick coaxial) to the bridge's AUI port, or you can use the built-in BNC connector to connect the bridge to a thin coaxial network.

Q. What kind of transceiver cable should I use to connect to the HP 28683A Fiber-Optic Transceiver to the HP Remote Bridge RB? How will the bridge know to enable the AUI port?

A. It is not necessary to use a transceiver cable. The HP 28683A Fiber-Optic Transceiver, as well as the HP 28685B EtherTwist Transceiver and the HP 28641B ThinLAN Transceiver, can connect directly to the AUI port of the HP Remote Bridge RB. When the bridge first powers up or when it is reset, it will automatically sense which connector you are using on port 1 of the bridge.

Q. What are the different ways to connect the HP 28674B Remote Bridge RB to a WAN link?

A. The HP 28674B Remote Bridge RB's WAN link port consists of a 62-pin universal connector. There are four interface cable options that you can specify when you order the HP 28674B. The HP Remote Bridge RB automatically senses which interface cable is connected to its WAN port. Wide area link speeds between 9.6 Kbit/s and 2.048 Mbit/s are possible.

Cable Type	Connector (Device End)	Option Number
V.35 cable, 5 m	34-pin, male	001
RS-232 cable, 5 m	25-pin D, male	002
X.21 cable, 5 m	15-pin D, male	003
RS-422/449 cable, 5 m	37-pin D, male	004

Note that the HP 28674A Remote Bridge differs from the "B" version in that it has a built-in V.35 connector (rather than a 62-pin connector on its WAN port. It is not necessary to order a cable option with the "A" version remote bridge.

Q. Do I need to configure the connector I plan to use (AUI or BNC) on port 1 of the HP Remote Bridge RB?

A. No configuration is needed. Choose one connector by simply attaching the appropriate cable/device (an AUI cable or a transceiver to the AUI connector, or a BNC "T" and thin coaxial cable to the BNC connector). Each connector has a Port LED. When the bridge is powered on, the hardware circuitry will automatically sense which connector on port 1 you are using and its Port LED will turn on.

Q. If I plan to use the AUI connector of port 1, do I need to terminate the ThinLAN (BNC) connector?

A. No. The hardware interface at port 1 automatically knows that you are using the AUI connector. The unused and unterminated BNC connector does not affect the bridge operation.

Q. How can I establish a console session on the bridge?

A. First attach your terminal or modem to the console (RS-232) port. To start a bridge console session, the bridge must have successfully completed self-test and initialization. During the self-test, the bridge tests to see that both ports are properly terminated and have functional LANs attached. If the ports are not terminated, the bridge will fail its self-test with a net fail indication (the Self-test, Net Fail, and Fault LEDs are all on.) Make sure that both of the bridge ports are either attached to viable networks or are terminated with loopback connectors before the bridge is powered on. The bridge will then complete its self-test and initialization and the console session can be started by pressing the Enter key a few times.

Q. Do I need to set the password on my bridge?

A. By default, the HP Remote Bridge RB is shipped with no password set. You can set the password by using the console port or HP OpenView network management.

Once your password is set, the bridge will always prompt you to enter the password in these three instances

- when you initiate a console session
- when you change the bridge password
- when you change bridge parameters with HP OpenView network management

Q. What can I do if the bridge password is lost/forgotten?

A. To delete the password, press the button labeled "Password Clear" on the bridge (located to the left of port 1). Hold the button for approximately one second to erase the password. The "Password Clear" button is recessed (to prevent accidental pressing). To press it, use a non-conducting pointed implement like a toothpick.

For HP 28674A Remote Bridges (the earlier bridge product), make sure that the firmware revision is C.01.xx or D.01.xx. (The Password Clear functional is provided in both the C.01.xx and D.01.xx revisions.) Also, on older bridges, the label for the button may be "Config-Clear".

Q. What is the difference between the Password Clear function and the Config-Clear Reset function?

A. The Password Clear function is used to clear your bridge password only. The Config-Clear Reset function resets the firmware code and the configuration parameters in the bridge to the factory-set values. You should use the Config-Clear Reset function as a last resort.

For more information, see the "Saving your Hub and Bridge Configurations" Product Note located in the Advanced Topics section of this document.

Q. Do I need to set the IP configuration parameters on my bridge if I'm using Novell NetWare software?

A. No. When using Novell NetWare, it is not necessary for you to set the IP configuration parameters on your bridge. The HP OpenView Interconnect Manager/DOS (HP 27256D) and the HP bridges support IPX communications.

If you are not using Novell NetWare software, you must set the IP configuration parameters on your bridge if you wish to manage your bridges with HP OpenView network management using IP communications.

Q. How do I set the IP configuration parameters on my bridge?

A. To set the IP configuration parameters on your bridge, you must attach a terminal or terminal emulator to the bridge's console port. Once a console port session is established, then use the IP command to set the IP parameters for your bridge.

Status LEDs

Q. What does the Fault LED indicate?

A. The Fault LED (yellow) is ON if the bridge or network has failed during the self-test or normal operation. (The Fault LEDs are located on the back as well as the front of the bridge.) If the Fault and Self-test LEDs are both ON during a self-test, the bridge is at fault. If only the Fault LED is ON, it indicates bridge failure during normal operation. You should reset the bridge to run its self-test.

See the bridge's manual for details of the LED pattern interpretations.

Q. What does it mean if the Fault and the LAN port's Net Fail LEDs are ON?

A. If these LEDs are ON during a self-test or normal operation, this most likely indicates that the LAN cable or transceiver is bad or is improperly connected, or the LAN cable is unterminated.

Q. What does it mean if the WAN port's Net Fail LED is ON?

A. The WAN port's Net Fail LED can indicate both initialization failure and operational failure:

- This LED turns ON (and the Fault LED turns ON) during initialization if the bridge cannot detect carrier, or if the WAN link terminating equipment is in loopback mode and the bridge is unable to establish a connection with the remote bridge or router at the other end of the WAN link.
- This LED turns ON during normal bridging operation when the logical link between the remote-bridge pair (or between a remote bridge and a router) becomes disconnected and the bridge also detects a loss of carrier.

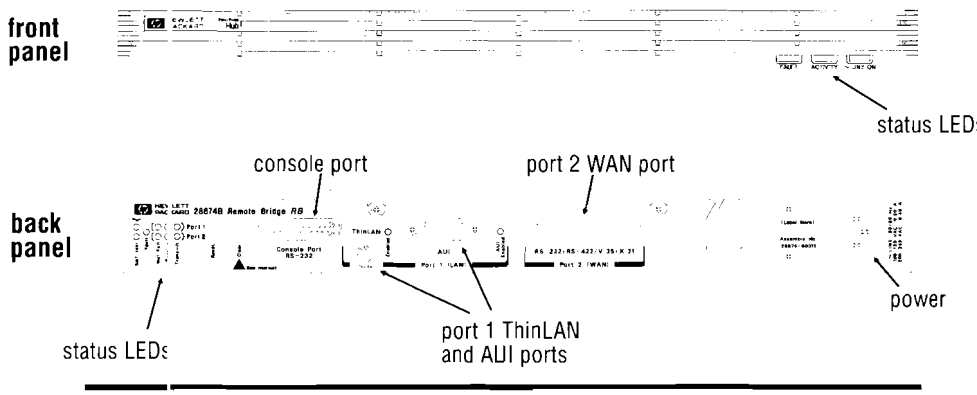
HP Remote Bridge RB

Installation Steps

HP 28674B

The HP 28674B Remote Bridge RB is designed to be used in pairs to connect two 10-Mbit/s IEEE 802.3/Ethernet networks across a 9.6 Kbit/s to 2.048 Mbit/s wide area link.

Installation details are provided in the *HP Remote Bridge RB Installation and Reference Guide* (28674-90003).



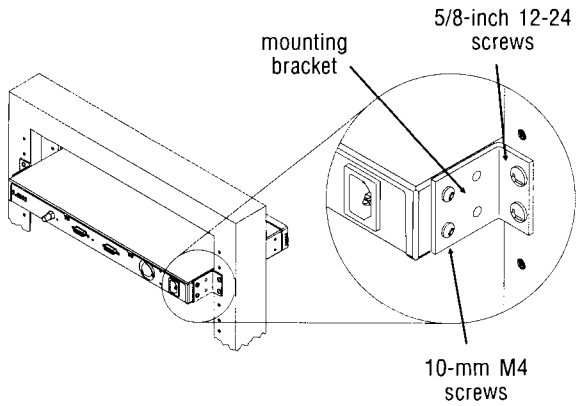
Mount the bridge.

Mount the bridge in a 19-inch telco rack, or on a wall, or attach the rubber feet to the bottom of the bridge and place it on a surface near a power source.

The mounting brackets can be oriented to mount the bridge in a number of different ways.

Example rack mounting:

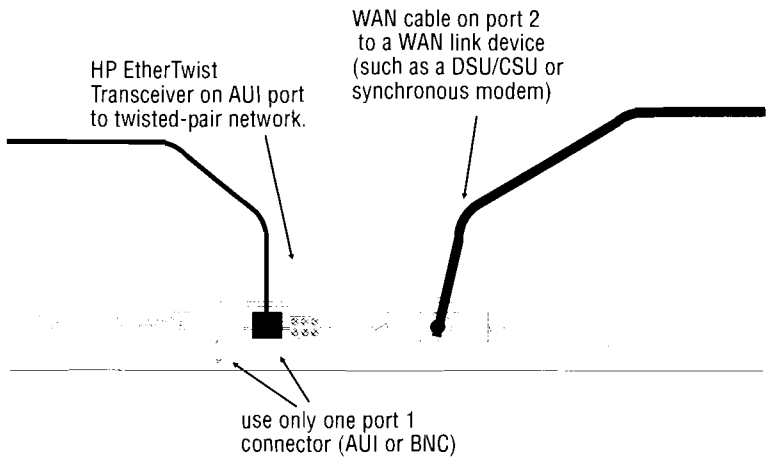
1. Attach the mounting brackets to the bridge's sides with the 10-mm M4 screws provided.
2. Position the bridge in the rack and secure with the 5/8-inch 12-24 screws provided.



Connect the networks to the bridge.

Attach the LAN cable to the port 1 connector and the WAN cable (supplied) to the port 2 connector. Use only one of the port 1 connectors (BNC or AUI). The illustration shows an example using the AUI connector with the appropriate transceiver attached.

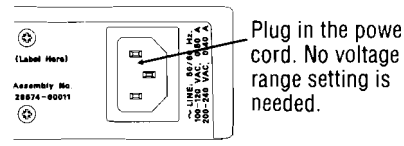
See the *HP Remote Bridge RB Installation and Reference Guide* for details on attaching cables and devices to the bridge's ports.



Plug in the bridge and verify its operation.

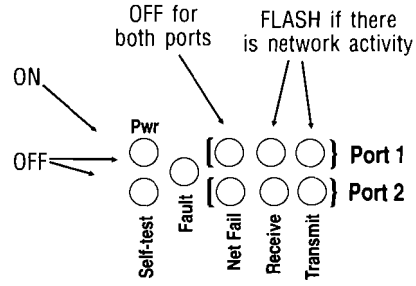
1. Plug the power cord into the bridge's power socket and into an ac power source.

   The bridge automatically adjusts to any ac power between 90 and 240 volts.



2. Check the LEDs on the bridge's back panel.

   If the bridge is working properly and if it can establish a connection to the bridge or router at the other end of the WAN link, you should see the LED pattern shown in the illustration. Until the connection is established, the Fault and Port 2 Net Fail LEDs will be ON.



See the HP Remote Bridge RB Installation and Reference Guide for more information, including how to customize the bridge's configuration from the bridge's console interface.

HEWLETT PACKARD

HP Router ER

Technical Data

Product Number
HP 27285A

The HP 27285A Router ER is a high-performance, multiprotocol router that can also function as a bridge. Using the same form factor as HP's EtherTwist hubs, this 4-port router is part of HP's rack-and-stack family of network products. The HP Router ER connects to two local Ethernet/IEEE 802.3 networks and to two synchronous WAN links, each at speeds up to 2.048 Mbits/second.

Highlights

☆ **Concurrent Multiprotocol Routing and Bridging**
The standard configuration of the HP Router ER supports concurrent operation of five popular routing protocols: TCP/IP, DECnet IV, Novell IPX, Xerox XNS, and AppleTalk II. For packets that can not be routed, the router can function as a learning bridge with the IEEE Spanning Tree Protocol. It can also connect to X.25 networks in a variety of configurations. The router's port configuration allows connection to two local area networks and two wide area networks.

☆ **High Performance**
The HP Router ER employs a Motorola 68020 (25-MHz) processor and a multiple-bus architecture for excellent LAN-to-LAN performance, even in multiprotocol networks with high traffic loads.

Protocol	Number of 64-Byte Packets per Second
Ethernet Learning Bridge	11,900
IP Routing over Ethernet	9,000
IP Routing over 802.3	8,300
DECnet IV Routing over Ethernet	6,600
Novell IPX Routing over Ethernet	6,200
AppleTalk Routing over Ethernet	7,500

☆ **Ease of Use**
Despite the inherent complexities of routing, the HP Router ER approaches plug-and-play operation. The Quick Config utility allows the router's basic parameters to be set by answering a short series of questions; a split screen displays the current configuration and provides context-sensitive help. Extensive router management is available through the router's console port or via Telnet (remote terminal) access over the network.

Features

- Provides concurrent multiprotocol routing and bridging for maximum flexibility in supporting the connection of different multivendor devices on the network.
- Offers five standard routing protocols: TCP/IP (RIP/OSPF), DECnet IV, Xerox XNS, Novell IPX, and AppleTalk II.
- Operates concurrently as a multiport bridge with the IEEE 802.1 Spanning Tree Protocol.
- Can transfer data through X.25 public data networks (PDN) and defense data networks (DDN) on both WAN ports. The X.25 software is included as a standard feature at no additional cost.
- Allows load balancing between multiple WAN links of equal bandwidth for best use of leased lines between remote routers. Supports two Ethernet/IEEE 802.3 LAN connections via the standard AUI ports.
- Supports two synchronous WAN connections via the HP universal interface ports with the appropriate 5-meter interface cable (RS-232, RS-422/449, V.35, X.21). The HP Router ER automatically senses which specific interface cable is connected. Wide area link speeds between 9.6 Kbits/second and 2.048 Mbits/second are possible.
- Supports BOOTP relay agent for initializing from a preset configuration held in a server.
- Allows remote software updates via TFTP, providing the vehicle to download a new software version over the LAN to multiple routers.
- Provides network security and isolation by allowing user-configurable traffic filtering based on type of service, protocol, subnet address, and/or network node addresses.
- Offers standards-based network management using the Simple Network Management Protocol (SNMP). This protocol is supported by HP's OpenView Interconnect Manager/DOS (HP 27256D). In addition, router management is available through the router's console (RS-232) port and via Telnet (remote terminal) access over the network.
- Allows simple configuration using the Quick Config option on the terminal console menu. A complete configuration editor is available for detailed tuning of the router's configuration.
- Mounts in a standard 19-inch rack, using one 1.75-inch rack space. All necessary mounting hardware is included.
- Includes computer-based tutorial (CBT) on 5.25-inch media to provide a self-paced training overview of router operation. HP is the only router vendor supplying valuable training with all units, free of charge.

Specifications

Environmental Characteristics

Operating Temperature: 0°C to 55°C (32°F to 131°F)

Relative Humidity: 15% to 95% @ 40°C (104°F) noncondensing

Physical Characteristics

Dimensions: 42.6 cm by 23.5 cm by 4.4 cm
(16.8 in. by 9.3 in. by 1.7 in.)

Weight 2.7 kg (6.0 lbs)

Electrical Characteristics

Voltage:	100-120 V ac	200-240 V ac
Current:	0.6 A max	0.45 A max
Frequency:	50/60 Hz	50/60 Hz

The HP Router ER automatically adjusts to any voltage from 90 to 240 volts.

Standards

Communications:	Ethernet 1.0 & 2.0 IEEE 802.3 IEEE 802.3 Type 10Base2 IEEE 802.1 Spanning Tree Protocol version 9 RS-232-C on the console port
Safety:	UL 1950 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class B EN 55022 (1988) Class B VCCI Class 2 FTZ 1046/84 (VDE Level B)
Immunity:	
ESD	IEC 801-2: 1991 3kV CD, 8kV AD prEN 55101-2: 1990
Radiated Emissions:	IEC 801-3:1984 3 V/m prEN 55024-3: 1991

WAN Interface Cables

The WAN (synchronous) interface cable must be ordered separately. Choose the appropriate cable listed below and place the order with HP's Support Material Organization (SMO). This adapter cable must be ordered for each synchronous port to provide the physical interface connection to the WAN link terminating equipment (for example, DSU/CSU).

28606-63008	V.35 Synchronous Port
28606-63006	RS-232 Synchronous Port
28606-63005	RS-449/422 Synchronous Port
28606-63001	X.21 Synchronous Port

Warranty

HP 27285A Router ER is warranted for one year against defects.

HEWLETT PACKARD

HP Router TR

Technical Data

Product Number
HP 27286A

The HP 27286A Router TR is a high-performance, multiprotocol router for connection of Ethernet, token ring, and wide area networks. Using the same form factor as the HP EtherTwist hubs and bridges, this 4-port router is the newest addition to HP's rack-and-stack family of network components. The HP Router TR connects to one local Ethernet/IEEE 802.3 network, one token ring/IEEE 802.5 4/16-Mbit/s network, and up to two synchronous WAN links, each at speeds up to 2.048 Mbits per second. The port configuration on the HP Router TR is ideal for internetworking different network types.

Highlights

☆ **Concurrent Multiprotocol Routing**
The standard configuration of the HP Router TR supports concurrent operation of five popular routing protocols: TCP/IP (RIP/OSPF), DECnet IV, Novell IPX, Xerox XNS, and AppleTalk II. For packets that can not be routed, the HP Router TR can function as a MAC-layer bridge with the IEEE Spanning Tree Protocol on the Ethernet port and Source Routing Protocol on the token ring port. Bridging is possible only between one of the local ports and the WAN ports. The router comes standard with X.25 software for configuring one or both WAN ports. The router's port configuration allows connection to two local area networks (one Ethernet and one token ring) and two wide area networks.

☆ **High Performance**
The Router TR employs a Motorola 68020 (25-MHz) processor, a multiple-bus architecture, and the FASTMAC software from MADGE Networks, Ltd., for excellent Ethernet-to-token ring routing performance, even in multiprotocol networks with high traffic loads. Approximately 5,500 (64-byte) packets per second can be forwarded between the two LANs.

☆ **Ease of Use**
Despite the inherent complexities of routing, the HP Router TR approaches the level of plug-and-play operation. The Quick-Config utility on the console port allows the router's basic parameters to be set by answering a short series of questions; a split screen displays the current configuration and provides context-sensitive help. Extensive router management is available through the router's console port or via Telnet (remote terminal) access over the network. The HP Interconnect Manager applications offer both a DOS and UNIX version for control of the router's SNMP parameters.

Features

- Provides concurrent multiprotocol routing between all ports and bridging for each LAN and WAN port for maximum flexibility in supporting the connection of different multivendor devices on the network.
- Offers five standard routing protocols: TCP/IP (RIP/OSPF), DECnet IV, Xerox XNS, Novell IPX, and AppleTalk II.
- Operates concurrently as a bridge between the LAN and WAN ports. The IEEE 802.1 Spanning Tree Protocol can be used on the Ethernet LAN port and IEEE Source Routing can be used on the token ring port.
- Can transfer data through X.25 public data networks (PDN) and defense data networks (DDN) on both WAN ports. The X.25 software is included as a standard feature at no additional cost.
- Allows load balancing between two WAN links of equal bandwidth for best use of leased lines between multiple remote routers.
- Supports two synchronous WAN connections via the HP universal interface ports with the appropriate 5-meter interface cable (RS-232, RS-422/449, V.35, or X.21). The HP Router TR automatically senses which interface cable is connected. Wide area link speeds between 9.6 Kbits/second and 2.048 Mbits/second are possible.
- Provides support of synchronous pass-through to allow certain IBM SNA traffic to use common internet services.
- Supports BOOTP relay agent for initializing from a preset configuration held in a server.
- Allows remote software updates via TFTP, providing the vehicle to download a new software version over the LAN to multiple routers.
- Provides network security and isolation by allowing user-configurable traffic filtering based on type of service, protocol, subnet address, and/or network node addresses.
- Offers standards-based network management using the Simple Network Management Protocol (SNMP). This protocol is supported by HP's OpenView Interconnect Manager/DOS (HP 27256D). In addition, router management is available through the router's console (RS-232) port and via Telnet (remote terminal) access over the network.
- Allows for easy configuration using the Quick-Config option on the terminal menu. A complete configuration editor is available for detailed tuning of the router's configuration.
- Mounts in a standard 19-inch equipment rack, using only one 1.75-inch rack space. All necessary mounting hardware is included.
- Includes computer-based tutorial (CBT) on 5.25-inch media to provide a self-paced training overview of router operation. HP is the only router vendor supplying valuable training with all units, free of charge.

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Weight: 2.7 kg (6.0 lbs)

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Current:	0.9 A max	0.6 A max
Frequency:	50/60 Hz	50/60 Hz

The HP Router TR automatically adjusts to any voltage from 90 to 240 volts.

Standards

Communications:	Ethernet version 1.0 & 2.0 IEEE 802.3 IEEE 802.1 Spanning Tree Protocol version 9 RS-232-C on the console port
Safety:	UL 1950 CSA 950 Verified to IEC 950 / EN 60950
Emissions:	FCC Part 15 Class A CISPR-22 (1985) Class B EN 55022 (1988) Class B VCCI Class 2 FTZ 1046/84 (VDE Level B)
Immunity:	
ESD	IEC 801-2: 1991 3kV CD, 8kV AD prEN 55101-2: 1990
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WAN Interface Cables

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28606-63006	RS-232 Synchronous Port
28606-63005	RS-449/422 Synchronous Port
28606-63001	X.21 Synchronous Port

Warranty

HP 27286A Router TR is warranted for one year against defects.

HP Routers

Product Note

Questions and Answers

General

Q. When should I use a router versus using a bridge?

A. Similar to bridges (with Spanning Tree Protocol enabled), if one path in a network fails, a router can select another available path. This helps improve network fault tolerance. An important feature of routers is the ability to handle parallel active links. With bridges, only one parallel link is allowed to be active at one time. Routers can make use of the combined bandwidth of the links. This makes routers a good choice for use in complex network topologies.

Routers provide greater LAN isolation capabilities than bridges. This helps with network administration, problem isolation, and troubleshooting. For example, a bridge will filter out some packets, but generally will not filter out broadcast packets or packets with addresses it does not recognize. A router can provide greater isolation of broadcast traffic and can filter out packets addressed to unreachable destinations.

Routers allow greater control over network traffic than a bridge. For example, static routes let you direct certain packets along pre-determined paths. This allows you to restrict the paths of sensitive information. You can also define sophisticated traffic filters (providing more control than bridge filters) that restrict traffic of certain types to or from specific areas of the network.

Q. What protocols do the HP routers support?

A. HP routers support these protocol services: TCP/IP, IPX/SPX, AppleTalk Phase 2, DECnet IV, and XNS. Typically, a particular routing service has its own routing protocol (for example, TCP/IP, XNS, and IPX all use the RIP routing protocol). Each routing service, and its routing protocol, operates independently. So, it is possible for different routing protocols to select different paths for routing data whose source and destination are identical.

Q. What routing protocols do the HP routers support?

A. HP routers support RIP (routing information protocol), OSPF (open shortest path first), Routing Table Maintenance Protocol used by AppleTalk phase II, and DECnet Router Protocol used by DECnet phase IV.

The RIP routing protocol makes its routing decisions using hop count metrics. The hop count is the number of router-to-router hops between a router and a packet's destination. The selected paths are the ones that have the fewest number of hops.

The OSPF routing protocol uses factors such as costs associated with various network paths. The TCP/IP protocol service on HP routers can be configured to use either RIP or the OSPF routing protocol.

Q. What are site survey worksheets for?

A. Copies of site survey worksheets are provided in the router's configuration manuals. To configure HP routers, a minimum set of configuration decisions will need to be made in planning how each port and each routing service will be configured. The worksheets are a handy tool to be used when entering the configuration parameters into the HP routers.

Q. What is the difference between the HP Router ER and HP Router TR?

A. The HP Router ER and TR are very similar in that they are both high-performance, multi-protocol routers with bridging capabilities. They use the same form factor as the HP EtherTwist hubs and bridges and can be used with the HP modular, "rack-and-stack" family. Both routers include two synchronous WAN ports that may be used for a point-to-point WAN connection or an X.25 connection to a packet switching network such as a PDN (public data network).

The only difference is that the HP Router ER provides two connections to Ethernet/802.3 LANs. The HP Router TR provides one connection to a Ethernet/802.3 LAN, and one connection to an IEEE 802.5 token ring 4/16-Mbit/s LAN.

Q. What bridging capabilities are available on the HP Router ER?

A. For packets that cannot be routed, the HP Router ER functions as a MAC-layer bridge with IEEE Spanning Tree Protocol on any of the ports. This means that if a packet arrives with an unrecognized network layer protocol, HP Routers ERs use the bridging function to send the packet on toward its destination. The bridging function can be performed between all ports on the HP Router ER.

Q. What bridging capabilities are available on the HP Router TR?

A. The HP Router TR's Ethernet/802.3 LAN port functions the same as the ER. The token ring port on the HP Router TR provides source routing capability. Source routing is an OSI layer 2 protocol for bridging token ring packets. (Source routing is NOT a layer 3 protocol as the term "routing" is usually used.) Source routing allows token ring networks to communicate. This means that the router can bridge token ring to token ring traffic including traffic on the other side of source routing bridges.

For Ethernet/802.3 and token ring nodes to communicate with each other, TCP/IP, Novell IPX, or AppleTalk phase 2 routing must be used.

Q. What DSU/CSUs have been tested with HP routers?

A. See the "Tested DSU/CSUs Product Note" in the "Multisite LAN and WAN Connections" section for a list of the tested DSU/CSUs.

Q. Can I load share on the WAN links between two routers?

A. Yes. For each router, you can create a multi-circuit circuit group by placing two coterminous circuits in a single circuit group. Coterminous circuits have common starting points and common end points. You can connect two routers using their two WAN links. The router/bridge redirectors direct traffic to circuit groups and are unaware of the individual circuits. Thus, each router has one route to the network attached to the other router. In this way, traffic is load shared or routed on both circuits simultaneously.

Q. What processor does the HP Router ER/TR use?

A. The HP routers are controlled by a Motorola 68020 processor running at 25 MHz.

Q. How can I configure a mixed Cisco and HP Router ER/TR network? Do I need to configure a static route?

A. The Cisco router has the ability to enable/disable RIP on a per-port basis. You should enable RIP on the port that is connected to the HP Router ER/TR. If you do not wish to use RIP, then you will have to use a static or default route.

Note that Cisco routers use a proprietary routing protocol called IGRP. IGRP must be disabled on the ports talking with HP routers.

Ethernet/802.3 and Token Ring Connections

Q. Does the HP Router ER/TR support routing IP and IPX packets from token ring to Ethernet?

A. Yes, the routers can route IP, IPX, and AppleTalk packets from token ring to Ethernet and vice versa.

Q. Can the HP Router ER/TR route IBM SNA traffic?

A. No. However, the HP Router ER/TR can be used in a synchronous pass-through configuration between SNA-based devices.

Q. Does the HP Router ER/TR have SNA polling included with synchronous pass-through?

A. No. SNA polling is not supported with synchronous pass-through.

Q. Can the HP Router ER/TR bridge between Ethernet and token ring?

A. No. But, the HP Router ER/TR can route packets between Ethernet and token ring. (If source routing bridges are in the network, you must enable Source Route End Node support for the routing services used.)

Q. What is source routing?

A. Source routing allows token ring networks to communicate. That is, source routing is used for token ring packets only.

In source routing networks, originating stations select paths for packets. The station first discovers an optimal route for a particular destination (by generating discovery, or explorer, packets that track paths through the network) and then records that routing information in the packet itself. The source routing bridges (or bridge services on the router) make forwarding decisions by examining the routing data contained in the packet. Networks implementing source routing do not require a loop-free topology.

Q. How can I make a connection to the router's token ring port?

A. To connect your router to the TCU (trunk coupling unit) use a token ring cable that has a 9-pin (male) D-connector on one end and a MIC (medium interface connector) on the opposite end of the cable. The MIC should conform to the IEEE 802.5 specification.

Router Configuration

Q. What is the Telnet function?

A. Telnet is a TCP/IP service that allows you to interact with a remote node's console interface, by establishing a virtual terminal connection. That is, Telnet allows you to log on to another remote node's console interface. You can make a console connection from an HP router (that has IP routing and a Telnet session configured) to another router or an end node that also has the Telnet function.

Q. How can I configure my HP Router ER/TR?

A. There are two ways to configure your HP routers:

- **Via Console Port.** Using an RS-232-C cable, connect an ANSI or VT100 terminal (or PC emulating an ANSI or VT100 terminal) to the router's console port. Configure the terminal for 8 bits/character, 1 stop bit, no parity, and Xon/Xoff handshaking (the baud rate is automatically sensed on the routers).

  Once you've established the console port session, use either Quick Configuration or the Configuration Editor to set your router's parameters.

- **Via HP OpenView Interconnect Manager/DOS and the Telnet function.** Once a router has been configured with TCP/IP protocol services, it can be accessed by Telnet. Only subsequent changes to your router configurations can be made from a network management station running HP OpenView Interconnect Manager/DOS (HP 27256D). In other words, a router cannot be initially configured using Interconnect Manager's Telnet function. That is because it does not have TCP/IP protocol services configured yet.

Q. What is the difference between Quick Configuration and the Configuration Editor?

A. Quick Configuration allows you to configure a minimum set of the most common parameters to get started, using your site survey worksheets. Quick Configuration provides step-by-step instructions for each parameter listed, and displays the currently selected parameters in a single screen. For many installations, this will be all the configuration that is needed.

If your network design requires additional customization, such as for X.25 circuits, the spanning tree algorithm, or static routes, then you must use the full Configuration Editor, either after or instead of using Quick Configuration.

The Configuration Editor is menu-based and includes all configuration parameters. The first configuration menu (the Configuration Editor menu) gives each of the configuration categories and the number of entries currently configured in the category. You can select each category that you wish to configure.

Q. Can ACE.OUT (or operating system) files for the HP 27270A Router CR be shared with the HP 27285A Router ER? The HP 27286A Router TR?

A. No, the OS (operating system) files for the HP Router CR are not compatible with the files for the HP Router ER/TR.

Q. What is the difference between an address table used by a bridge and a routing table used by a router? Aren't the addresses the same?

A. A bridge's address table stores station addresses of end nodes. These station addresses are unique and are assigned by the network device's manufacturer. A router's routing table stores network layer addresses of networks and subnetworks. Network layer addresses are assigned by the network designer for specific protocol services used on the router.

SNMP Management

Q. Do HP routers have network management capabilities?

A. HP routers support SNMP (Simple Network Management Protocol), which enables them to be managed locally from a console, or remotely, using Telnet or HP OpenView network management applications. The routers support standard MIB-I (Management Information Base-I) variables, as defined in Request For Comments (RFC) 1156, as well as HP-specific MIB variables.

Q. How can I manage my routers?

A. Use HP OpenView Interconnect Manager/DOS (27256D) to manage your routers. You must configure the router with the IP routing service. The routers use SNMP/IP communications to communicate with the network management station.

Q. How can I access the learning bridge address table information, when IP is not configured on the router?

A. HP Routers uses IP for all SNMP access. Thus, you should have IP enabled so that you can access the Rgetb command or any other Rget command.

Q. How do you get the MAC address for the router's LAN links?

A. The MAC address is a MIB variable, so you can use the Get command on "cct.cct.variables.mac_addr".

Router Ports

Q. Do HP Routers support data compression on the WAN links?

A. No.

Q. Which speeds are supported on the X.21 interface on the HP routers?

A. HP Routers conform to the X.27 or V.11 specification for signaling. HP Routers support speeds ranging from 9.6 Kbit/s up to 2.048 Mbit/s.

Q. Do the HP Remote Bridge and HP Router ER/TR support dial-up capability on the WAN links?

A. No.

Q. When an HP remote bridge is connected to a router, what happens?

A. The remote bridge forwards packets to the router (just as always) and the router will make a routing or bridging decision based on the protocols used.

When a router forwards packets to the remote bridge, the bridge will either forward or filter the packet based on the packet's MAC layer (level 2) address.

Q. Does LLC2 take care of the link by retransmitting between two routers?

A. Yes, when using LLC2 (HDLC), the routers take care of any errors in transmission.

Q. Is there any performance difference between LLC1 and LLC2?

A. Yes, since there are acknowledgments being sent back and forth, there is slightly more bandwidth used by LLC2 than with LLC1.

Q. When connecting remote bridge to router, what designation should I use?

A. You must use LLC2 on the router and the remote bridge. The remote bridge only knows LLC Type 2; the router knows both LLC Type 1 and Type 2.

Protocol Services

Q. I have multiple Novell NetWare networks that I wish to connect with a router. Can I use the same network numbers in my existing networks?

A. Yes, you can use your existing network numbers. When configuring a port on an IPX router, each port will connect to a different IPX network and will have a different network number. Enter the IPX network number as an 8-digit hexadecimal number.

Q. What is a designated router in DECnet?

A. A designated router is a router within a DECnet area that is consulted by end nodes for routing information. The designated router will supply that information and the node will send its traffic to the appropriate router/node.

Q. Can HP routers interoperate with routers from DEC?

A. HP routers can interoperate over the local Ethernet LAN with routers from DEC. However, direct interoperability over the synchronous WAN links (serial links) is not supported.

This is also true for the other protocol services. Currently, a WAN connection must have an HP or Wellfleet router at the other end.

Q. Are all XNS-based protocol services supported by the HP routers?

A. No. The XNS (Xerox Network System) protocol service for HP routers is defined by the Xerox Graybook standard for the XNS protocol stack. Proprietary implementations of XNS used by vendors such as 3Com and Ungermann-Bass are not currently supported. Apollo Domain routing, which is also based on Xerox XNS, is not currently supported.

Q. Can I connect my LocalTalk network to the HP routers?

A. LocalTalk links to HP routers are not available. HP routers support AppleTalk Phase 2 routing over Ethernet/802.3 links or synchronous WAN links. AppleTalk Phase 1 routing is not supported; however, it can be relayed using the bridging capabilities of the router.

Q. What is a seed router in AppleTalk networks?

A. Each AppleTalk network is assigned one seed router. The seed router is responsible for supplying the network addressing information to all other AppleTalk routers and nodes on the network. Since a router will usually connect to more than one AppleTalk network, a single router may be the seed router for the network on one port (seed router port), but not for the network on another port (non-seed port).

Q. What is the maximum number of AppleTalk router hops can I have in the communication path between any two AppleTalk nodes?

A. AppleTalk routers exchange information with each other in Routing Table Maintenance Protocol (RTMP) packets. RTMP imposes a maximum network diameter of 16 hops.

Q. What types of X.25 circuits do the HP routers support?

A. HP routers support the following major types of X.25 circuits:

- X.25 point-to-point circuits establish dedicated virtual circuits with other routers. These circuits are activated at initialization and remain active even when not being used.

- X.25 PDN circuits provide access through a public data network to other routers or to RFC 877-compliant systems. The X.25 PDN service transmits only IP packets and uses dynamic virtual circuits. Dynamic virtual circuits are active only when being used.

Multisite LAN Design

Product Note

Maximum Network Topologies

Routing and bridging networks are built using many combinations of LANs and WANs. Network size restrictions are dependent on the routing or bridging services used. For example, if a simple multisite network contains IPX routers only, then use the maximum topologies recommended for the IPX protocol service. However, if a multisite network contains a mix of multiprotocol routers, then the maximum topology is based on the protocol service that has the smallest limitation.

Here is a summary of the maximum network topologies for each protocol service.

Learning Bridge: With the Spanning Tree Protocol enabled, the IEEE 802.1 standard recommends that there be no more than seven forwarding bridges in the active path between any two nodes on the network.

IPX: IPX uses RIP as its routing protocol, which imposes a maximum network diameter of 15 hops.

IP: If RIP is the routing protocol, a network diameter of no larger than 15 hops is recommended, although a diameter of up to 127 hops can be configured. RIP interface cost is expressed in terms of hops. If OSPF is the routing protocol, the maximum path cost is 65535. Interface cost for OSPF is expressed in terms of an arbitrary integer value. The interface cost is configurable for both RIP and OSPF.

AppleTalk: RTMP (routing table maintenance protocol) imposes a maximum network diameter of 16 hops.

DECnet: A DECnet network can have up to 63 areas with one or more routers within an area. The maximum number of areas that a DECnet packet can pass through is 30 areas. Also, the maximum number of hops within an area is 30 hops.

Multisite LAN Design

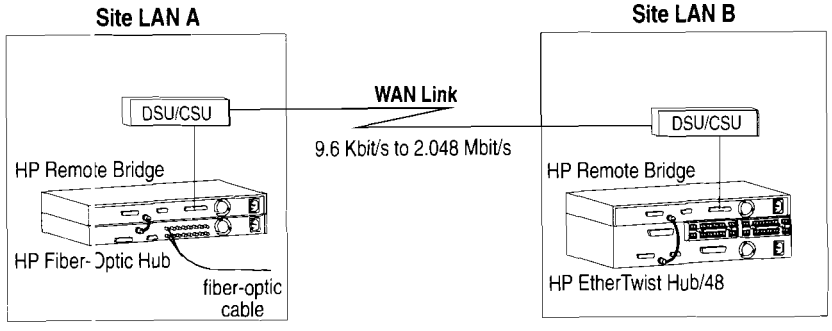
Product Note

WAN Topologies Using Remote Bridges

The following are examples of using the HP Remote Bridge RB in the multisite LAN.

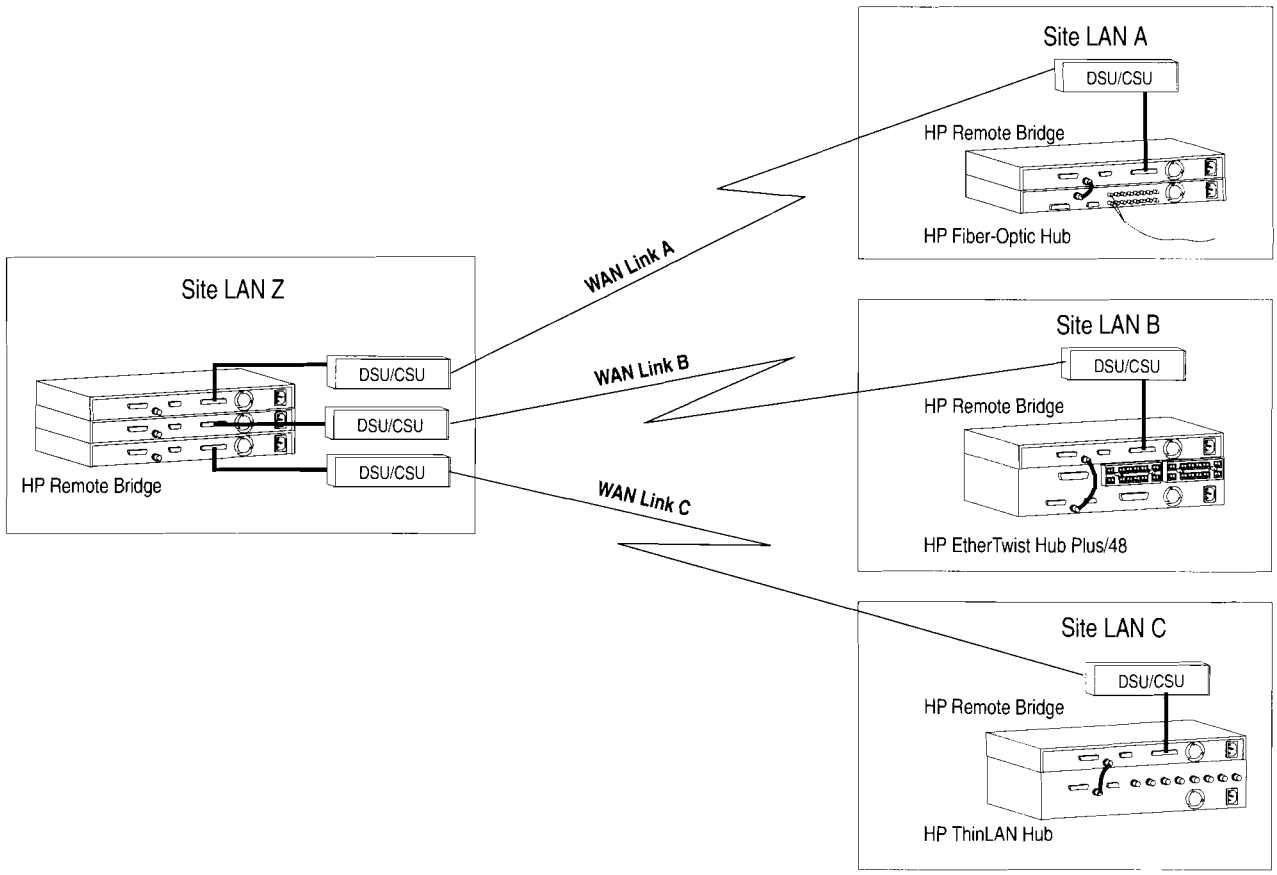
Example 1.

Point-to-Point Configuration



The HP Remote Bridges are best used in the point-to-point connection of two geographically dispersed sites.

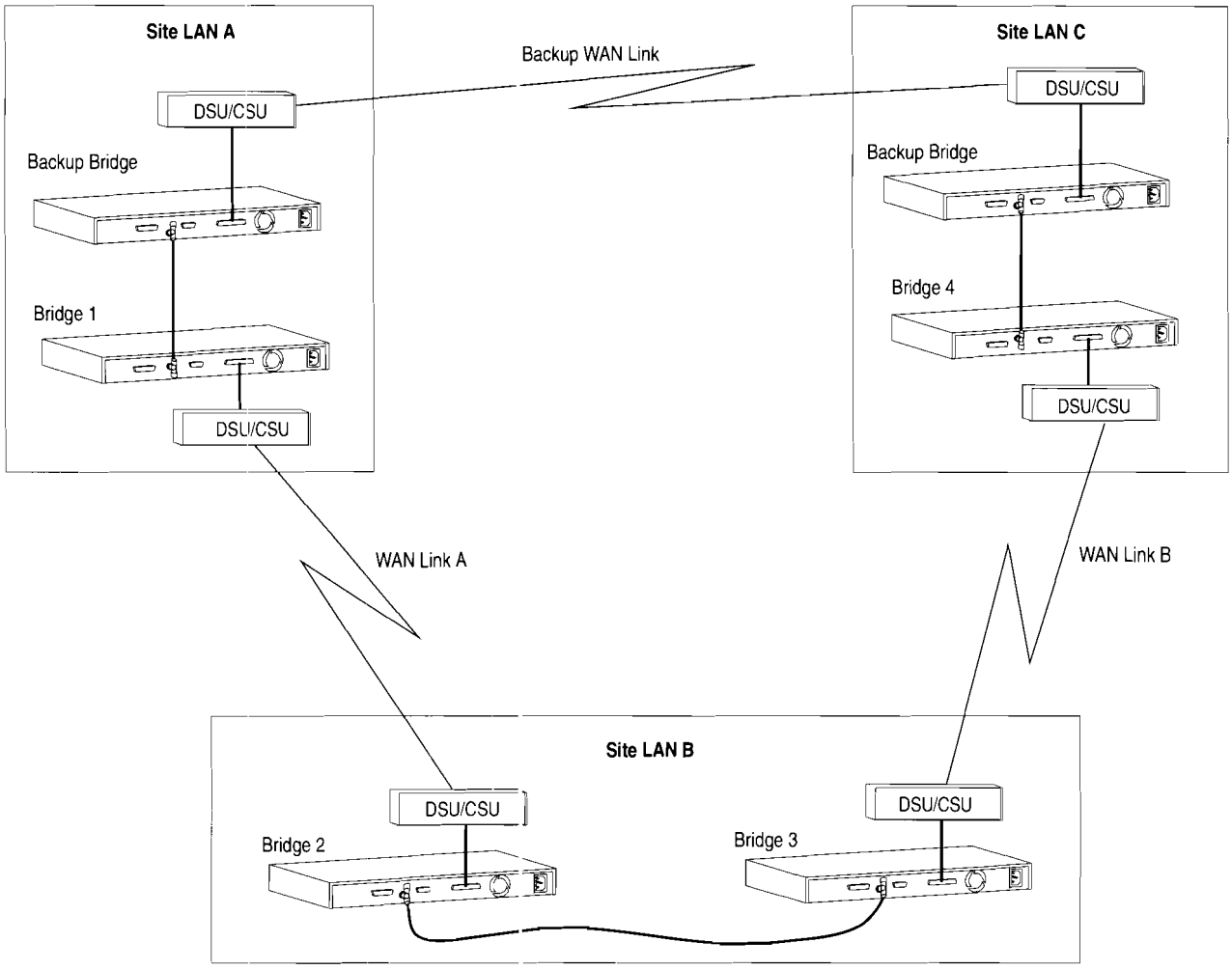
Example 2. Using Remote Bridges to Connect Multiple Sites



This example illustrates the use of the HP Remote Bridges in a star topology to remotely connect site LANs A, B, and C to site LAN Z.

As an example application, a main education office wishes to have central access to student records from all schools in the school district. Using remote bridges, site LAN Z (at the education office) can remotely connect to the site LAN in each school.

Example 3. Using the Remote Bridges for a Redundant Path



Since the HP Remote Bridge RB supports the IEEE Spanning Tree Protocol (STP), you can use the bridges to provide a redundant path in case a failure occurs in the network's active path.

In this example, if you require backup for your entire multisite LAN, you can add two remote bridges, two DSU/CSUs and a backup WAN link. In effect, this creates a "loop"in the multisite LAN.

For illustration purposes, we will assume that the Spanning Tree Protocol has determined that Bridge 1, Bridge 2, Bridge 3, and Bridge 4 are forwarding bridges and the bridges at the top of the picture are backup bridges. You don't need to configure your bridges as backup bridges or forwarding bridges. The Spanning Tree Protocol automatically does this for you. For more information on the Spanning Tree Protocol, see the Advanced Topics section of this document.

If Bridge 2 fails, the two backup remote bridges and the backup WAN link will automatically become active.

Similarly, if WAN link B fails, the two backup remote bridges and the backup WAN link will automatically become active.

Multisite LAN Design

Product Note

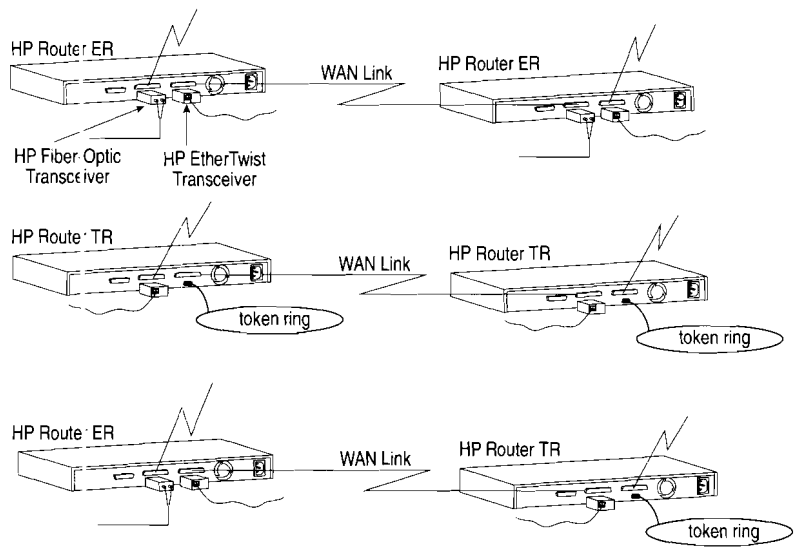
WAN Topologies using Routers

The HP routers support the three basic WAN topologies shown below. Note that some topologies are restricted to certain routing or bridging services, as indicated.

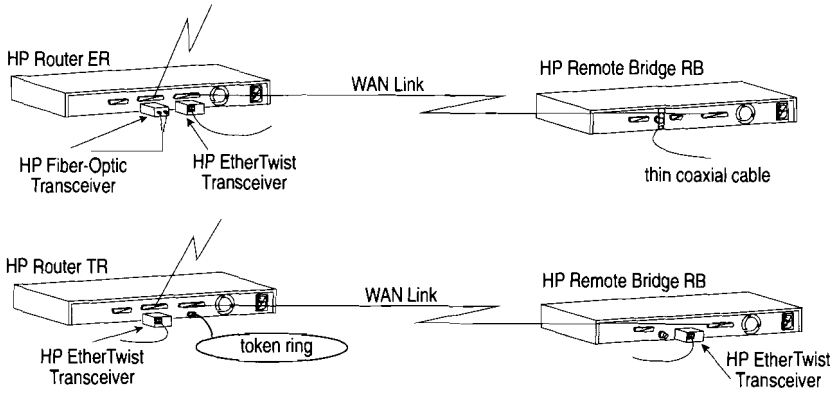
WAN Point-to-Point

HP routers can be connected over synchronous point-to-point links as shown in the figures below. Routers at each end attach to the WAN link terminating equipment, typically a modem or DSU/CSU. An HP router can also be attached to the HP 28674B Remote Bridge RB over a point-to-point link. When an HP remote bridge is connected to a router, the remote bridge forwards packets to the router (just as always) and the router will make a routing or bridging decision based on the protocols used. When a router forwards packets to the remote bridge, the bridge will either forward or filter the packet based on the packet's MAC Layer (level 2) address. All routing and bridging services are supported over these links. HP routers and the HP remote bridge can also be attached to routers from Wellfleet, Inc., over a point-to-point link. However, they are not compatible with products from Cisco Systems, Inc., and DEC over this type of link.

Point-to-point WAN link connections between HP Router ERs and HP Router TRs

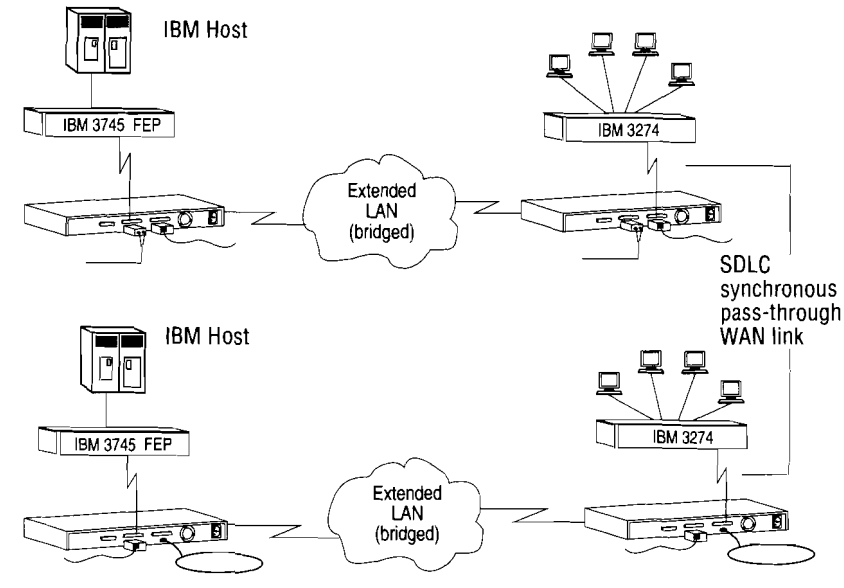


Point-to-point WAN connections between HP routers and HP remote bridges.



Synchronous Pass-Through

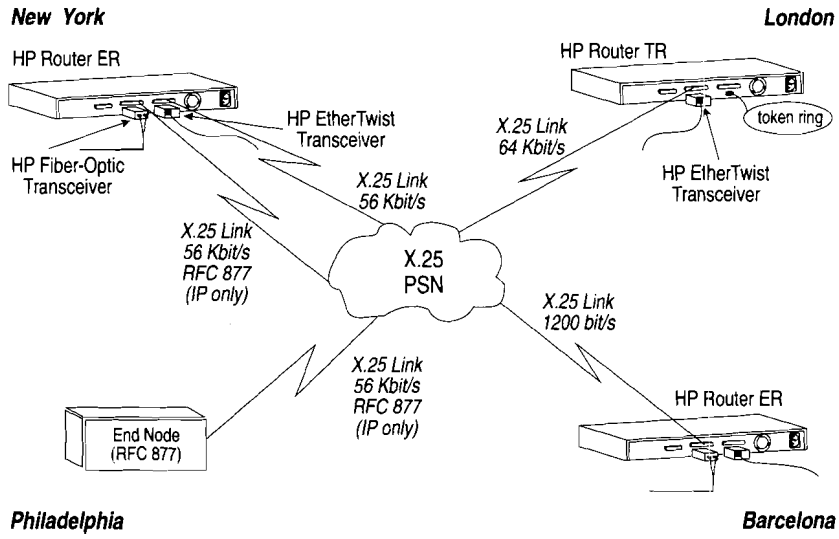
HP routers can be configured to provide transparent communications across a bridge network between two synchronous devices. The type of synchronous traffic that may be sent over synchronous pass-through is limited to HDLC (High-level Data Link Control) or HDLC derivatives such as SDLC (Synchronous Data Link Control) and LAP-B (Link Access Procedure Balanced). As shown in the figure below, a common application is connection of an IBM 3745 front-end processor to a remote SNA device, such as an IBM 3274 cluster controller for terminal connection. The synchronous devices are each connected to an HP router WAN port, with bridging service enabled, using modems or modem eliminators. Note that the synchronous data is transparently bridged, not routed, through the network.



X.25 Packet Switching Network

As shown in the figure below, HP routers can be connected through an X.25 packet switching network (PSN). With the exception of IP, all bridging and routing services over X.25 operate between two routers, rather than between a router and an end node. IP routing services can be configured either way.

WAN connection through an X.25 packet switching network.

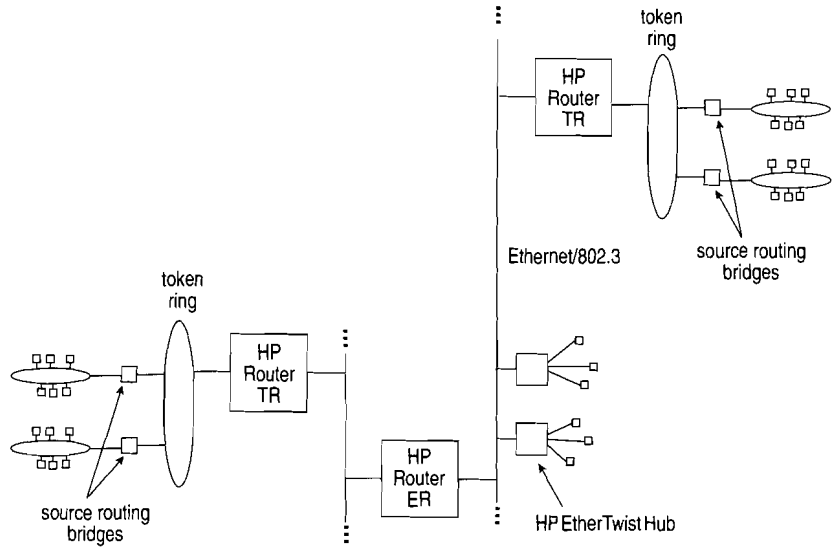


Avoid topologies containing paths between multiple X.25 networks. Each packet sent between the X.25 network (DCE) and the HP router (X.25 DTE) must be acknowledged. This uses a significant amount of the limited bandwidth of the link between the router and the X.25 DCE, typically 64 Kbit/s or less. The time that it would take for packets to traverse multiple X.25 networks typically results in transport-layer timeouts and connection session failures on end nodes.

Source-Routing Bridging

Source-routing bridging operates at the OSI layer 2 and allows bridging between token ring networks. This is **not** a layer 3 protocol as the term "routin" is usually used. Source-routing bridging allows connection of several token ring networks. In the example shown following, two HP Router TRs and one HP Router ER are used to connect token ring networks that contains source routing bridges. On all of the routers, you must enable source routing for the router ports using the bridge service.

Enable source routing on all HP Routers using the bridging (layer 2) service.

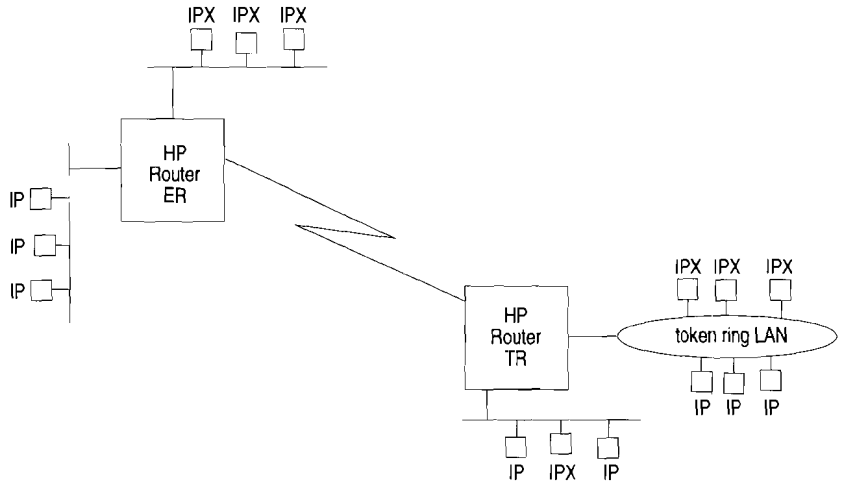


In source routing networks, originating stations select paths for packets. The station first discovers an optimal route for a particular destination (by generating discovery—or explorer—packets that track paths through the network) and then records that routing information in the packet itself. The source routing bridges (or bridging services on the HP Routers) make forwarding decisions by examining the routing data contained in the packet. Networks implementing source routing do not require a loop-free topology.

Layer 3 Routing

For Ethernet/802.3 and token ring nodes to communicate with each other, a layer 3 protocol, such as IP, IPX, XNS, or AppleTalk Phase 2 routing must be used. For example, an HP Router ER is used in a point-to-point WAN link topology with an HP Router TR to connect a token ring LAN and an Ethernet LAN. In the figure following, in order for Ethernet and token ring nodes to communicate with each other, IP, IPX, XNS, or AppleTalk routing must be used.

Enable source route end node support on the HP Router TR's token ring port for each applicable routing service (IP and IPX).



On the HP routers, each routing service (IP, IPX, XNS, or AppleTalk Phase 2) must be used with source route end node support enabled on the token ring port only. Source route end node support allows the routers to accept packets explicitly addressed to it and to participate in the route discovery process. When each routing service is enabled (that is, IP, IPX, XNS, or AppleTalk) for source route end node support, the routing service acts as an end node from a source routing perspective. The routing services are users of the source routing protocol. Source route end node support is enabled separately for each applicable routing service.

When possible, the use of layer 3 routing (rather than layer 2 source-routing bridging) is recommended.

More information on token ring and Ethernet/802.3 topologies are discussed in the *HP Router Reference Guide.*

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Multisite LAN Design

Product Note

LAN Topologies Using Routers

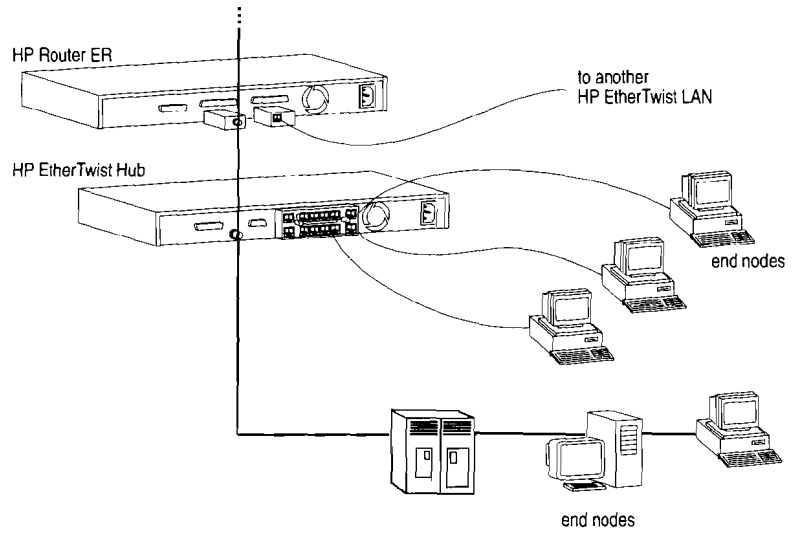
For LAN connections, the HP Router ER supports Ethernet and IEEE 802.3 media access methods with several media, including thin coax, unshielded twisted-pair (UTP) cable, and optical fiber. In addition to supporting an Ethernet/802.3 LAN, the HP Router TR supports the IEEE 802.5 token ring media access method over shielded twisted-pair cabling.

There are three basic LAN topologies when routers are used to interconnect local and/or remote networks. LANs in an internetwork will be connected by routers using one or more of these basic topologies.

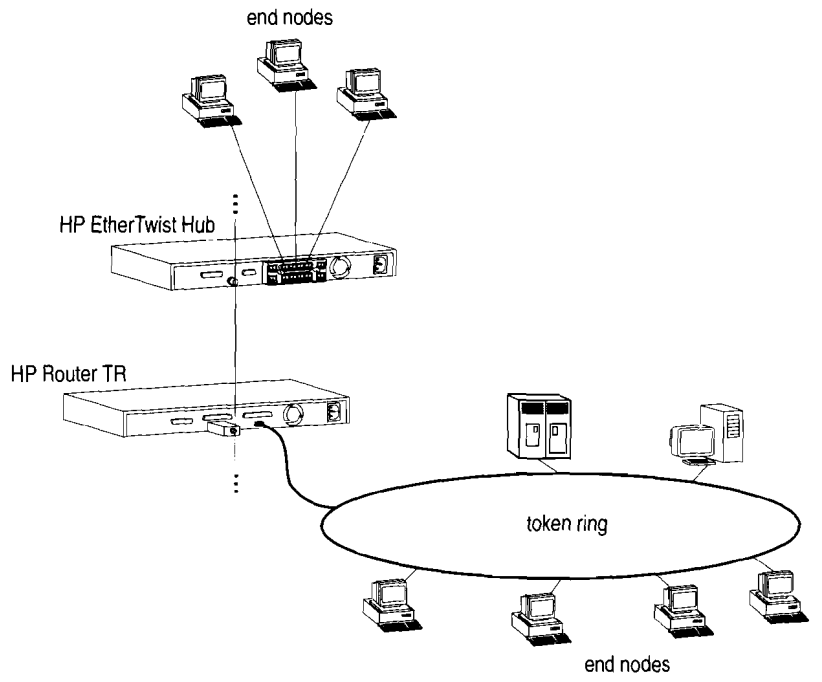
LAN with a Single Router and Multiple End Nodes

The first basic LAN topology is a LAN with a single router and one or more end nodes. All communication to other LANs must pass through this router. A factor to consider is that the router is now a single point of failure for access to other networks. If this is a serious concern, then an additional router on this LAN may be necessary.

A single HP Router ER on a LAN with end nodes.



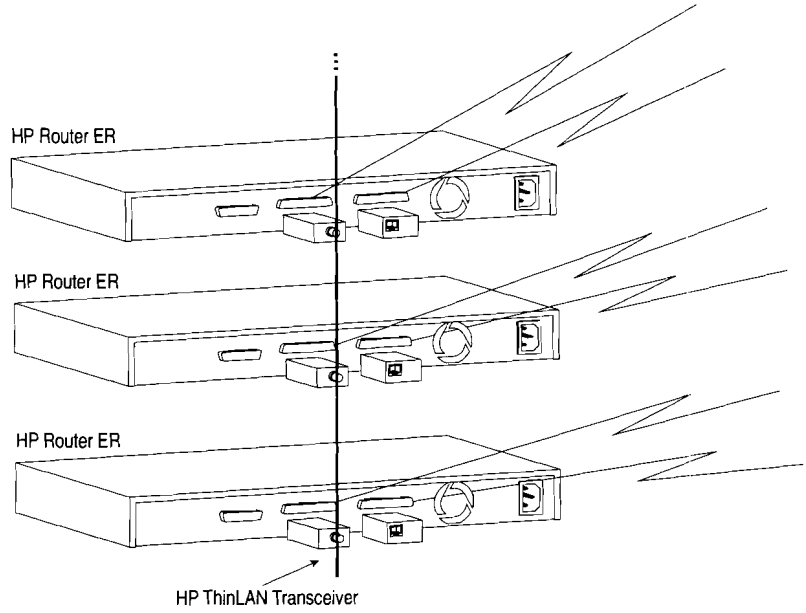
A single HP Router TR on a LAN with end nodes.



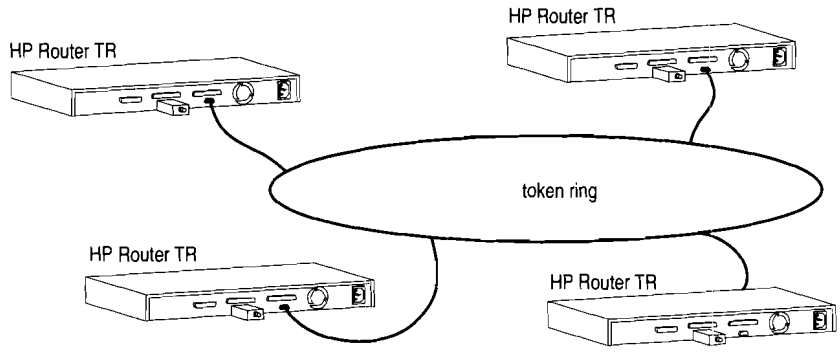
LAN with Multiple Routers and No End Nodes

Another basic LAN topology is a LAN with multiple routers and no end nodes. The routers will often have several WAN links to remote sites. The LAN is used as a high speed backbone for the routers. Routers with higher port counts (greater than 4 ports), such as the HP 27270A Router CR, can often be used in this configuration to reduce the total number of routers. Fewer routers will generate less routing message traffic on the backbone and may provide better performance.

Several HP Router ERs on a LAN backbone.



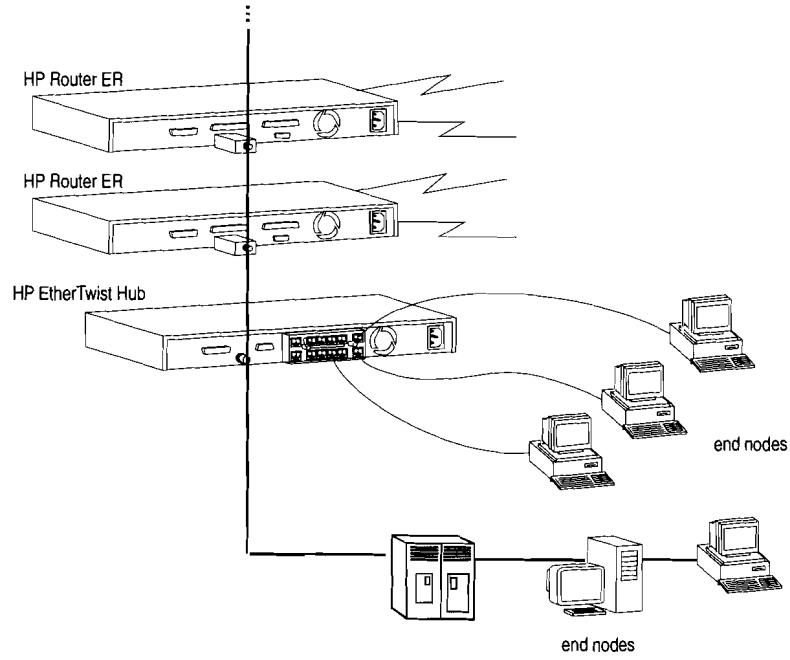
Several HP Router TRs on a token ring LAN backbone.



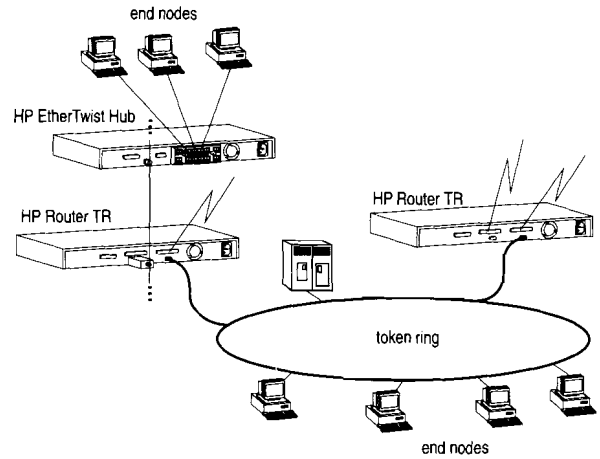
LAN with Multiple Routers and End Nodes

The last basic topology is a LAN with multiple end nodes and multiple routers. When multiple routers are on a LAN with end nodes, a mechanism must be provided for notifying the end nodes about which router should be used for "off-LAN" communications. In other words, which router should a particular end node use for WAN link communications. The routing services supported on HP routers each use a different mechanism. The mechanisms and caveats are documented in greater detail in the *HP Router Reference Guide*.

Several HP Router ERs and end nodes on a LAN.



Several HP Router TRs and end nodes on a token ring LAN.



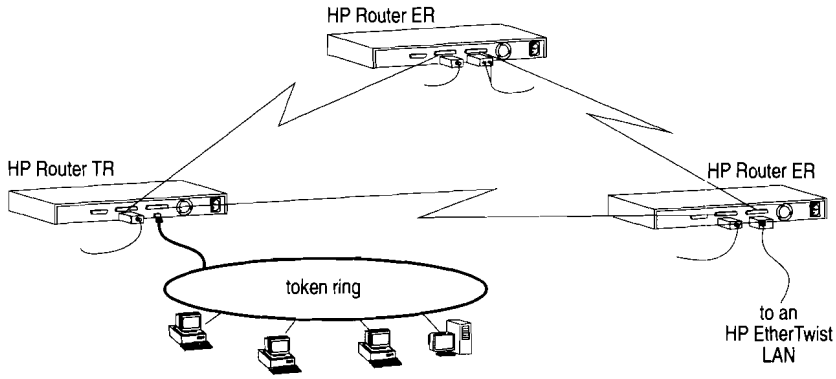
Multisite LAN Design

Product Note

Mesh Topologies Using Routers

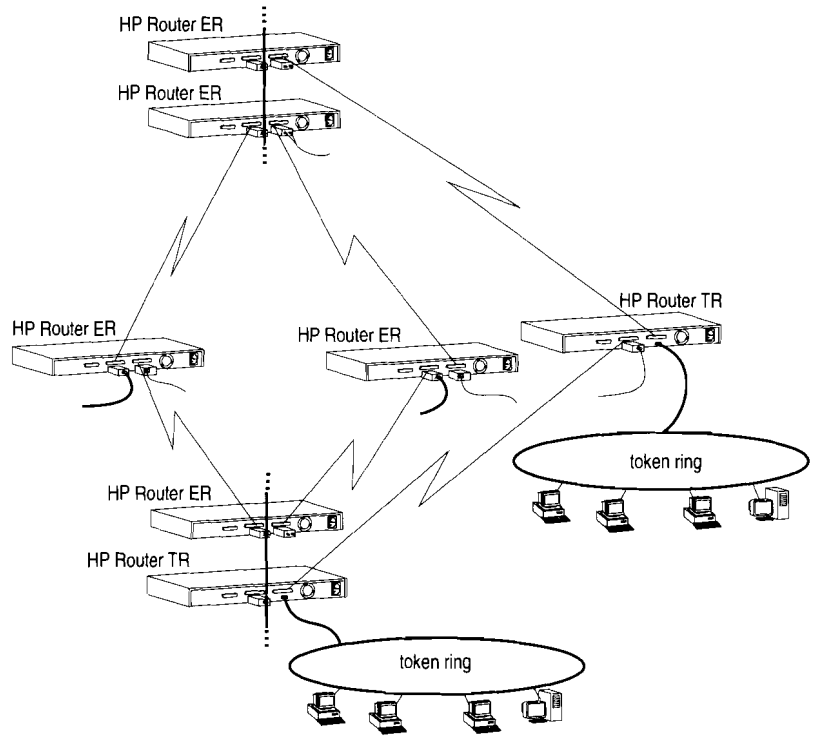
To improve reliability and enhance performance, router and bridge networks are often built in a mesh topology with multiple paths to some networks. Routing and bridging services on HP routers support mesh topologies. The routing services potentially allow all links to be active and transport data concurrently. The network-layer protocol services and routing protocols work together to assure that the best path is selected.

To use the bridging service in a mesh network, the Spanning Tree Protocol must be enabled. This protocol will create a single path to all destination networks by placing some links in backup mode. These links may be activated only in the event of failure of an active link or router (with the bridging service).



Simple mesh topology with HP Router ERs and HP Router TR.

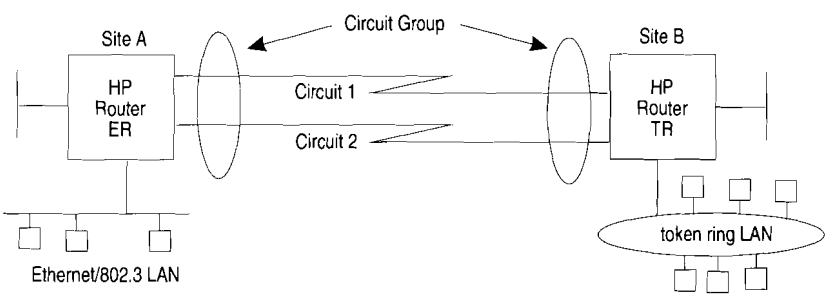
Complex mesh topology with HP Router ERs and HP Router TRs.



Load Sharing and Fast Recovery from a Circuit Failure

You can create a topology that offers load sharing and fast recovery by using multi-circuit circuit groups. A circuit group is a logical structure that contains one or more circuits. A multi-circuit group is created by placing two or more coterminous circuits in a single circuit group. Coterminous circuits have common starting points and common end points.

For example, in the figure below two circuits (WAN links) are used between the HP Router ER and HP Router TR. Both circuits have been configured as members of a single circuit group on each router. The router/bridge redirectors direct traffic (internally) to circuit groups and are unaware of individual circuits. Thus, from each router's point of view, it has one route to the networks attached to the other router. Under normal operating conditions, traffic is load shared or routed on both circuits simultaneously.



When one circuit fails, traffic is carried on the remaining circuit(s). The router/bridge redirectors are unaware of the failure and thus do not try to find an alternate route. When the failed circuit is restored, it will automatically be used for sending traffic to the remote router.

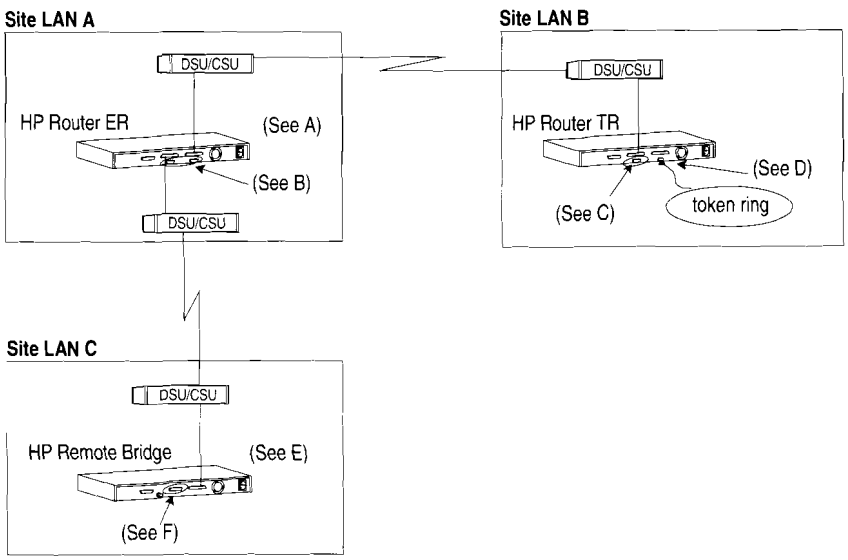
For bridging, must the Spanning Tree Protocol be enabled to eliminate the loop created by the additional load sharing circuit? No, Spanning Tree Protocol is not required since logically there is no loop. The bridging redirector uses the single circuit group, rather than the two links. This is one of the strengths of using multi-circuit circuit groups. Surviving a circuit failure in this way should have little or no effect on applications over the routing services. The time to detect and remove a failed circuit is 10 to 15 seconds.

There are limitations on the user of multi-circuit circuitry groups. These limitations are discussed in detail in the *HP Router Reference Guide.*

HP EtherTwist Networks

Ordering Guide

Multisite LAN



To create this multisite LAN between three site LANs, the following items are needed:

- one HP Remote Bridge RB
- one HP Router ER,
- one HP Router TR
- four DSU/CSUs (WAN Link equipment)
- two WAN connections

The letters referenced on the illustration correspond to the ordering sections that follow.

Product Number	Description
A. What you need to connect an HP Router ER to an HP Router TR via WAN connection.	
27285A	Router ER. Includes router and documentation.
27286A	Router TR. Includes router and documentation.
—	(2) DSU/CSUs.
—	(2) DSU/CSU cables.
	Depending on the DSU/CSU interface, order one of these cables for each DSU/CSU:
28606-63006	RS-232 cable, 5 meters
28606-63005	RS-422/449 cable, 5 meters
28606-63008	V.35 cable, 5 meters
28606-63001	X.21 cable, 5 meters

Product Number	Description
B. What you need to connect an HP Router ER to Ethernet or IEEE 802.3 networks.	
28685B	EtherTwist Transceiver. Includes transceiver and installation steps.
—	Unshielded twisted-pair cable.
or	
28683A	Fiber-Optic Transceiver. Includes transceiver and installation steps.
—	Fiber-optic cable.
or	
28641B	ThinLAN Transceiver. Includes transceiver and installation steps.
—	Thin coaxial cable.
—	The HP transceiver generally attaches direcly to an AUI port on the router. For installations where there is not enough clearance for the transceiver, or where additional cable length is needed between the transceiver and the router, an AUI cable (HP 92254A to H) of the appropriate length can be inserted between the transceiver and the router.
C. What you need to connect an HP Router TR to a local Ethernet or IEEE 802.3 network.	
28685B	EtherTwist Transceiver. Includes transceiver and installation steps.
—	Unshielded twisted-pair cable.
or	
28683A	Fiber-Optic Transceiver. Includes transceiver and installation steps.
—	Fiber-optic cable.
or	
28641B	ThinLAN Transceiver. Includes transceiver and installation steps.
—	Thin coaxial cable.
—	The HP transceiver generally attaches direcly to an AUI port on the router. For installations where there is not enough clearance for the transceiver, or where additional cable length is needed between the transceiver and the router, an AUI cable (HP 92254A to H) of the appropriate length can be inserted between the transceiver and the router.
D. What you need to connect an HP Router TR to a local token ring network.	
—	Shielded twisted-pair token ring cable. (See the "ProductNote—Router Cables and Connectors" later in this document.

Product Number	Description
E. What you need to connect an HP Router ER to an HP Remote Bridge RB via WAN connection.	
27285A	Router ER. Includes router and documentation.
28674B	Remote Bridge RB. Includes bridge and documentation.
—	(2) DSU/CSUs
—	(2) DSU/CSU cables
Depending on the DSU/CSU interface, order one of these cables for the router:	
28606-63006	RS-232 cable, 5 meters
28606-63005	RS-422/449 cable, 5 meters
28606-63008	V.35 cable, 5 meters
28606-63001	X.21 cable, 5 meters
Depending on the DSU/CSU interface, specify one of these cable options for the remote bridge:	
001	V.35 cable, 5 meters
002	RS-232 cable, 5 meters
003	X.21 cable, 5 meters
004	RS-422/449 cable, 5 meters
F. What you need to connect an HP Remote Bridge RB to a local Ethernet or IEEE 802.3 network.	
28685B	EtherTwist Transceiver. Includes transceiver and installation steps.
—	Unshielded twisted-pair cable.
or	
28683A	Fiber-Optic Transceiver. Includes transceiver and installation steps.
—	Fiber-optic cable.
or	
28641B	ThinLAN Transceiver. Includes transceiver and installation steps.
—	Thin coaxial cable.
—	The HP transceiver generally attaches direcly to an AUI port on the bridge. For installations where there is not enough clearance for the transceiver, or where additional cable length is needed between the transceiver and the bridge, an AUI cable (HP 92254A to H) of the appropriate length can be inserted between the transceiver and the bridge.
or	
92227N	"T"connector.
—	Thin coaxial cable.

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Mulitsite LAN and WAN Connections

Product Note

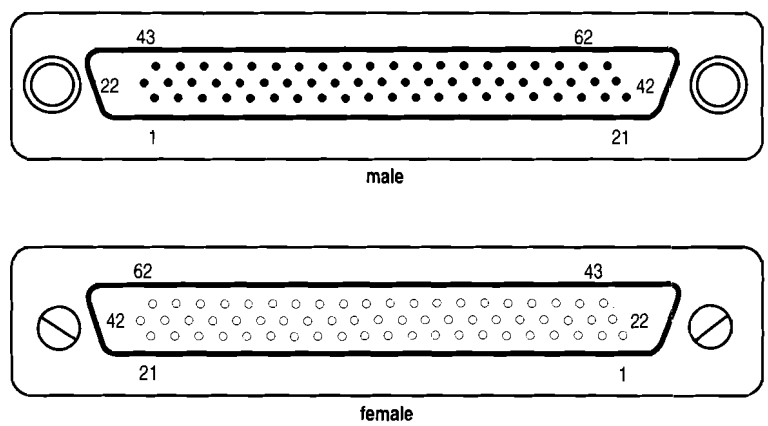
Router Cables and Connectors

This product note lists cables that have been tested and verified for use with the HP routers. The minimum pin-outs are shown, in case you wish to use an unlisted cable or manufacture your own. Note that each pin-out does not necessarily match the pin-out for the corresponding HP cable, but cables manufactured to follow the minimum pin-out will function correctly. Loopback connectors for all router ports are also shown in this product note.

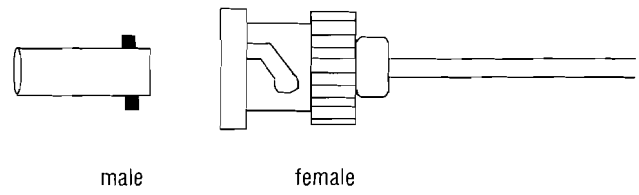
Product	Available Connections (Ports)
HP 28674B Remote Bridge RB	1 BNC, 1 female 62-pin connector, 1 female AUI, 1 female 25-pin RS-232 (console port)
HP 27285A Router ER	2 female AUI, 2 female 62-pin connector, 1 female 25-pin RS-232 (console port)
HP 27286A Router TR	1 female AUI, 1 female 9-pin D connector 2 female 62-pin connector, 1 female 25-pin RS-232 (console port)

Cabling

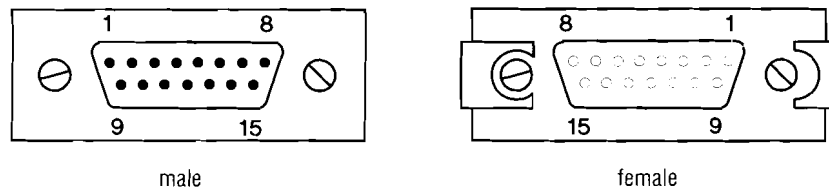
62-Pin Connector



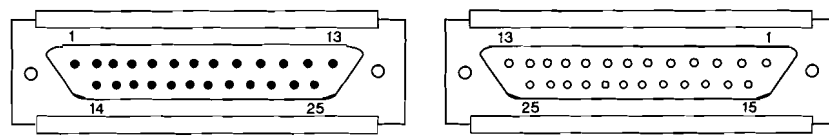
BNC Connectors



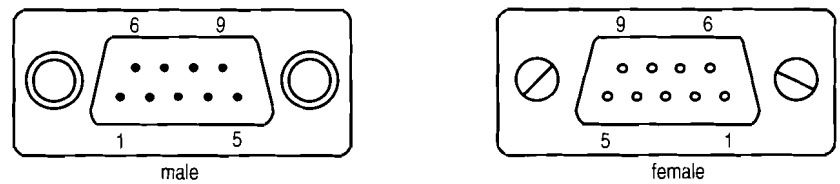
15-Pin D (AUI) Connector



Standard 25-Pin RS-232-C Connector



9-Pin Token Ring Port Connector



HP Cables

Cable and Connector on Router	Connector on Attached Device	HP Product or Part Number
RS-232-C cable for a modem connected to console port	for 25-pin female port	13242M, 13242N, 17355M
	for 25-pin male port	31391A
RS-232-C cable for a terminal or PC connecting to console port	for 25-pin female port	13242G *, 40242G *
	for 25-pin male port	13242H
	for 9-pin female port	92221P *
	for 9-pin male port	24542G *
Transceiver that has an AUI port, directly connecting to a LAN port	for LAN cable (These transceivers do not need an AUI cable.)	28685A EtherTwist, 28641B ThinLAN, 28683A Fiber-Optic
AUI stub cable (for other transceivers) connecting to LAN port	for transceiver's 15-pin male port	92264D (1 meter) 92254A through H (6-48 meters) 92254J (5 meters)
RS-422/449 cable connecting to a WAN port	for 37-pin female port	28606-63005 (5 meters)
V.35 cable (balanced X.27) connecting to a WAN port	for 34-pin female port	28606-63008 (5 meters)
X.21 cable connecting to a WAN port	for 15-pin female port	28606-63001 (5 meters)
RS-232-C cable connecting to a WAN port	for 25-pin female port	28606-63006 (5 meters)
RS-422/449 Synchronous Test cable	for connecting two 62-pin female ports	5061-2556
RS-422/449 Synchronous Test cable	for connecting a 62-pin female port to an HP Router CR 15-pin female COM port	5061-2557
* For these cables, the signals DTR (pin 20) and RTS (pin 4) must be on, or high, on your terminal or in your terminal emulation program.		

Other Standard Cables

Cable and Connector on Router	Terminal	PC or Modem Port
RS-232-C cable for a modem connected to console port	for 25-pin female or male port	Use a standard modem cable.
RS-232-C cable for a terminal or PC connected to console port *	for 25-pin male port	Attach a null modem adapter** (Tandy Null Modem Adapter No. 26-1496 has been tested) to the console port. Then attach a straight-through modem cable to the null modem adapter.
	for 9-pin male port	Use a Black Box PC/AT Serial Printer Cable (EVNBPC has been tested). OR Attach a null modem adapter** (Tandy Null Modem Adapter No. 26-1496 has been tested) to the console port. Then attach a modem cable (Black Box Cable EVNBMC and Cablex PC Modem Cable have been tested) to the null modem adapter.

* For these cables, the signals DTR (pin 20) and RTS (pin 4) must be on, or high, on your terminal or in your terminal emulation program.

** The required minimum pin-out is listed in the next section, "Cable/Connector Pin-Outs".

Token Ring Cables

Cable and Connector on Router	Connector on Attached Device	Usage
Token ring shielded twisted-pair cable connected to the nine-pin female token ring port with a male nine-pin subminiature D-connector.	A Medium Interface Connector (MIC) conforming to IEEE 802.5 specifications for connection to a Trunk Coupling Unit (TCU).	Available from several vendors, such as Black Box and Inmac. Not offered by Hewlett-Packard.

Cable/Connector Pin-Outs

Router Console Port Connector Pin-Out

PIN	US	CCITT	DIN
1	CHS GND	101	
2	Tx	103	D1
3	Rx	104	D2
4	RTS	105	S2
5	CTS	106	M2
6	DSR	107	M1
7	GND	102	
8	DCD	109	M5
20	DTR	108	S1
22	RI	125	M3
23	SR	111	

RS-232-C Cable for Modems—Minimum Pin-Out

Modem end 25-pin male		Router end 25-pin male	Signal
2	←	2	Tx
3	→	3	Rx
4	←	4	RTS
5	→	5	CTS
6	→	6	DSR
7	—	7	GND
8	→	8	CD or DCD
20	←	20	DTR
22	→	22	RI
23	←	23	DRS—typically on V.24 (European) modems

Available HP cables: 13242M/N, 17355M

RS-232-C Cable for Terminal/PC with 25-Pin Connector—Minimum Pin-Out

Terminal/PC end 25-pin male		Router end 25-pin male	
Tx	2 →	2	Tx
Rx	3 ←	3	Rx
GND	7 —	7	GND
		5	CTS
		6	DSR
		8	DCD
		22	RI
		23	DRS

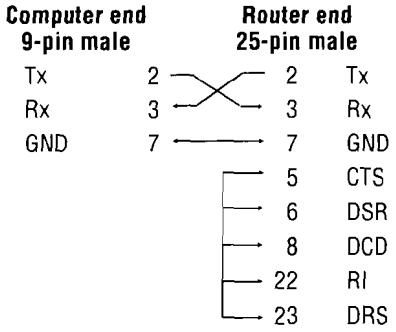
Available HP cables: 13242G, 40242G

RS-232-C Cable for Terminal/PC with 9-Pin Connector—Minimum Pin-Out

Terminal/PC end 9-pin female		Hub end 25-pin male	
Tx	2 →	2	Tx
Rx	3 ←	3	Rx
GND	5 —	7	GND
		5	CTS
		6	DSR
		8	DCD
		22	RI
		23	DRS

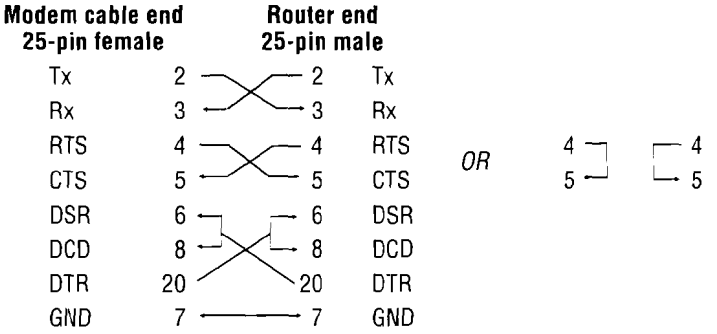
Available HP cable: 24542G

RS-232-C Cable for HP Portable (110) and Portable Plus—Minimum Pin-Out



Available HP cable: 92221P

Null-Modem Adapter for Use with Modem Cable —Minimum Pin-Out



Note: DTR (pin 20) and RTS (pin 4) must be on, or high, on your terminal or in your terminal emulation program.

Available HP cable: 92221P

Router Ethernet/802.3 LAN Port Definition

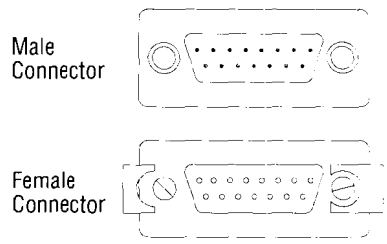
The LAN ports are compatible with the IEEE 802.3 standard for the Attachment Unit Interface (AUI).

AUI Cable—Minimum Pin-Out

Transceiver end 15-pin female	Router end 15-pin male	Signal Name, Circuit
1	1	Chassis Ground
2	2	Control In, A
3	3	Data Out, A
4	4	Data In, Shield (common drain)
5	5	Data In, A
6	6	Voltage Common
9	9	Control In, B
10	10	Data Out, B
11	11	Chassis Ground
12	12	Data In, B
13	13	Voltage Plus
14	14	Chassis Ground

For this connection, you can use:

- HP 92264D (1-meter ThinLAN AUI extension, pin 4 not connected)
- HP 92254A through H (6-meter through 48-meter ThickLAN cables)
- HP 92254J (5-meter ThinLAN AUI cable, pin 4 not connected)



Some longer cables may have all 15 pins wired. See the IEEE 802.3 standards document for definitions of the pins not shown here.

Router Token Ring/802.5 LAN Port Definition

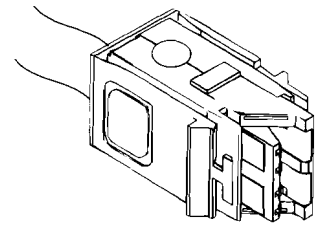
This port accepts the standard nine-pin subminiature D-connector for shielded twisted-pair token-ring cable.

Pin Definition of Token Ring Connector

Nine-Pin Connector	Token Ring Signal
1	Data In A
2	Ground
3	5V Out
4	Ground
5	Data Out B
6	Data In A
7	Ground
8	Ground
9	Data Out A

The opposite end of the token-ring cable should be fitted with a Medium Interface Connector (MIC) conforming to the 802.5 specification.

Router Token Ring (802.5 MIC) Connector



RS-449/422 WAN Cable—Minimum Pin-Out

WAN link end 37-pin male	Router end 62-pin male	RS-449 and Signal Name, Circuit	
4	17	SD	Send Data, A
5	2	ST	Send Timing, A
6	1	RD	Receive Data, A
7	15	RS	Request to Send, A
8	3	RT	Receive Timing, A
9	4	CS	Clear to Send, A
10	54		Reserved
11	5	DM	Data Mode, A
12	16	TR	Terminal Ready, A
13	6	RR	Receiver Ready, A
14	53		Reserved
15	48		Reserved
16	55		Reserved
17	14	TT	Terminal Timing, A
18	8		Reserved
19	9, 30, 32	SG	Signal Ground
20	47		Reserved
22	38	SD	Send Data, B
23	23	ST	Send Timing, B
24	22	RD	Receive Data, B
25	36	RS	Request to Send, B
26	24	RT	Receive Timing, B
27	25	CS	Clear to Send, B
28	33		Reserved
29	26	DM	Data Mode, B
30	37	TR	Terminal Ready, B
31	27	RR	Receiver Ready, B
33	29		Reserved
34	34		Reserved
35	35	TT	Terminal Timing, B
37	10	SC	Send Common

V.35 WAN Cable—Minimum Pin-Out

WAN link end 34-pin male	Router end 62-pin male	CCITT and Signal Name, Circuit
B	9	102 Signal Ground
	22	
	23	
	24	
	25	
	26	
	27	
	47	
	31	
	32	
	52	
	50	
C	57	105 Ready to Send
D	4	106 Clear to Send
E	46	107 Data Mode
F	6	109 Receiver Ready
H	58	108.2 Terminal Ready
J	48	Reserved
P	21	103 Send Data, A
R	20	104 Receive Data, A
S	42	103 Send Data, B
T	41	104 Receive Data, B
U	61	Transmit Timing, A
V	18	115 Receive Timing, A
W	60	Transmit Timing, B
X	39	115 Receive Timing, B
Y	19	114 Send Timing, A
AA	40	114 Send Timing, B

X.21 WAN Cable—Minimum Pin-Out

WAN link end 15-pin male	Router end 62-pin male	X.21 and Signal Name, Circuit
2	17	T Send Data, A
3	16	C Control, A
4	1	R Receive Data, A
5	4	I Indicator, A
6	3	S Send Timing, A
8	9	G Ground
	32	
	47	
9	38	T Send Data, B
10	37	C Control, B
11	22	R Receive Data, B
12	25	I Indicator, B
13	24	S Send Timing, B

RS-232-C WAN Cable—Minimum Pin-Out

WAN link end 15-pin male	Router end 62-pin male	X.21 and Signal Name, Circuit	
2	59	BA	Send Data
3	1	BB	Receive Data
4	57	CA	Request to Send
5	4	CB	Clear to Send
6	46	CC	Data Mode
7	9	AB	Signal Ground
	22		
	23		
	24		
	25		
	26		
	27		
	47		
	30		
	31		
	52		
8	6	CF	Receiver Ready
12	28		Reserved
13	7		Reserved
14	13		Reserved
15	2	DB	Send Timing
16	49		Reserved
17	3	DD	Receive Timing
19	12		Reserved
20	58	CD	Terminal Ready
21	29		Reserved
22	48		Reserved
23	55		Reserved
24	56	DA	Terminal Timing

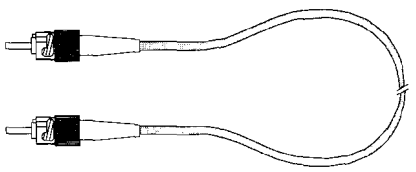
The maximum cable length is 15 meters (50 feet).

Loopback Connectors

The four loopback connectors shown below are useful for trouble-shooting your HP Fiber-Optic Hub Plus, HP ThinLAN Hub Plus, and HP bridges. The connectors for the AUI, ThinLAN, and console ports are included in the HP Extended LAN Troubleshooting Kit, product number HP 28689B, or all four can be purchased separately. Contact your HP-authorized LAN dealer or your local HP sales office for assistance.

For Fiber-Optic Ports

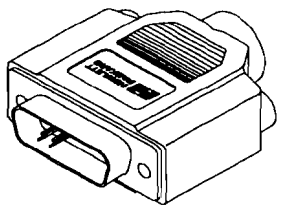
HP Fiber-Optic Loopback Cable,
HP part number 5041-3738.



For AUI Port

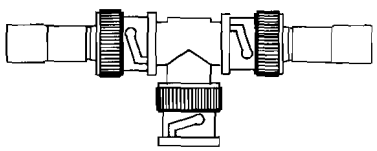
HP part number 28663-63001.
The following pins are connected:

- pin 3 to pin 5
- pin 10 to pin 12



For ThinLAN Port

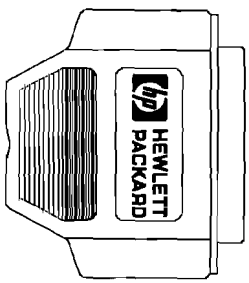
HP part number 5061-4990.
BNC "T" with two 50-ohm terminators attached.



For Console Port

HP part number 5062-3355.
The following pins are connected:

- pin 2 to pin 3
- pin 4 to pin 5 to pin 8
- pin 6 to pin 20 to pin 22
- pin 7 to pin 23



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Multisite LAN and WAN Connections

Product Note

Purchasing/Leasing WAN Links

The purpose of this product note is to provide an overview of the activities required to obtain WAN link connections for your HP Remote Bridge, HP Router ER, or HP Router TR.

To build your multisite LAN, you will need WAN link connections and WAN link terminating equipment. A WAN link can be any variety of transmission medium such as twisted-pair cable provided through phone lines, fiber-optic cable, coaxial cable, microwave, or satellite. A WAN link usually requires an arrangement for a leased line. This can be done through the local phone company if the ends of the line are in one phone company's service areas. If not, it is necessary to work through a common carrier for your region or country. A WAN link might connect to a packet switching network through an X.25 connection. WAN link speeds can range from 9.6 Kbit/s up to 1.544 Mbit/s (T1) in the U.S. or up to 2.048 Mbit/s (E1) in Europe.

The WAN link terminating equipment can be devices such as high-speed modems or DSU/CSUs (data service units or channel service units). These provide access to common line services such as CEPT/T1 (2.048 Mbit/s and 1.544 Mbit/s), fractional T1, and 56-Kbit/s digital data services (DDS).

Common WAN link services

WAN Link Speed	Service
9.6 Kbit/s 19.2 Kbit/s	Analog lines using high speed modems or DDS (digital data services)
56 Kbit/s	DDS (digital data services)
Multiples of 56 Kbit/s (112, 168, 224 Kbit/s, etc. up to T1 speed)	
Multiples of 64 Kbit/s (128, 192, 256 Kbit/s, etc. up to T1 speed)	Fractional T1
1.544 Mbit/s	T1
2.048 Mbit/s	E1 (CEPT)

Introduction

WAN link service providers, known as IXCs (inter-exchange carriers) and LECs (local exchange carriers), can help you set-up and service your WAN link(s). AT&T, Sprint, and MCI are examples of IXCs in the U.S. If you have a multisite LAN that spans the U.S., then you can use an IXC service provider for your WAN link needs.

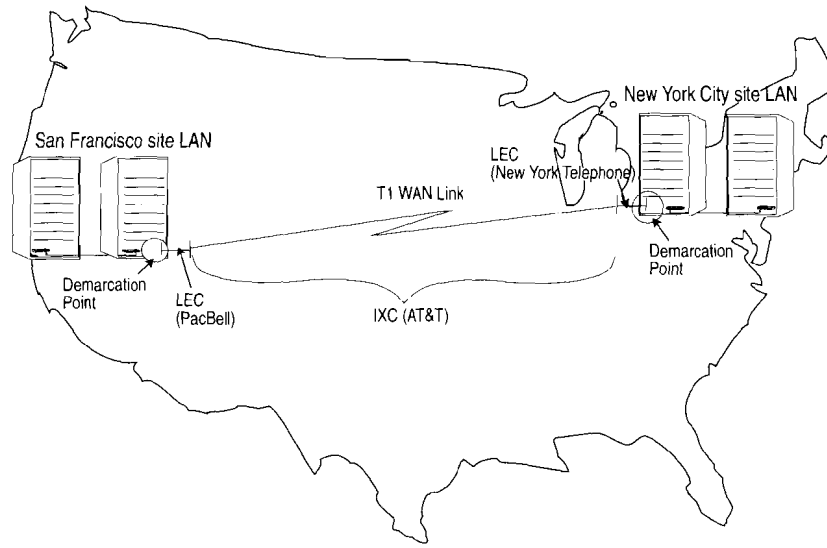
LECs are local phone companies that service a particular city or a limited area. For example, if your multisite LAN connects sites within the same city and is serviced by a local phone company, then an LEC will be able to provide your WAN link services. You don't need to contact an IXC for WAN link services.

The role of the service provider (IXC or LEC) is to maintain end-to-end WAN link connections between your sites. If there is a problem with the WAN link, the service provider is responsible for correcting the problem. In a troubleshooting situation, it is important to be able to isolate the fault to the WAN link services (phone company), the WAN link equipment (DSU/CSUs), or the network equipment (remote bridges and routers).

Example

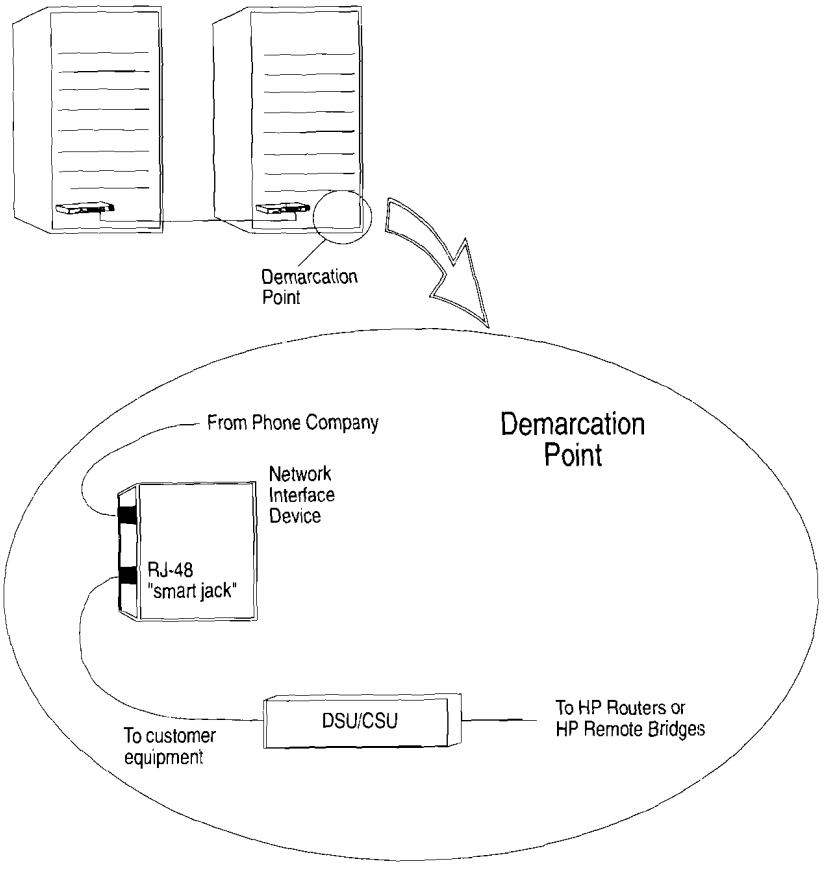
This example illustrates the various WAN link equipment needed to connect site LANs located in San Francisco and New York City using a T1 WAN link.

Multisite LAN between San Francisco and New York City.



In this example, AT&T is the IXC that provides the WAN link services for this multisite LAN. AT&T will also work with an LEC for the San Francisco area (Pacific Bell, for example) to provide the local WAN link connection. Similarly, AT&T will work with an LEC in the NYC area (New York Telephone, for example) to provide the complete (end-to-end) WAN link services.

Demarcation point.

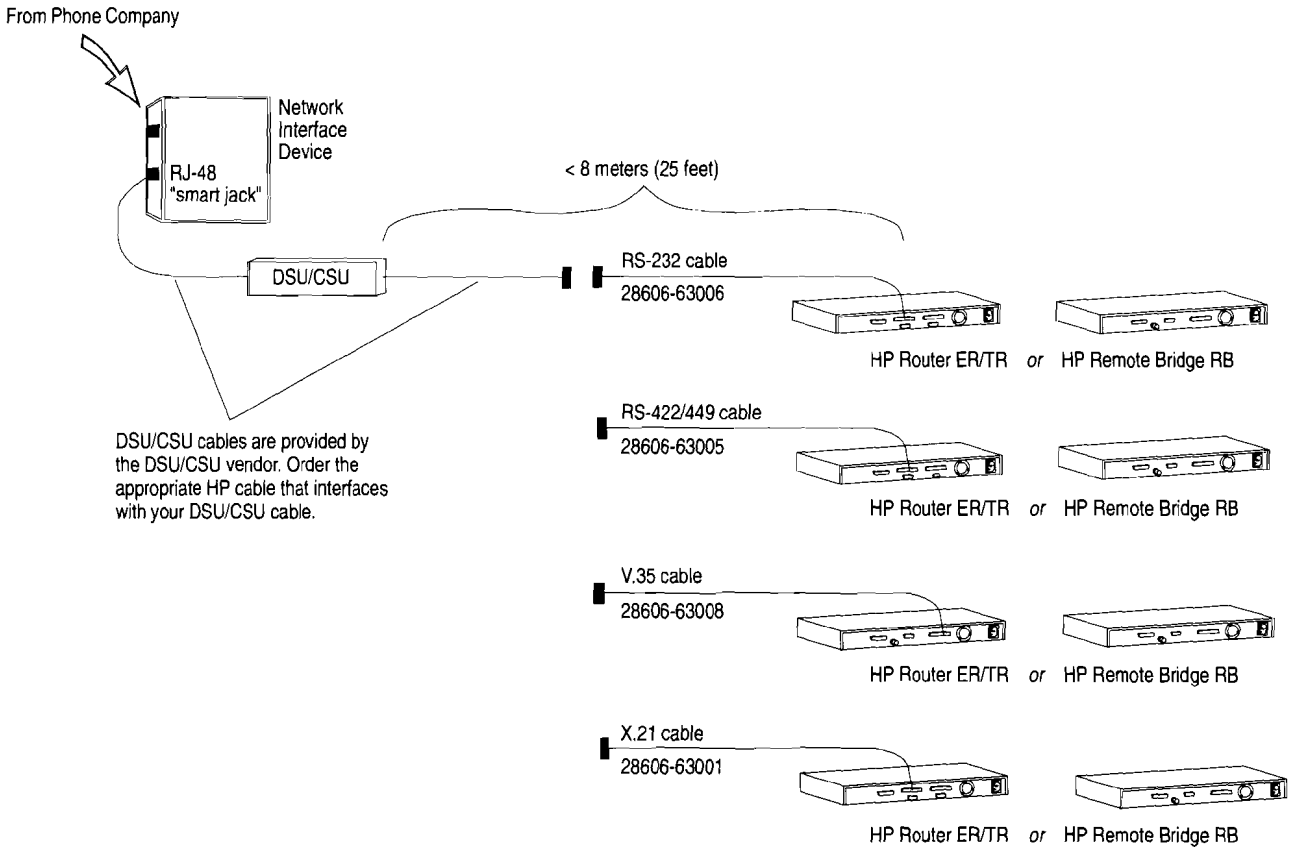


The point at which the IXC provides the WAN link connection to each site is called the demarcation point (or demarc point). At the demarc point, a network interface device is supplied by the IXC (or LEC). The network interface device provides the connection between the phone company and your network equipment. You can attach your DSU/CSU to the RJ-48 connector (also known as a "smart jack").

The DSU/CSU vendor provides the cable that connects the DSU/CSU to the smart jack. This cable length is limited by the design specification of the DSU/CSU. Typically, you should use a length of 8 meters (25 feet) or less.

DSU/CSU to Router or Remote Bridge Connection

From the DSU/CSU, you can connect to an HP remote bridge or router. The cable length between the DSU/CSU and the remote bridge or router is typically limited to 8 meters (25 ft.) or less. Due to this limitation, remote bridges, and routers are installed at the site's demarcation point. That is, they are kept close to the DSU/CSUs.



Multisite LAN and WAN Connections

Product Note

Supported DSU/CSUs and Modems

The following is a list of DSU/CSUs supported for the HP Remote Bridge and HP Routers.

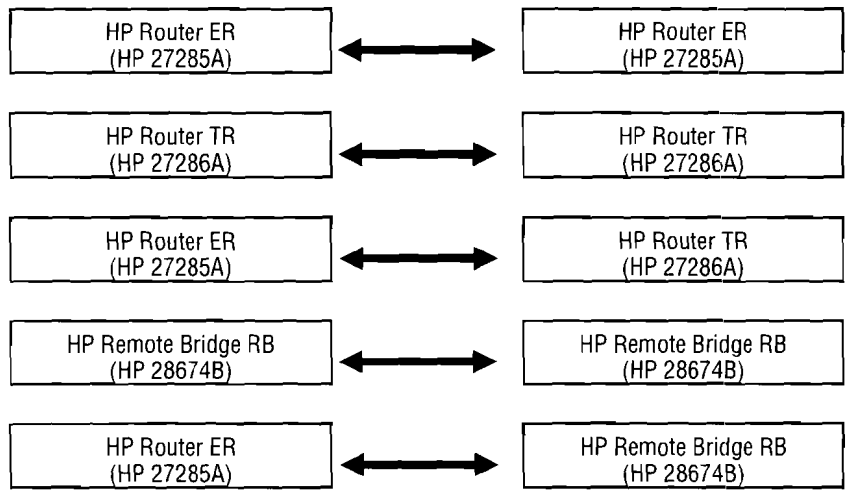
Vendor	Product	DTE I/F	DTE Data Rate	WAN I/F
Scitec	Integrator 1544	- V.35 - RS-449	56 or 64 Kbps x n (n = 1 to 24)	RJ45C T1
Scitec	SAT D4	- V.35 - RS-449	1.344 to 1.544 Mbps	DB15 T1
Digital Link	DL551VII	- V.35 - RS-449	1.344 to 1.544 Mbps	RJ48 T1
Digital Link	DL2048V	- V.35 - RS449 - X.21	1.984 or 2.048 Mbps	G.703 E1
Digital Link	DL551VX	- V.35 - RS-449	56 or 64 kbps x n (n = 1 to 24)	RJ48 T1
Digital Link	DL551VX-FT	- V.35 - RS-449	56 or 64 kbps x n (n = 1 to 24)	RJ48 T1 Fractional
Larse	Split-T	- V.35 - RS-449	56 or 64 Kbps x n (n = 1 to 24)	DB15 T1 Fractional
Codex	3500	- V.35	2.4 to 56 Kbps	DDS
AT&T Paradyne	Comsphere 3610	- V.35	2.4 to 64 Kbps	DDS, ASDS

Multisite LAN and WAN Connections

Product Note

Synchronous Test Cable for HP Routers and HP Remote Bridges

A 5-meter RS-422 synchronous test cable (HP p/n: 5061-2556) can be used for a local point-to-point connection between WAN ports as shown below. The synchronous test cable provides a means of connecting an HP Remote Bridge RB or HP Router directly to another HP remote bridge or router without the need of a modem eliminator. The synchronous test cable uses a 62-pin DB male connector at each end. Use the synchronous test cable for demonstration, instruction, or testing of HP remote bridges and routers.



Setting the WAN Speed

The WAN speed over the synchronous test cable with HP remote bridges can be one of four speeds: 2400, 9600, 19.2K, or 76K baud. When using the synchronous test cable with HP routers, the WAN can operate at any speed. The speed is derived from the remote bridge or router's console port baud rate. When the synchronous test cable is used, the speed of the WAN port will be eight times that of the console port speed. For example, when an ASCII terminal is attached to any remote bridge console port and is set to 300 baud, the WAN speed will be 300 x 8 = 2400 baud. If the remote bridge's console port baud rate is 9600, then the WAN speed will be 9600 x 8 = 76K baud. When an ANSI (or VT100) terminal is attached to any router console port and is set to 19.2K baud, the WAN speed will be 19.2K x 8 = 154K baud.

Note that routers can operate at any WAN speed. The remote bridge can only operate at one of the following speeds: 2400, 9600, 19.2K, or 76K when used with the synchronous test cable.

The console port baud rate may be set using two methods. With one method, the remote bridge and router can automatically speed-sense the terminal baud rate. The console port speed can be set by first setting the terminal baud rate, and then attaching it to the remote bridge's or router's console port. The remote bridge and router will detect the set terminal speed after the Enter (or Return) key is pressed three or more times.

The second method may be used when a terminal is already attached to the console port of the remote bridge or router and communication is established. To change the speed of the WAN port without disconnecting the console port cable, use the console port's Speed command. At the MAIN prompt type:

```
MAIN> sp
```

This will result in the following prompt:

```
Change console port baud rate (Y/N)>
```

After typing "Y", the following prompt will be displayed:

```
Enter new baud rate (300, 1200, 2400, 9600)>
```

After entering the desired baud rate the following prompt will be displayed:

```
Reconfigure terminal with new baud rate now, then press Return to Continue...
```

Once the terminal has been reconfigured and the Enter (or Return) key has been pressed, the MAIN> prompt will appear again.

Clock Source in a Remote Bridge-to-Remote Bridge Connection

The HP remote bridge automatically senses when a synchronous test cable is attached and can generate the necessary synchronous clocking used by the remote bridge's WAN interface.

Since the remote bridge's WAN interface is synchronous, and is based on common external clock(s), it is necessary that one of the remote bridges take on the role of master and generate the necessary clocking, while the other bridge simply uses the generated clock.

The synchronous test cable is not wired identically at each end. On just one end of the synchronous test cable, there are three designated pins which the remote bridge uses to identify the test cable. This end of the synchronous test cable is labeled "Clock Source". When the clock source end is attached to a remote bridge, that bridge automatically becomes the master and generates the clock.

For a remote bridge-to-remote bridge connection it is not important which end of the synchronous test cable is attached to a given bridge. All HP remote bridges with the 62-pin WAN interface are capable of being the clock source.

This remote bridge becomes the master and generates clocking.

Clock Source in a Router-to-Router Connection

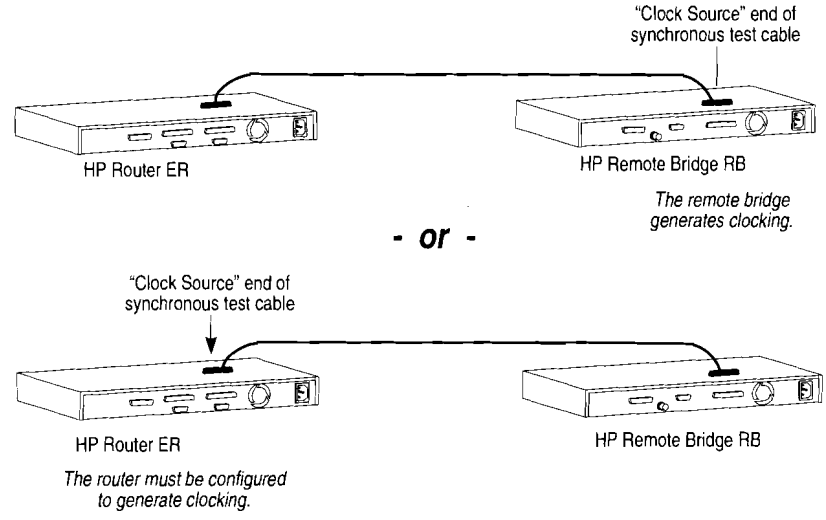
A synchronous test cable can be used between an HP Router ER/TR and another HP Router ER/TR. In the router-to-router connection, it doesn't matter which router you choose to attach the "Clock Source" end of the synchronous test cable.

The router that receives the clock source end of the test cable is the router that will be configured (via the console port) to provide the clock source. That is, the router that becomes the master and generates the clocking, is the router that you configure to provide the clock source using the console port and the Configuration Editor. You don't need to configure clocking on the other router.

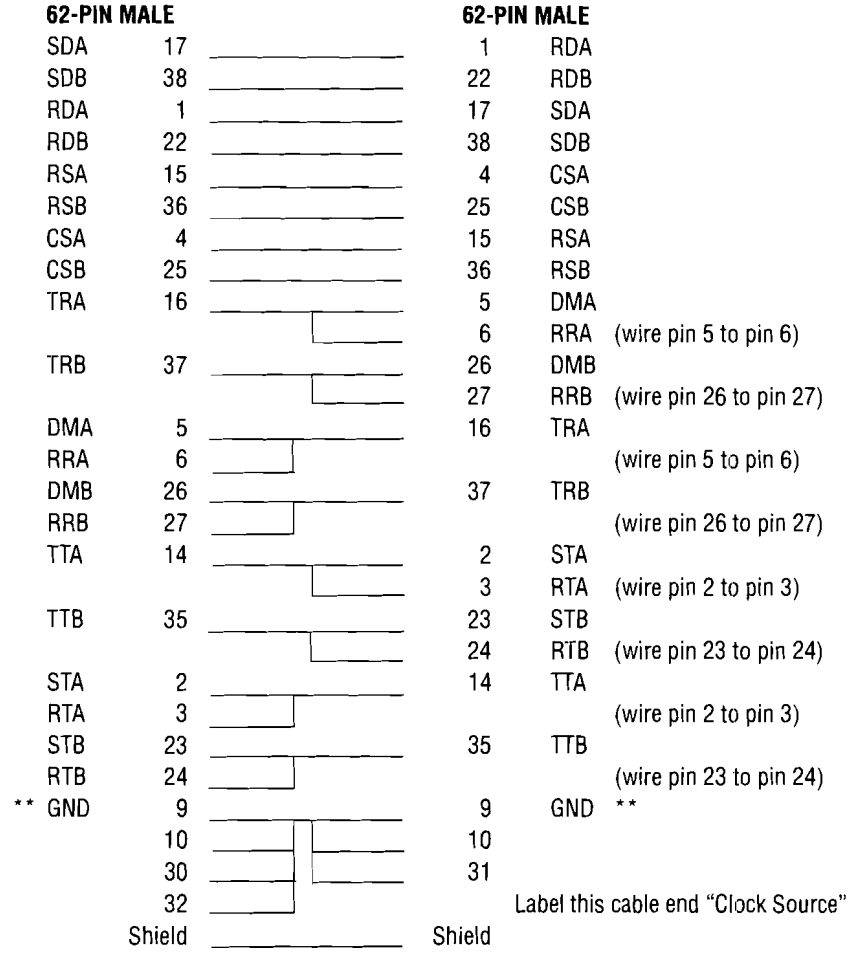
The HP Router TR is configured (via console port) to provide clocking.

Clock Source in a Router-to-Remote Bridge Connection

When an HP Router ER/TR is connected to an HP remote bridge, it is important to note which device is attached to the "Clock Source" end of the test cable. If the remote bridge is attached to the clock source end of the cable, then the remote bridge will generate the clocking. However, if the router is attached to the clock source end of the test cable, the router must be configured to generate the clocking.



Synchronous Test Cable
(HP 5061-2556)



** Note: Wire pin 9 (GND of each 62-pin connector as follows:

1. Connect pin 9 to pins 10, 30, and 32 on one end only.
2. Connect pin 9 to pins 10 and 31 on the other end and label this end as "Clock Source".

The following differential pairs of signals should be twisted-pair wires in the cable:

SDx [pins 17, 38] = Send Data
RDx [pins 2, 22] = Receive Data
RSx [pins 15, 36] = Request to Send
CSx [pins 4, 25] = Clear to Send
TRx [pins 16, 37] = Terminal Ready
DMx [pins 5, 26] = Data Mode
RRx [pins 6, 27] = Receiver Ready
TTx [pins 14, 35] = Terminal Timing
STx [pins 2, 23] = Send Timing
RTx [pins 3,24] = Receive Timing

where x is "A" for the negative signal of the pair (first pin number) and "B"for the positive signal of the pair (second pin number).

Technical Reference Guide

Network Management

- **Introduction**
- **HP OpenView Hub Manager/DOS**
- **HP OpenView Interconnect Manager/DOS**
- **HP OpenView Resoruce Manager/DOS**

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HP OpenView Network Management

Introduction

Network Management Software

The HP OpenView network management products described in this section are Microsoft Windows applications and operate on a PC using MS-DOS and MS-Windows. They include:

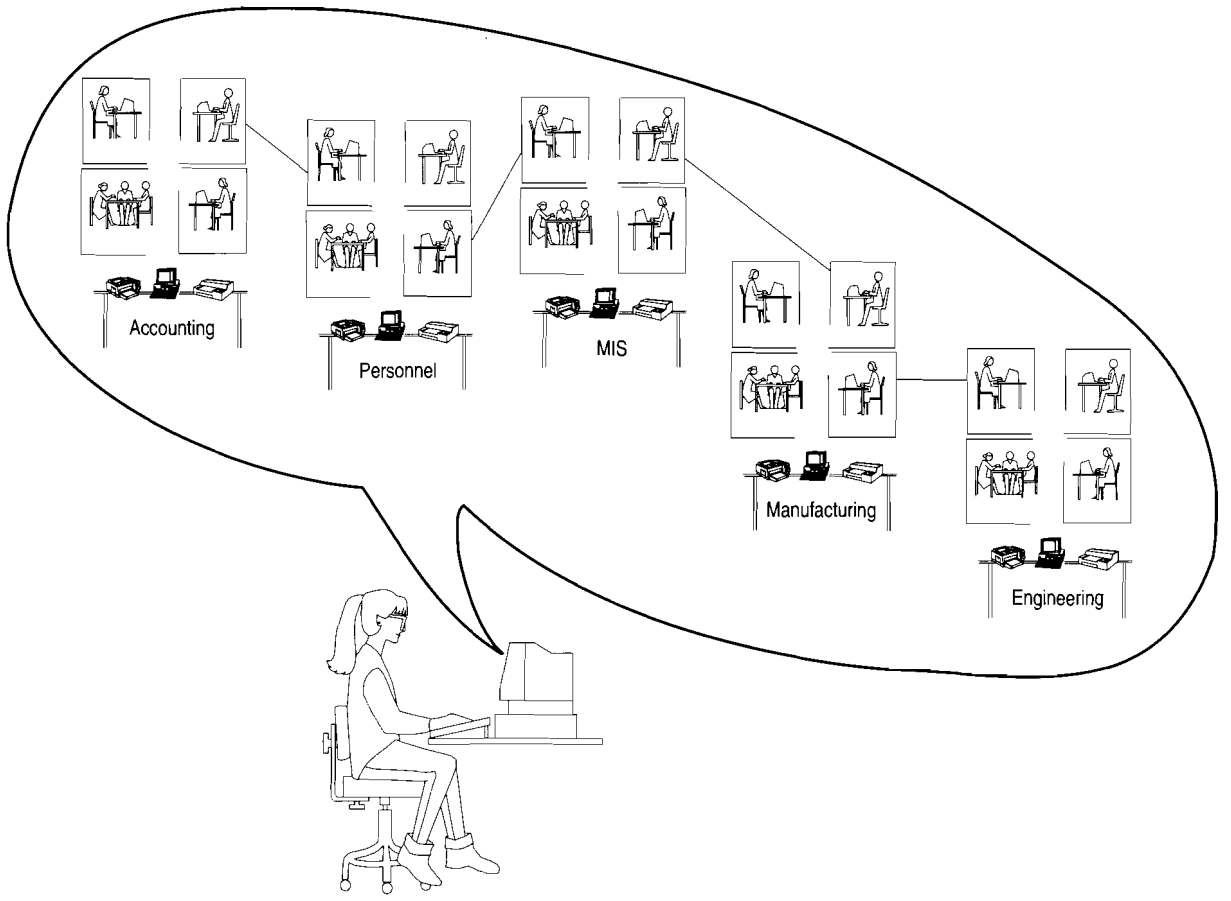
- **HP 28686D OpenView Hub Manager/DOS**
- **HP 27256D OpenView Interconnect Manager/DOS**
- **HP 27257D OpenView Resource Manager/DOS**

Hub Manager/DOS software manages hubs (such as EtherTwist, fiber-optic, and ThinLAN hubs). It is typically used in small networks consisting primarily of workgroup LANs.

Interconnect Manager/DOS software manages hubs, bridges, and routers. It is typically used in larger networks, and will manage site and multisite LANs from a single, central management station.

Both Hub Manager/DOS and Interconnect Manager/DOS provide automatic discovery of network devices (such as hubs, bridges, routers, and end nodes) and automatically create (draw) a map of your network. HP OpenView network management products use SNMP (Simple Network Management Protocol) and the IP or the IPX network layer (layer 3) protocols to communicate with and manage any SNMP/IP- or SNMP/IPX-based hub, bridge, and router.

Resource Manager/DOS software performs real-time traffic analysis on segments on your networks. Resource Manager/DOS is one of the first products from Hewlett-Packard that uses the EASE technology. EASE stands for Embedded Advanced Sampling Environment, and is a technology that uses packet sampling and real-time traffic analysis to deliver predictive data about a network. It can identify top talkers, heavy users, communication pairs, and error sources. This data allows you to plan for growth and to optimize your network resources. Resource Manager/DOS software runs on top of either Hub Manager/DOS or Interconnect Manager/DOS and displays its analysis results on the same console as the Hub Manager's or Interconnect Manager's network map. The traffic analysis data can be presented in easy-to-read pie, bar, stacked bar, and group bar chart forms, and a copy of the charts can be printed at any time.



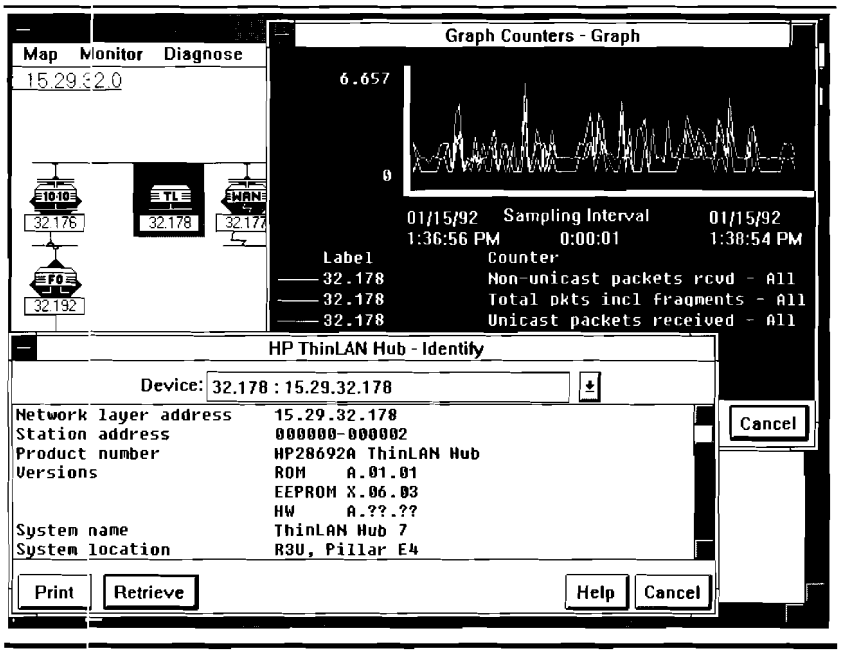
HP OpenView Network Management

HP OpenView Network Management

Technical Data

HP OpenView Hub Manager/DOS

The HP 28686D OpenView Hub Manager/DOS is a workgroup-level manager for hubs, PCs, workstations, printers, and network adapter cards. HP OpenView Hub Manager/DOS is a Microsoft Windows enhanced-mode application that is capable of providing the power of multitasking to manage a multivendor workgroup environment. Hub Manager also offers an easy upgrade path to site and multisite management.



Highlights

☆ **Management by Remote Control**
You no longer need to feel tied to your desk when HP OpenView Hub Manager is running. Based on a carefully designed and fully integrated remote alarm notification system, Hub Manager can notify you when an alarm is triggered on your network. Regardless of where you are at the time of the alarm—at your desk or across the globe—Hub Manager will activate a pager or a voice-activated system to inform you of alarms. You are immediately notified of network utilization levels, security violations, or other thresholds you set as alarms.

☆ **Integrated Multivendor Management**
Our leading-edge discovery and layout function automatically discovers and lays out all your NetWare/IPX clients/servers and IP devices in a single network map. Using the map, you can monitor and control devices on your network down to the PC on your desk or the printer on your network. To understand which user/PC is generating the most traffic on your network, activate the Hub Manager graphing facility. To browse another vendor's MIB (management information base), including proprietary extensions, activate the MIB browser facility. Because the Hub Manager application is designed for Microsoft Windows enhanced mode, performance is not compromised by these comprehensive, easy-to-use features.

☆ **Ease of Use and Upgrade**
Despite the complexity of your network, HP OpenView Hub Manager/DOS gives you seamless integration of multivendor IP and IPX management. Hub Manager's icon-based color graphic interface, context-sensitive online help, and task-oriented documentation let you perform management functions quickly and easily. This ease of use—combined with the low cost of Hub Manager—lets you manage your workgroup at a fraction of what an hour of downtime could cost you. As your network grows, you can easily upgrade your network management functions, while maintaining your expertise and investment in HP OpenView Hub Manager/DOS, by purchasing HP OpenView Interconnect Manager/DOS (HP 27256D).

Features

- Notifies you of network alarms remotely—at your desk or across the globe.
- Draws your network map automatically, including multivendor devices with NetWare/IPX or IP support.
- Knows what is in your work group, down to the level of identifying personal computers on your desk and printers connected to your network.
- Manages personal computers and/or the personal computer network adapter cards via the ports on the HP EtherTwist Hub Plus, avoiding the cost and performance degradation caused by running an SNMP/IP agent on your personal computer.
- Monitors workgroup network utilization—including multivendor devices with IP or IPX support—through the graphing facility.
- Provides easy point-and-click browsing of MIB-II or proprietary MIB extensions with the Hub Manager browser facility.
- Secures hubs on the network through a password encryption for each hub on your network.
- Protects your investment through standards support and a seamless upgrade path. HP OpenView Hub Manager fully supports the SNMP/IP, SNMP/IPX, and MIB-II standards.
- Makes control of your workgroup as simple as setting thresholds and configuring HP OpenView Hub Manager/DOS to monitor the workgroup and trigger when needed.
- Allows uploading and downloading of hub configuration files, for modifying an existing configuration or copying of configurations between hubs.

Specifications

System Requirements

- MS-DOS, version 3.2, 3.3, 4.01, or 5.0
- Microsoft Windows version 3.0A or 3.1
- 2 Mbytes minimum of extended memory; 4 Mbytes recommended
- 5 Mbytes available hard disk space
- VGA or EGA monitor (VGA recommended)
- Microsoft Windows-compatible mouse

Warranty

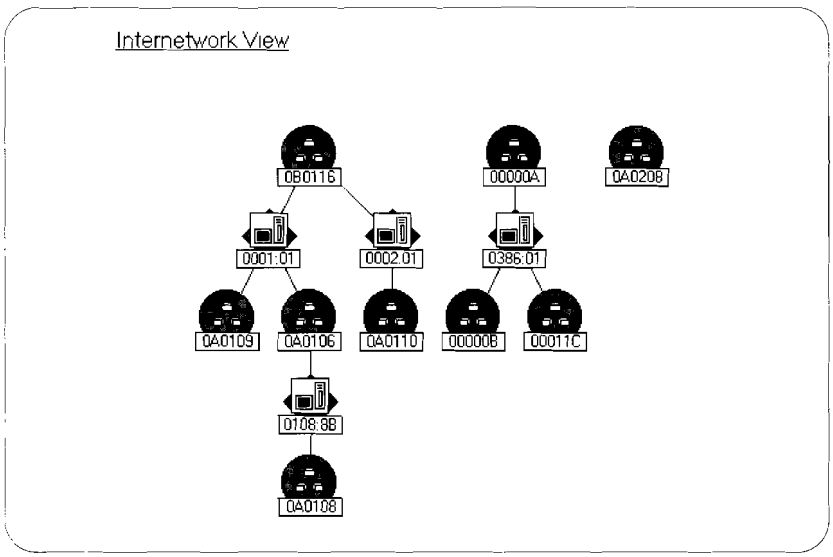
HP 28686D OpenView Hub Manager/DOS is warranted for 90 days against defects.

HP OpenView Network Management

Technical Data

HP OpenView Interconnect Manager/DOS

The HP 27256D OpenView Interconnect Manager/DOS is an integrated multivendor SNMP manager for personal computers, workstations, printers, network adapter cards, hubs, bridges, and routers. HP OpenView Interconnect Manager is a Microsoft Windows enhanced-mode application that is capable of providing the power of multitasking to manage a multivendor extended LAN and a dynamic environment.



Highlights

☆ **Management by Remote Control**
You no longer need to sit and watch HP OpenView Interconnect Manager running. Based on a carefully designed and fully integrated remote alarm notification system, Interconnect Manager can notify you when an alarm is triggered on your network. Regardless of where you are at the time of the alarm—across your desk or across the globe—Interconnect Manager will activate a pager or a voice-activated system to inform you of alarms. You are immediately notified of network utilization, security violation, or other thresholds you set as alarms.

☆ Integrated Multivendor Management

Our leading-edge discovery and layout function automatically discovers and lays out all your NetWare/IPX clients/servers and IP devices in a single network map. Using the map, you can monitor and control devices on your network down to the PC on your desk or the printer on your network. To understand which side of your LAN is generating the most traffic across the LAN Bridge, or which PC is generating the most errors on a specific hub, activate the Interconnect Manager graphing facility. To browse another vendor's MIB (management information base), including proprietary extensions, activate the MIB browser facility. Because the Interconnect Manager application is designed for Microsoft Windows enhanced mode, performance is not compromised by these comprehensive, easy-to-use features.

☆ Controlled Levels of Management

To arm your network managers with different levels of monitoring and control across the network, Interconnect Manager lets you decide at map-drawing time to exclude certain subnets from being drawn. This will eliminate their visibility to certain network management functions. Also, after the map has been drawn, you can assign passwords to devices on your network and provide the password only to network managers who are responsible for control functions like configuration changes. This will make monitoring available to all network managers, with control permitted only for those with the password.

Features

- Notifies you of network alarms remotely—across your desk or across the globe.
- Draws your network map automatically, including multivendor devices with NetWare/IPX or IP support.
- Knows what is on your network, down to the level of identifying personal computers on your desk and printers connected to your network.
- Manages personal computers and/or the personal computer network adapter cards via the ports on the EtherTwist Hub/Plus, avoiding the cost and performance degradation caused by running an SNMP/IP agent on your personal computer.
- Monitors network utilization—including multivendor devices with IP or IPX support—through the graphing facility.
- Provides easy point-and-click browsing of MIB-II or proprietary MIB extensions with Interconnect Manager MIB browser facility.
- Secures network devices through a password encryption for each device on your network.
- Protects your investment through standards support and a seamless upgrade path. HP OpenView Interconnect Manager fully supports SNMP/IP, SNMP/IPX, and MIB-II.
- Reduces your learning curve through an easy-to-use graphical user interface, context-sensitive help, and task-oriented documentation.
- Makes control of your network as simple as setting thresholds and configuring Interconnect Manager to monitor the network and trigger when needed.

- Allows control of bridges through setting spanning tree parameters and setting wildcards for filtering and/or forwarding.
- Performs router configuration through Telnet, which is fully integrated with the discovered routers on your network map.
- Allows uploading and downloading of device configuration files, for modifying an existing configuration or copying of configurations between similar devices.

Specifications

System Requirements

- MS-DOS, version 3.2, 3.3, 4.01, or 5.0
- Microsoft Windows version 3.0A or 3.1
- 2 Mbytes minimum of extended memory; 4 Mbytes recommended
- 10 Mbytes available hard disk space
- VGA or EGA monitor (VGA recommended)
- Microsoft Windows-compatible mouse

Warranty

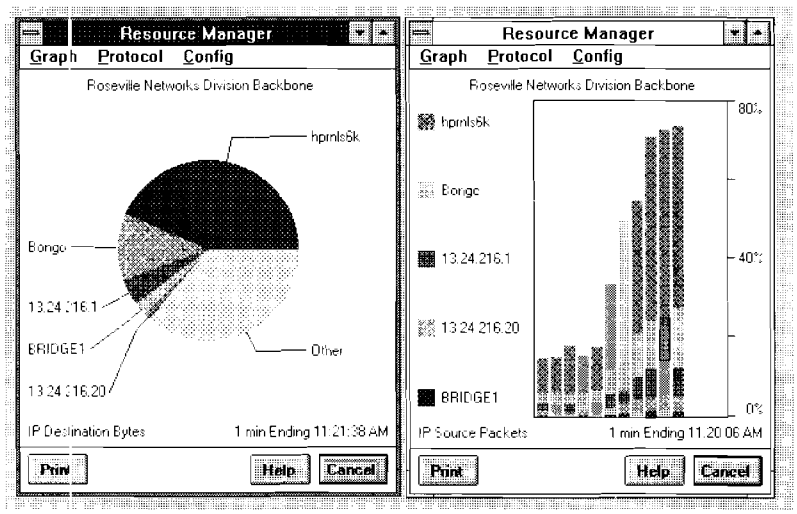
HP 27256D OpenView Interconnect Manager/DOS is warranted for 90 days against defects.

HP OpenView Network Management

Technical Data

HP OpenView Resource Manager/DOS

The HP 27257D OpenView Resource Manager/DOS is an advanced, real-time trend analysis product. It allows network managers to monitor trends on the network by identifying top talkers, heavy users, communication pairs, and errors and their sources. Monitoring is based on IP, IPX, or MAC addresses, and is graphically displayed or printed as pie charts, bar charts, or time-series charts. Resource Manager is fully integrated with HP OpenView Hub Manager/DOS and HP OpenView Interconnect Manager/DOS.



Highlights

Single View Management
HP OpenView Resource Manager/DOS uses the HP EASE (Embedded Advanced Sampling Environment) instrumentation functions in HP EtherTwist hubs and bridges to sample network trends. Not only does this help you identify trouble spots on your network—and show you where to focus your high-end LAN analysis instruments—it also delivers the trend information you need right to the management station you use to control the devices on your network, whether that station is across the office or across the globe.

☆ **Integrated Solution**
HP OpenView Resource Manager/DOS is so thoroughly integrated with HP's OpenView Hub Manager/DOS and Interconnect Manager/DOS that it even shares the same network map with them. To analyze your network's traffic patterns with Resource Manager, simply point and click on the map to select a cable segment, then pull down the menus to choose the analysis options. When the analysis indicates a particular device that needs attention, clicking on that device's icon on the same map will make all the device monitoring and control functions of Hub Manager/DOS or Interconnect Manager/DOS available to you.

☆ **Easy Upgrade**
Adding the power of embedded instrumentation to your network is as easy as downloading new firmware code to your existing EtherTwist hubs and bridges. Because the HP hubs and bridges store their firmware in flash EPROM, upgrading is like installing a software patch—there are no chips to replace, and you don't even have to open up the cabinet. And when future network management products are introduced, you will be able to download any firmware upgrades across the network from a central network management station.

Features

- Provides real-time trend analysis for any segment on your network.
- Uses Hewlett-Packard's embedded instrumentation architecture.
- Provides full integration with Hub Manager/DOS and Interconnect Manager/DOS.
- Identifies top five talkers/heavy users.
- Identifies top talkers based on bytes or packets as sources or receivers.
- Identifies top multicast and broadcast sources.
- Tracks network errors and their sources.
- Identifies communication pairs involved in various activities.
- Monitors network trends based on IP, IPX, or MAC addresses.
- Displays network trends in pie charts, bar charts, or time series charts.
- Prints network trends in pie charts, bar charts, or time-series charts.

Specifications

System Requirements

- MS-DOS, version 3.2, 3.3, 4.01, or 5.0
- Microsoft Windows version 3.0A, or 3.1
- 2 Mbytes of extended memory
- 10 Mbytes available hard disk space
- VGA or EGA monitor (VGA recommended)
- HP OpenView Hub Manager/DOS or HP OpenView Interconnect Manager/DOS

Warranty

HP 27257D OpenView Resource Manager/DOS is warranted for 90 days against defects.

HEWLETT PACKARD

HP OpenView Network Management

Product Note

What's New

This product note highlights the new network management features and enhancements included with HP OpenView Hub Manager/DOS (HP 28686D), Interconnect Manager/DOS (HP 27256D), and Resource Manager/DOS (HP 27257D).

HP EASE

HP OpenView Resource Manager/DOS uses the HP EASE technology (Embedded Advanced Sampling Environment) to identify network usage patterns. The HP EASE technology is based on algorithms that selectively sample traffic (in real time) on a network segment and analyze the collected data. Only filtered data is passed by the algorithms to the Resource Manager for further analysis. The filters can detect the top five active users on the network, such as the sources, the receivers, communication pairs, and error sources. The trend analysis data can also show the amount of IP, IPX (Novell NetWare Internet Packet Exchange) protocols or station addresses on the network.

HP managed hubs and bridges ship (after June 1, 1992) with agent firmware (version D.01.xx) that includes support for HP EASE. Since HP EASE software is embedded in the agent firmware, the hubs and bridges can act as data-gathering instruments on the network. By distributing the data-gathering throughout the entire network, HP EASE software can pass accurate, real-time data in compact form to a central management station from any part of the network. HP EASE uses advanced sampling techniques that use a very small portion of the total network traffic.

HP Resource Manager/DOS

HP OpenView Resource Manager/DOS (HP 27257D) is the first network management software to take advantage of the HP EASE technology. Resource Manager performs trend analysis on the traffic flowing through the network and identifies the stations generating the most traffic and the most errors on the network. This information indicates parts of the network you may want to monitor further with a LAN analyzer, and points out devices appropriate for monitoring and control with HP OpenView Hub Manager/DOS or Interconnect Manager/DOS. Future network management software using the HP EASE technology will predict traffic trends and problems on the network and actually prescribe the corrective actions you should take.

Resource Manager software runs on top of either Hub Manager/DOS or Interconnect Manager/DOS. On the network management station console, you simply select a segment(s) on the network map by clicking on the segment(s) you wish to analyze. The HP managed hubs and bridges on the segment are then polled by Resource Manager. The embedded EASE software in the hubs and bridges will pass sampled and filtered packets to Resource Manager to further analyze. The EASE technology selectively samples and filters the network traffic, rather than collect and report data about all packets passing through the network. Since HP EASE uses this sampling technique, it minimizes polling to less than 1% of the total network traffic. Resource Manager presents the analyzed data in easy-to-understand pie, bar, stacked bar, and grouped bar charts.

HP Interconnect Manager/DOS

HP 27256D OpenView Interconnect Manager/DOS is a hub and bridge management tool that runs under HP OpenView Windows on a personal computer. HP Interconnect Manager/DOS is a superset of the hub manager product. HP Interconnect Manager/DOS includes all of the HP Hub Manager/DOS features and functions, and, in addition, provides management of local and remote HP bridges. Note that there is no separate HP Bridge Manager/DOS product.

You can upgrade from prior versions of HP Hub Manager or HP Bridge Manager. HP OpenView Hub Manager versions "A", "B", or "C" can upgrade to HP 28686D OpenView Hub Manager/DOS. HP OpenView Bridge Manager versions "A", "B", or "C" can upgrade to the HP 27256D Interconnect Manager/DOS. HP 27256D OpenView Interconnect Manager/DOS is the suggested upgrade for all prior HP OpenView Bridge Manager versions.

Integrated Multivendor Management

HP OpenView Hub Manager/DOS (HP 28686D), Interconnect Manager/DOS (HP 27256D), and HP managed hubs and bridges provide seamless integration of multivendor IP and IPX management. New HP hubs and bridges have agent firmware (version D.01.xx) that supports both SNMP/IP and SNMP/IPX. The leading-edge discovery and layout function automatically discovers and lays out all your NetWare/IPX clients and servers, or your IP devices, in a single network map. Using the map, you can monitor and control devices on your network down to the PC on your desk or the printer on your network.

You can also browse another vendor's MIB (management information base), including proprietary extensions, by activating the MIB browser facility.

Action on Events

The new Action on Events feature of HP OpenView Hub Manager/DOS and Interconnect Manager/DOS allows actions to be initiated automatically when events occur. You no longer need to feel tied to your desk when HP OpenView Hub Manager/DOS or Interconnect Manager/DOS is running on your network management station. Regardless of where you are at the time of the alarm, you can be notified of network utilization levels, security violation, or other thresholds you set as alarms.

One major purpose of the Action on Events feature is to facilitate remote alarm notification. For instance, you can use Action on Events as part of a software-controlled system in which your pager is activated whenever certain events occur, such as a device going offline. This way, you could be notified immediately of important events on the network without having to be physically seated at the management station.

If you have a speaker system connected to your management station, you could use the Action on Events feature as part of a process that results in a audio message from the speaker alerting you of an event on the network.

Another example of using the Action on Events feature would be to facilitate logging of data related to events. You can create a Windows Recorder macro that turns on logging of specific hub or bridge counters, and have it activated when an event occurs.

Note that the Action on Events feature does not itself perform actions. Rather, the Action on Events feature interfaces a user-supplied action file with Hub Manager's and Interconnect Manager's event monitoring capabilities. You specify the actions that will occur in the action file. The action file is the executable code that performs or initiates an action or actions. The user is responsible for creating an action file, which can be a program or a DOS batch file.

Updating Agent Firmware

The new update firmware allows you to download future upgrades of agent firmware across the network from the network management station to any HP hub plus or bridge. Agent firmware upgrades protect your hardware investment and provide an easy-to-use and convenient method for adding upgrades. The update utility lets you upgrade firmware without physically opening the network device and risking hardware damage by inserting new ROMs. This new function is available on HP hubs and bridges that have firmware version D.01.xx (this version is shipped with new hubs and bridges).

For future agent firmware upgrades to hubs or bridges, say E.01.01 or later, you can use your management station to update your hubs' and bridges' agent firmware over the network.

Emulator and Training

To help you become familiar with HP OpenView network management, emulator software is included with each HP OpenView Interconnect Manager/DOS and Hub Manager/DOS product. The emulator lets you practice using the manager without requiring or affecting a live network.

Once you have installed HP OpenView Hub Manager/DOS or Interconnect Manager/DOS, the software provides an emulation mode of operation as well as live network operation. In a live network operation, the manager interacts with the network through the network services that are installed on the network management station. In emulation mode, the manager does not interact with a live network. In fact, in emulation mode, the manager does not interact with, or even require, network services software on the management station. The emulator can be used to give demonstrations, and is a training tool for HP OpenView network management products.

The computer-based training disk is a standalone program that takes you through conceptual and applied network management tasks. Two training kits are available and are sold separately:

- *HP EtherTwist: Building and Managing the Workgroup and Site LAN*, part number 27256+49N-0

or

- *HP EtherTwist: Building and Managing the Multisite LAN*, part number 27286+49A-0

Each training kit contains the emulator disks.

HP OpenView Network Management

Product Note

HP's Network Management Pieces

Basic Hardware Components

The basic hardware components needed to install HP OpenView Hub Manager/DOS or Interconnect Manager/DOS are:

- IBM PC AT-compatible computer (Intel 80286, 80386, or 80486 processor)
- Minimum 12-MHz system clock speed
- 640 Kbytes system memory
- Minimum 2 Mbytes *extended* memory for manager operation; 4 Mbytes recommended.
- VGA monitor and interface card
  - EGA monitor can be used but will present some viewing distortion because of lower display pixel count
- High-resolution monitor (optional)
- MS-Windows–supported mouse
- MS-Windows–supported printer (optional)
- 6 to 8 Mbytes available hard disk space
- One floppy disk drive—1.2-Mbyte or 1.44-Mbyte
- One of the following network adapter cards:
  - HP PC LAN Adapter/8 TP (HP 27245A)
  - HP MC LAN Adapter/16 TP (HP 27246A)
  - HP PC LAN Adapter/16 (HP 27247A)
  - HP PC LAN Adapter/16 TP Plus (HP 27247B)
  - HP EISA LAN Adapter/32 TP (HP 27248A)
  - HP PC LAN Adapter/16 TL Plus(HP 27252A)
  - 3Com EtherLink II thin coaxial adapter card
  - 3Com EtherLink/MC Micro Channel thin coaxial adapter card
  - 3Com EtherLink II TP 10Base-T adapter card
  - 3Com EtherLink/MC TP Micro Channel 10Base-T adapter card
  - Western Digital EtherCard+ thin coax adapter card
  - Western Digital EtherCard+ Micro Channel thin coaxial adapter card
  - Western Digital EtherCard+ 10T 10Base-T card
  - Western Digital EtherCard+ 10T/A Micro Channel 10Base-T card

The following personal computers have been tested and approved for use with HP OpenView Interconnect Manager/DOS and HP OpenView Hub Manager/DOS:

- HP Vectra ES/12 and 286/12
- HP Vectra QS/16, QS/20, RS/16, RS/20, RS/25C, and 486/25
- IBM PC AT and PS/2 Models 50,55,60,70, and 80
- Compaq DeskPro 286 and 386

Basic Software Components

The basic software components needed to install HP OpenView Interconnect Manager/DOS or HP OpenView Hub Manager/DOS are:

- Microsoft DOS version 3.2, 3.3, 4.01, or 5.0

- Microsoft Windows 3.00a (5-disk package; not included with Hub Manager/DOS or Interconnect Manager/DOS). Using version 3.0 (instead of 3.00a) in combination with our application will cause intermittent crashes on 80386 processor-based PCs. On 80286 processor-based PCs the application may not work at all. Please call Microsoft online support (for an upgrade from version 3.0 to 3.00a.

  in the U.S. 1-800-426-9400
  outside the U.S. 1-206-882-8088

  or

- Microsoft Windows 3.1
- HP ARPA Services 2.1 installation disk (included with the product) for operation in IP mode.
  The full HP ARPA Services software product is not provided with the product.
  or

  For operation in IPX mode, you need to run client versions of NetWare that meet or exceed the versions listed below.

  If you are using non-ODI drivers:
  - IPX.OBJ v3.10
  - NETX.COM v3.22 *or*
    EMSNETX.EXE v3.22 *or*
    XMSNETX.EXE v3.22

  If you are using ODI drivers:
  - IPXODI.COM v1.30
  - NETX.COM v3.22 *or*
    EMSNETX.EXE v3.22 *or*
    XMSNETX.EXE v3.22
  - LSL.COM v1.21

  You can either copy the latest versions of the above listed files from CompuServe, or you can copy the files provided on the HUBMANAGER2 or ICMANAGER2 disks in the NWUPDATE directory. Note that the files supplied on the product disks are the minimum acceptable client versions. We recommend that you switch to the latest versions of the files as soon as they become available.

  HP OpenView Interconnect Manager/DOS and Hub Manager/DOS use the Internet Protocol transport provided by the ARPA product to communicate over the network with HP's bridges, hubs and routers. Interconnect Manager/DOS and Hub Manager/DOS provide the same SNMP functionality in the IPX environment.

- HP OpenView Windows version A.05.01
  (included with HP OpenView manager application)
  Disks: OPENVIEW1
  OPENVIEW2
  OPENVIEW3

  The installation program will prompt for OPENVIEW1 and OPENVIEW2 disks only. OPENVIEW3 will not need to be loaded.

- HP OpenView Hub Manager/DOS – HP 28686D version D.01.00
  Disk: HUBMANAGER1
  HUBMANAGER2

- HP OpenView Interconnect Manager/DOS – HP 27256D version D.01.00
  Disks: ICMANAGER1
  ICMANAGER2
  ICMANAGER3

Managed Components

The following components can be managed with HP OpenView Interconnect Manager/DOS.

- **HP 28688A EtherTwist Hub Plus**
  (12-port twisted-pair Type 10Base-T repeater, EEPROM code version D.01.00 or later)
- **HP 28688B EtherTwist Hub Plus**
  (12-port twisted-pair Type 10Base-T repeater, EEPROM code version D.01.00 or later)
- **HP 28682A Fiber-Optic Hub Plus**
  (8-port fiber-optic repeater, EEPROM code version D.01.01 or greater)
- **HP 28699A EtherTwist Hub Plus/48**
  (48 port twisted-pair Type 10Base-T repeater, EEPROM code version D.01.01 or later)
- **HP 28692A ThinLAN Hub Plus**
  (9-port thin coax repeater, EEPROM code version D.01.00 or later)
- **HP 28673A 10:10 LAN Bridge MB**
  (RAM code version D.01.00 or later)
- **HP 28674B Remote Bridge RB**
  (RAM code version D.01.00 or later)

Note: HP hubs and bridges with earlier versions of device code (A.01.00, B.01.00, and C.01.00) are updated free of charge by ordering HP OpenView Interconnect Manager/DOS.

- **HP 27285A Router ER**
  (RAM code version D.01.00 or later)
- **HP 27286A Router TR**
  (RAM code version D.01.00 or later)

The following components can be managed with HP OpenView Hub Manager/DOS.

- **HP 28688A EtherTwist Hub Plus**
  (12-port twisted-pair Type 10Base-T repeater, EEPROM code version D.01.00 or later)
- **HP 28688B EtherTwist Hub Plus**
  (12-port twisted-pair Type 10Base-T repeater, EEPROM code version D.01.00 or later)
- **HP 28682A Fiber-Optic Hub Plus**
  (8-port fiber-optic repeater, EEPROM code version D.01.01 or later)
- **HP 28699A EtherTwist Hub Plus/48**
  (48 port twisted-pair Type 10Base-T repeater, EEPROM code version D.01.01 or later)
- **HP 28692A ThinLAN Hub Plus**
  (9-port thin coax repeater, EEPROM code version D.01.00 or later)

Note: HP hubs with earlier versions of device code (A.01.00, B.01.00, and C.01.00) are updated free of charge by ordering HP OpenView Hub Manager/DOS.

Other network devices can be automatically detected by HP OpenView Hub Manager/DOS and Interconnect Manager/DOS. In addition, the managers can access some information from devices manufactured by other companies as long as such devices are SNMP/MIB-II compatible.

HP Network Components

The following HP components can be used with HP's managed devices and provide high versatility in network topology implementation.

- **HP 28685A/B EtherTwist Transceiver**
  Attaches an IEEE 802.3 AUI port to twisted-pair cable.
- **HP 28683A Fiber-Optic Transceiver**
  Attaches an IEEE 802.3 AUI port to a fiber-optic network.
- **HP 28641B ThinLAN Transceiver**
  Attaches an IEEE 802.3 AUI port to a ThinLAN coaxial network.
- **HP 27245A PC LAN Adapter/8 TP**
  An 8-bit ISA card that connects a personal computer to a twisted-pair cable.
- **HP 27267A PC LAN Adapter/8 TP** 6-pack
  The 6-card package of HP 27245A adapter cards.
- **HP 27247B PC LAN Adapter/16 TP Plus**
  A 16-bit ISA card that connects a personal computer to either a twisted-pair cable or an AUI-connected transceiver.
- **HP 27269B PC LAN Adapter/16 Plus** 6-pack
  The 6-card package of HP 27247B adapter cards.
- **HP 27252A PC LAN Adapter/16 TL Plus**
  An 16-bit ISA card that connects a personal computer to either a thin coaxial cable segment or an AUI-connected transceiver.
- **HP 27246A MC LAN Adapter/16 TP**
  A 16-bit Micro Channel card that connects a personal computer with Micro Channel architecture to twisted-pair cable.
- **HP 27248A EISA LAN Adapter/32 TP**
  An Extended Industry Standard Architecture (EISA) personal computer adapter card that connects to either a twisted-pair cable or an AUI-connected transceiver. It is currently not supported for use with HP OpenView Hub Manager/DOS and Interconnect Manager/DOS.

HP OpenView Network Management

Product Note

How the Pieces Fit Together

Overview

This product note gives you an overview of how the HP OpenView Interconnect Manager/DOS or Hub Manager/DOS software and HP network hardware fit together in a managed network.

When you order HP OpenView Interconnect Manager/DOS you get several different pieces of software:

- HP OpenView Interconnect Manager/DOS
- HP OpenView Windows
- HP ARPA Services (for operation in IP mode)

When you order HP OpenView Hub Manager/DOS you get several different pieces of software:

- HP OpenView Hub Manager/DOS
- HP OpenView Windows
- HP ARPA Services (for operation in IP mode)

For both Hub Manager/DOS and Interconnect Manager/DOS to operate in IPX mode, you need to run client versions of NetWare that meet or exceed the versions listed below.

If you are using non-ODI drivers:

- IPX.OBJ v3.10
- NETX.COM v3.22 *or*
  EMSNETX.EXE v3.22 *or*
  XMSNETX.EXE v3.22

If you are using ODI drivers:

- IPXCDI.COM v1.30
- NETX.COM v3.22 *or*
  EMSNETX.EXE v3.22 *or*
  XMSNETX.EXE v3.22
- LSL.COM v1.21

In addition to these, you provide the necessary operating system software:

- MS-DOS 3.2, 3.3, 4.01, or 5.0
- Microsoft Windows 3.00a or 3.1

Finally, you may need to upgrade your managed HP hubs or HP bridges with the latest software (comes with Interconnect Manager/DOS or Hub Manager/DOS):

- Agent software (revision D)

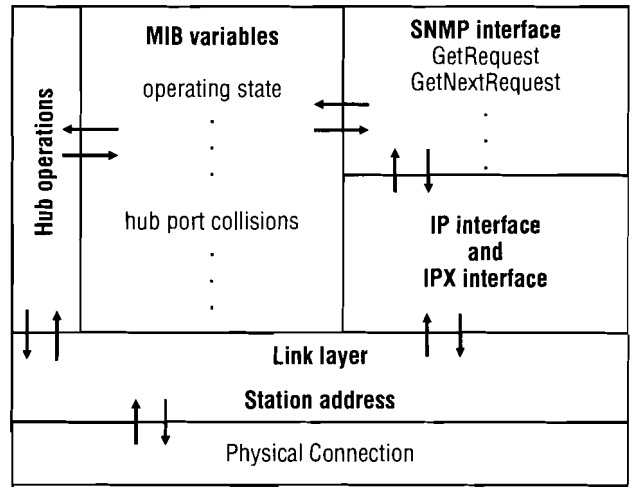
The agent software is shrink-wrapped to the box in an envelope entitled *Network Management Agent Software Upgrade*. This envelope contains a floppy disk and an instruction guide. The floppy disk contains a download program and software for HP hubs and bridges. The hub and bridge software must be compatible with the software in HP OpenView Interconnect Manager/DOS or Hub Manager/DOS . If your bridge or hub was purchased before the HP 27256D Interconnect Manager/DOS or HP 28286D Hub Manager/DOS was available for sale, the software in the hub or bridge will not be compatible with this version of the Interconnect and Hub Manager/DOS. If it is not, the *Network Management Agent Software Upgrade* is provided so that you can download the correct version of software into your bridges or hubs. The new software can be downloaded from a PC to a hub or a bridge through its console port.

The Managed Device

For example, consider an HP managed hub that is being managed by the HP OpenView Hub Manager/DOS. The hub is "managed" by conversation between the Network Management station (running Interconnect Manager/DOS) and the hub's agent software. The agent software is executable code that is held in the hub's memory.

This conversation between the management station and the managed device consists primarily of requests for data and responses to the requests. To perform this conversation, the hub's agent software must interact with several other entities that are also a part of the agent software:

- the list of MIB variables
- the SNMP interface
- the IP interface or the IPX interface



MIB variables. The list of MIB variables—formally known as the Management Information Base—contains status and control information related to normal hub operations. The control variables provide instructions to the agent software for carrying out hub operations. The status variables are updated by the hub agent with information it gathers as it carries out normal hub operations (receiving and transmitting packets, detecting collisions, ...). The Hub Manager/DOS software sets the control variables and reads the status variables using SNMP commands.

SNMP interface. Both the Hub Manager/DOS and the managed hub have an SNMP interface. The SNMP interface consists of data request and data response commands. The agent software and the Hub Manager/DOS software use these commands to exchange information and instructions—this is the language that the Hub Manager/DOS uses to manage the hub.

For example, the Hub Manager/DOS might use an SNMP GetRequest command to query the hub for the number of collisions on a given port, using the MIB variable "`hubPortCollisions`". The agent firmware would reply using the SNMP GetResponse command. (There is more detailed information on SNMP and the MIB variables in the product note entitled "What are SNMP and MIB?", later in this guide.)

IP interface. Both the Hub Manager/DOS and the managed hub have an IP interface. The agent software uses its Internet Protocol (IP) interface to communicate across the network to Hub Manager/DOS.

The firmware in a bridge or a router operates in much the same way as the hub firmware shown here. Although hub operations, and thus the specific MIB variables, are different from those of a bridge, the structure of the agent software for the bridge is similar.

and

IPX Interface. With the HP Interconnect Manager/DOS (HP 27256D) and HP Hub Manager/DOS (HP 28686D) products, the IPX interface has been added to all HP managed hubs, and bridges. Note that managed hubs, and bridges must have software revision D.01.00 or later. Hubs and bridges with agent software versions before D.01.00 (such as A.01.00, B.01.00, C.01.00, etc.) must be updated to the D.01.00 revision using the Network Management Agent Update Software. HP OpenView Hub Manager (HP 28686A/B/C) and HP OpenView Bridge Manager (HP 28653A/B/C) products do not support the IPX interface.

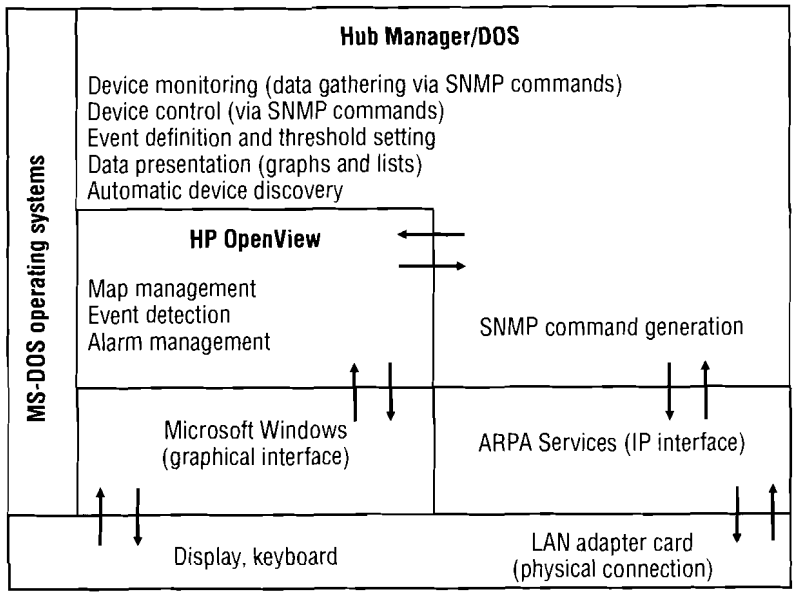
The agent software can use the IPX interface to communicate across the network to the network management station (running Interconnect Manager/DOS or Hub Manager/DOS).

The Management Station

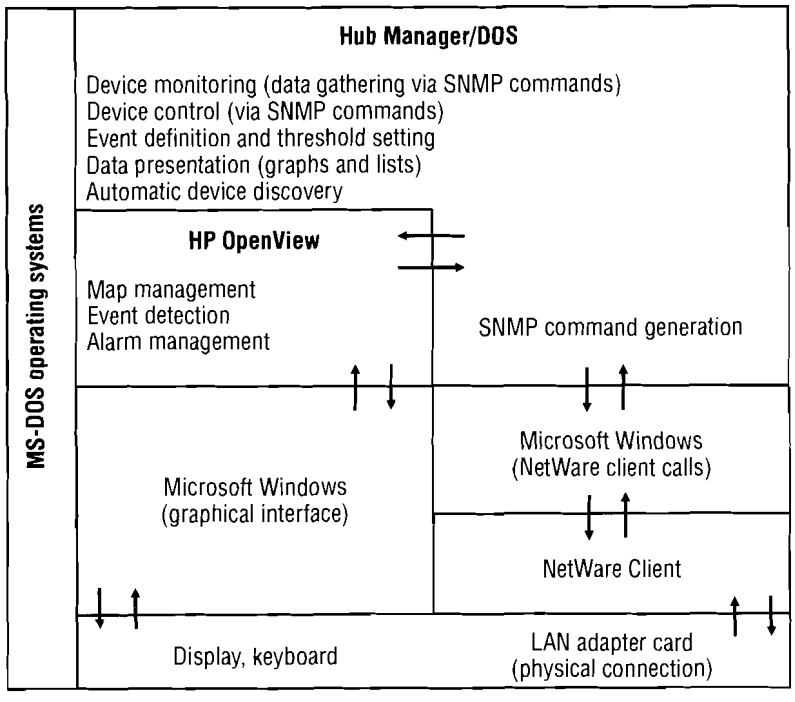
As the example in the figure below indicates, several pieces of software work together to let you manage a hub on the network.

DOS and Windows. MS-DOS and Microsoft Windows provide the operating environment for the management software. DOS provides the basic operating system that lets the computer execute software, and Windows provides the graphical interface that lets you interact easily with information on the computer's monitor.

Hub Manager/DOS software using ARPA Services (IP interface) on the management station.



Hub Manager/DOS software using NetWare (IPX interface) on the management station.

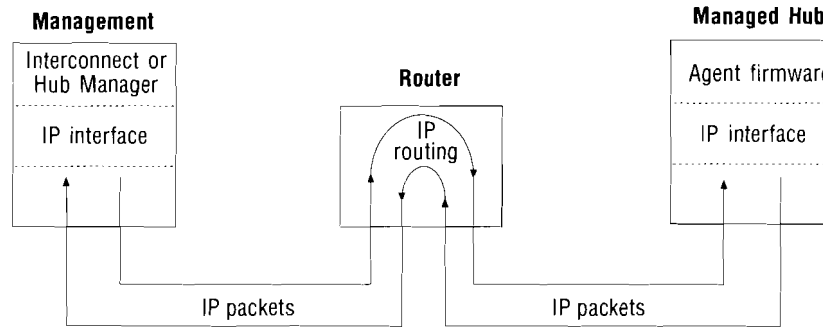


OpenView. The HP OpenView software provides an operating environment that is tailored specifically for network management. It does not directly manage network devices, but instead performs general tasks such as managing the network map and handling events that are generated by hubs and bridges on the network.

Hub Manager/DOS. The HP OpenView Hub Manager/DOS software performs the actual hub management. The Hub Manager/DOS software is the user interface that lets you manage the MIB variables in a hub without having to know the details of all those variables. Hub Manager/DOS translates your mouse clicks and other instructions into SNMP commands that read or write the hub's MIB variables, and thus affect the operation of the hub.

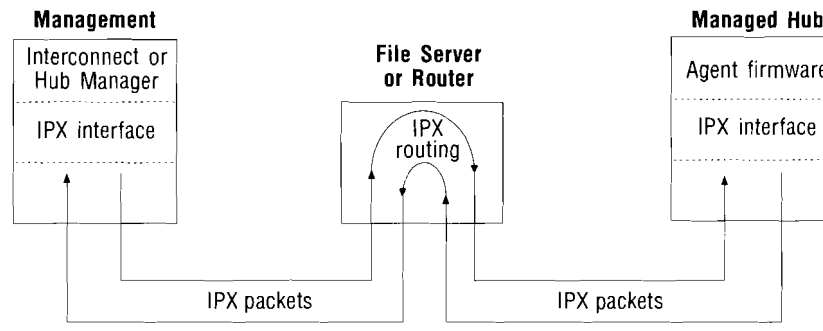
HP OpenView Hub Manager/DOS and Interconnect Manager/DOS both support SNMP/IPX and SNMP/IP. This means that the managers can use either the IPX transport protocol or the IP transport protocol to communicate with managed devices. But they cannot use both IPX and IP and the same time. Before you begin the network management software installation, you must decide whether you will run the manager in IPX mode or IP mode. Hence, you have a choice to use ARPA Services or Novell NetWare.

ARPA Services. The ARPA Services software lets the management station communicate across the network with the IP interface in the hub's agent firmware. (Note that the ARPA Services software included with the Interconnect Manager/DOS and Hub Manager/DOS products does not cover the complete range of ARPA services; it provides only the IP interface.) IP operates at the network layer (layer 3 of the Open System Interconnect communications hierarchy), the layer at which routers operate. By using IP, Interconnect Manager/DOS or Hub Manager/DOS can communicate with hubs anywhere on the network, even across IP router boundaries.



or

NetWare Client. The network management station uses NetWare client calls via Microsoft Windows to communicate across the network with the IPX interface in the hub's agent firmware. IPX operates at the network layer (layer 3 of the OSI communications model), the layer at which routers operate. By using IPX, Interconnect Manager/DOS or Hub Manager/DOS can communicate with hubs anywhere on the network, even across IPX router boundaries. (The router must be able to route IPX packets.)



HP OpenView Network Management

Product Note

What are SNMP and MIB?

SNMP—Simple Network Management Protocol

Hewlett-Packard has implemented SNMP as a standard protocol for the network management of its current product line of EtherTwist hubs, bridges, and routers. SNMP evolved from SGMP (Simple Gateway Management Protocol), a protocol that was developed for the management of routers and was proposed by the Internet Activities Board[1] in 1988 as a strategy for the management of the U.S.-wide TCP/IP-based Internet.

SNMP has become the de facto industry standard protocol for network management, and has been implemented by many vendors on repeaters, bridges, routers, and other devices.

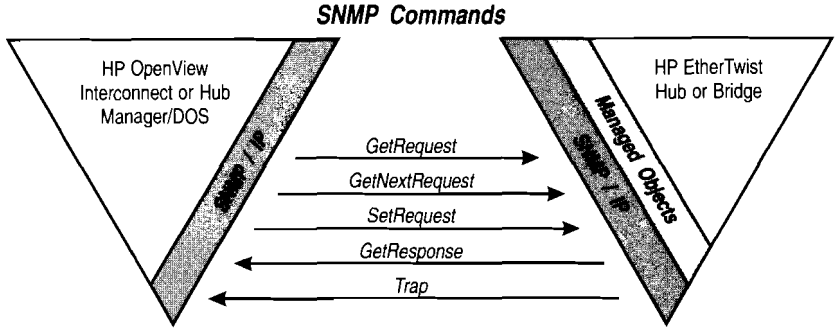
SNMP uses a simple fetch-and-store command philosophy. It fetches data from a data item (called an object) in the managed device and stores data into the data item. SNMP has the five following operations:

`GetRequest`	– Manager queries agents on the status of objects.
`GetNextRequest`	– A GetRequest steps through the MIB sequentially.
`SetRequest`	– Manager directs a change in the value of a MIB object.
`GetResponse`	– Agent answers a GetRequest, GetNextRequest, or SetRequest.
`Trap`	– Agent notifies manager that a significant event has occurred.

1 The Internet Activities Board is the official committee for TCP/IP-related standards issued as Request For Comments (RFCs).

The following picture illustrates SNMP use by the network manager and its managed devices.

SNMP uses a transport level protocol called User Datagram Protocol (UDP). UDP provides a connectionless delivery service that uses Internet Protocol (IP) or Novell's IPX protocol services to deliver messages between the OpenView Manager and its managed devices.



The advantage of using SNMP is its simplicity. By being simple, SNMP provides the following:

- Minimizes network traffic using single-packet request/ response transactions without using connection packets.
- Minimizes firmware code size in managed devices.
- Allows for the network manager to control its own retry rates and device timeouts.
- Allows the network manager to enable a network management operation called a trap object on the managed device. This allows the managed device to report on pre-defined events that can occur at any time.

MIB—Management Information Base

While the need for network management protocol was answered by SNMP, there remained a need for a standard definition of network management data. The standard known as the management information base (MIB) answered that need. The MIB specifies the standard objects that a managed device must keep and the operations that are allowed on the managed device. The MIB specification also gave network device vendors the capability of adding proprietary extensions (their own MIB objects).

The original MIB definition, known as MIB-I, divides over 100 definitions (applicable to routers) of management information into the 8 object groups shown in the table below.

MIB Object Groups	Information Type
system	managed device operational states
interfaces	interface information such as counters
address translation	translation of IP addresses
ip	Internet Protocol software
icmp	Internet Control Message Protocol software
tcp	Transmission Control Protocol software
udp	User Datagram Protocol software
egp	Exterior Gateway Protocol software

MIB-I objects provided the needed first step in the establishment of management data, but were found to be limited in the following areas:

- the lack of object definitions for different types of network devices such as repeaters and bridges
- the lack of object definitions for media types such as coaxial cable, twisted-pair cable, fiber-optic cable, and T1 networks
- the lack of standardization in the development of proprietary extensions resulting in limited interoperability between different vendors' devices

MIB-II was proposed before the Internet Activities Board as a start towards resolving these problems.

MIB-II attempts to extend network management data from an Ethernet and wide area orientation (routers) to focus on multiple-media management in both LANs and WANs. Two new object groups were added to the 8 object groups defined by MIB-I. The new groups added were:

MIB II Object Groups	Information Type
transmission	multiple media-type support
SNMP	statistics on SNMP network traffic

Additionally, enhancements were made to the system, interface, TCP, and IP groups of the original MIB. The enhancements provided for device type identification and new operational features.

The question of vendor-specific object standardization remains to be decided as MIB-II evolves and vendors continue to implement their own proprietary extensions. In its hubs and bridges, Hewlett-Packard currently uses only the system and interfaces MIB object groups, along with its own proprietary MIB-II objects. A growing trend in the networking industry is the support of many vendors' devices by one network manager. Hewlett-Packard's OpenView Interconnect Manager/DOS and OpenView Hub Manager/DOS can retrieve and graph standard MIB-II counter objects from any third-party devices. Hewlett-Packard has also compiled vendor-specific proprietary extensions in its MIB Browser.

Other documents for reference reading

- *THE SIMPLE BOOK: An Introduction to Management of TCP/IP-based Internets*
  by Marshall T. Rose
  Prentice Hall
- *RFC 1052: IAB Recommendations for the Development of Internet Network Management Standards*
- *RFC 1109: Report of the Second Ad Hoc Network Management Review Group*
- *RFC 1155: Structure and Identification of Management Information for TCP/IP-Based Internets*
- *RFC 1156: Management Information Base for Network Management of TCP/IP-Based Internets*
- *RFC 1157: A Simple Network Management Protocol (SNMP)*
- *RFC 1158: Management Information Base for Network Management of TCP/IP-Based Internets: MIB II*
- LAN Technology, February 1991
  title: *SNMP Streamlines Multivendor Network Management*
  author: Tom Dolan
- LAN Technology, March 1990
  title: *Cutting Management Tasks Down to Size with SNMP*
  authors: Mark S. Fedor, Michael S. Richards, Martin L. Schoffstall
- Data Communications, October 1990
  title: *MIB II Extends SNMP Interoperability*
  author: Chris VandenBerg
- IEEE Network Magazine, July 1990
  title: *Network Management of TCP/IP Networks: Present and Future*
  authors: Amatzia Ben-Artzi, Asheem Chandna, Unni Warrier
- Data Communications, August 1989
  title: *TCP/IP Network Management, an Eye Toward OSI*
  authors: H. Kim Lew, Jim Robertson
- *Internetworking with TCP/IP*, Volume I, Second Edition
  by Douglas E. Comer
  Prentice Hall

HEWLETT PACKARD

HP OpenView Network Management

Product Note

How To Manage Your Network

Network Management Environments

Current network management environments range from simple workgroup LANs to complex site and multisite LANs. Hewlett-Packard's EtherTwist family of managed components provides solutions for these environments. The complete range of hub, bridge, and router products provides easy growth for a customer as his network environment evolves. Hewlett-Packard's OpenView Hub or Interconnect Manager/DOS offers you powerful EtherTwist network device management, along with versatile tools for managing third-party devices, to manage these environments.

Workgroup LANs are families of users who have common network dependencies such as common software, common computer hardware, and common service needs. These users share network needs such as PC-to-PC file transfers, PC-to-mainframe file transactions, and server peripherals. Hewlett-Packard's EtherTwist and ThinLAN hub products provide an excellent solution for workgroup LANs. Workgroup LANs can be cabled with twisted-pair or thin coaxial cabling.

Site LANs are collections of workgroup LANs typically situated with a centralized computer data center as the network base. Geographically, site LANs can be in one building or in a campus complex. Fiber-optic or thin coaxial backbones, usually based in the computer data center, connect the workgroup LANs. Hewlett-Packard's LAN bridges and fiber-optic hub provide the customer with an excellent backbone connecting solution.

A multisite LAN is a connection of site LANs. Multisite LANs are dispersed geographically and connected by wide area network (WAN) type devices. Hewlett-Packard's routers and remote bridge provide the customer with multisite LAN connectivity.

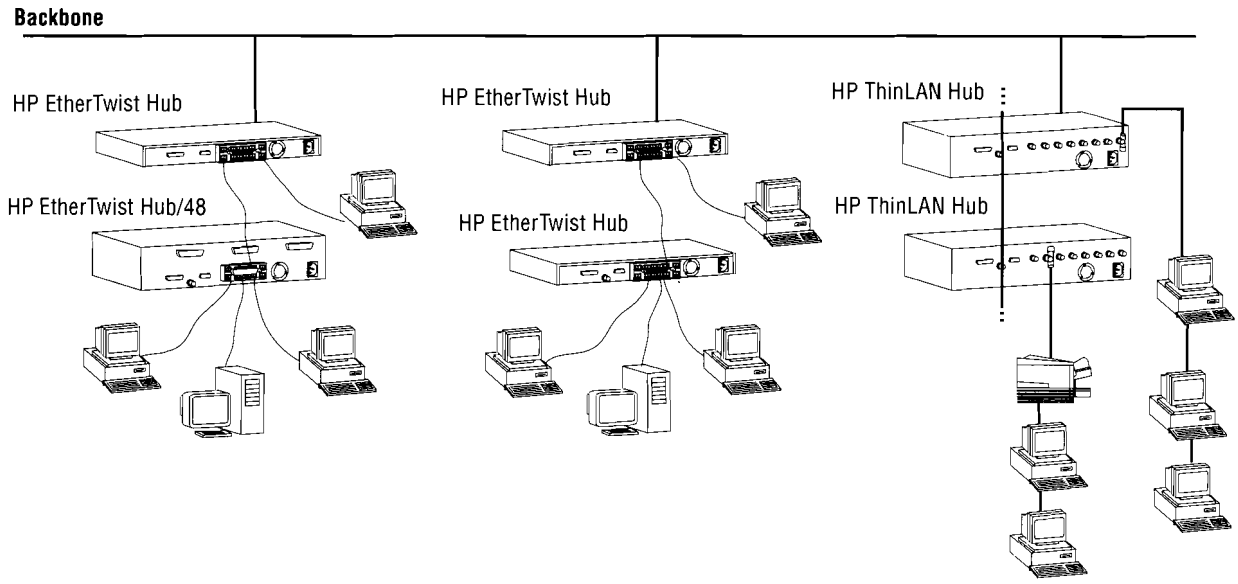
Hewlett-Packard's OpenView Hub Manager/DOS or Interconnect Manager/DOS software allows the customer to easily manage and control EtherTwist network devices in the workgroup LAN, the site LAN, and the multisite LAN environment. HP OpenView Hub Manager/DOS or Interconnect Manager/DOS provides monitoring and control tools to manage not only HP EtherTwist hubs and bridges, but also SNMP routers and non-HP SNMP devices.

Managing the Workgroup LAN

At the workgroup LAN level, customers will normally have an exclusively hub network. HP 28686D OpenView Hub Manager/DOS will provide the necessary tools to control the HP EtherTwist Hub Plus twisted-pair hubs, fiber-optic hubs, or HP ThinLAN hubs. The management focus in the workgroup LAN environment is monitoring hub ports, hub cascades, and network traffic growth. Hub Manager provides quick isolation features to help you resolve a network problem.

To manage a workgroup LAN, you must:

- set up and manage alarms
- monitor network links
- respond to network errors



Workgroup LAN

Alarm Setup and Management

Hub Manager provides monitoring of devices through background polling in OVRUN. Background polling will report unreachable and reachable hubs automatically. But network problems like downed hub ports, power failures, and intermittent network links must be set up as warning alarms. You must set up Hub Manager to have devices trigger an event (warning) alarm. The following event alarms can be set up to monitor the indicated problems on twisted-pair hubs, fiber-optic hubs, or thin coaxial hubs.

Event Alarm	Network Problem
Port segmentation	Too many port collisions from a connected device, or giant packets
Soft reset	Power failure
Bad packets	Bad LAN link (you must determine what are normal bad packet values for the network)
Link beat *(twisted-pair hubs only)*	Port connected device is either down or has been turned off

When event alarms are received, you must respond to the network error.

Monitor Network Links

You can monitor network links for network growth or network saturation. You can do this by the setup of counter event threshold values to trigger an event (warning) alarm or graph LAN activity over periods of time.

Responding to a Network Error

When an event alarm is triggered, the network map icon turns red or yellow. The bell alarm also turns red or yellow. You then verify the error by clicking twice on the bell alarm to view the error. After confirming an error, you will decide on a course of action.

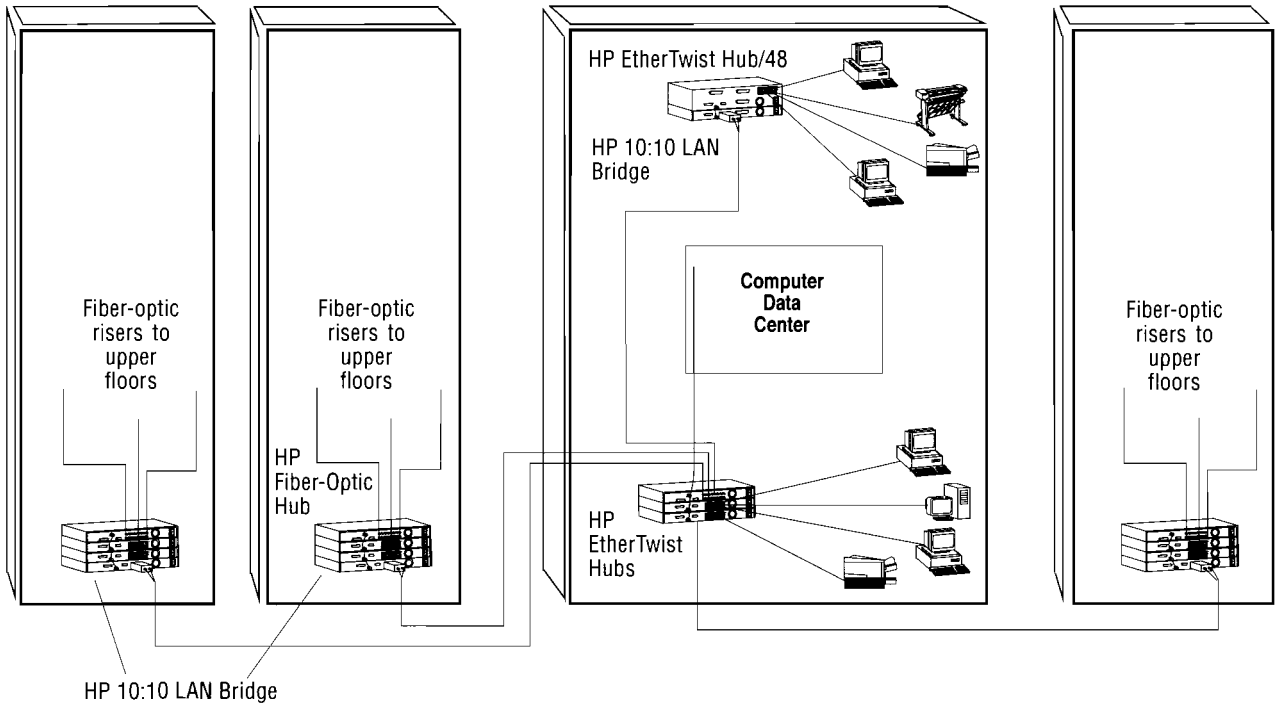
For red alarms, you have a device that SNMP cannot reach, meaning that Hub Manager/DOS cannot communicate with it. You must find out why the device is not responding. In some cases, more than one device may be flagged as down (red) due to hub cascading or relative positioning of the management station to the downed device in the network.

Managing a Site LAN

As previously defined, a site LAN consists of numerous workgroup LANs tied together by a common backbone or backbones. Site LANs include not only twisted-pair hubs or thin coaxial hubs, but also LAN bridges and fiber-optic hubs. LAN bridges and fiber-optic hubs connect backbones to workgroup LANs. To manage LAN bridges, EtherTwist hubs, ThinLAN hubs, fiber-optic hubs and routers, you can use HP OpenView Interconnect Manager/DOS.

For network administrators, site LANs change the operational priority of devices in the network. In workgroup LANs, the network administrator gave priority to non-responding hubs and hub ports. For a site LAN, priority now will be on operational backbone connections through LAN bridges and fiber-optic hubs.

The operation of a site LAN adds several items to the previously defined criteria for managing a workgroup LAN.



Site LAN

Alarm Setup and Management

With the inclusion of bridges and fiber-optic hubs, you must now consider setting up event (warning) alarms to trigger on specific bridge and fiber-optic hub events that could cause network problems. Background polling will now monitor the LAN bridge and fiber-optic hub along with the twisted-pair hubs and ThinLAN hubs. In addition to setting up event alarms on twisted-pair hubs and ThinLAN hubs, the following events can be set up for the LAN bridge and fiber-optic hub.

Event Alarm	Network Problem
Soft reset	Power failures
Bad packets	Bad LAN link (you must determine what is normal for your network)
Low light (fiber-optic hub only)	Bad transmitter or receiver circuit or a bad fiber-optic cable
Port segmentation (hubs only)	Too many port collisions from a connected device or giant packets.
Spanning tree state (bridges only)	Redundant link problems
Temperature	Over normal operating temperature

Monitor the Network

You can monitor backbones connected by bridges or fiber-optic hubs for network growth or network saturation. You can do this by the setup of counter event threshold values to trigger an event (warning) alarm or to graph LAN activity over long periods of time.

Responding to a Network Error

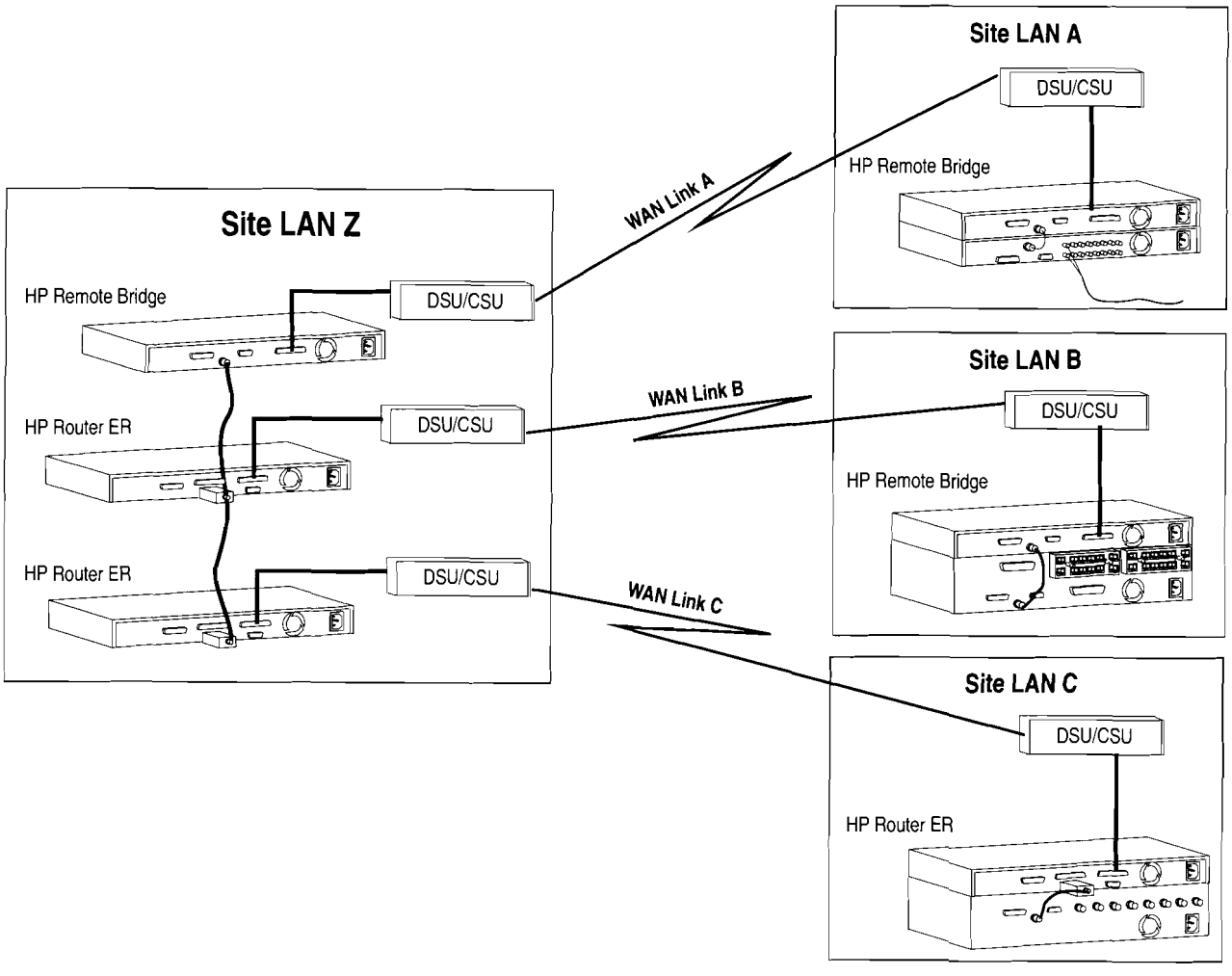
On a LAN bridge or fiber-optic hub, you should use the same procedures prescribed for a twisted-pair hub.

For red alarms, you have a hub or bridge that SNMP cannot reach, meaning that the manager cannot communicate with it. You must find out why the device is not responding. In some cases, more than one hub or bridge may be flagged as down (red) due to hub cascading or relative positioning of the management station to the device in the network.

Managing the Multisite LAN

Multisite LANs are connected site LANs that use routers and remote bridges to connect LAN backbones. In most cases, routers and remote bridges connect through telecommunications links. Telecommunications links are normally called WAN (wide area network) connections. HP OpenView Interconnect Manager/DOS provides features that manage bridges and routers.

The priority focus in multisite LANs now changes to site LAN connections through routers and remote bridges. WAN Links connecting site LANs are normally slower than LAN backbones. Currently, most WAN links cannot transport data more than 15% of the speed (T1 links) of a LAN backbone, and in many cases less than 1% (56-Kbit/s links) of the speed. Transporting data between site LANs becomes a priority when more and more network data traffic is exchanged.



Multisite LAN

Alarm Setup and Management

HP OpenView Interconnect Manager/DOS provides the same management for remote bridges as it does for LAN bridges. Interconnect Manager/DOS background polls remote bridges to monitor reachable and unreachable status as in other EtherTwist products. Using Interconnect Manager/DOS you can set the same event alarms as in the LAN bridge, plus WAN connection counters. Additional event (warning alarms) to set for the remote bridge are:

Event Alarms	Network Problem
HDLC errors	Possible telecommunications errors
HDLC FRMR frames received	Telecommunication errors

For routers, Interconnect Manager/DOS provides background polling of all routers on the network map. The Interconnect Manager/DOS software also provides Telnet, graphing and MIB browser capability for routers.

Monitor the Network

You can monitor backbones connected by routers or remote bridges for network growth or network saturation. You can do this by the setup of counter event threshold values to trigger an event alarm (remote bridge only) or to graph LAN activity over long periods of time.

Responding to a Network Error

On a remote bridge, the user should use the same procedures prescribed for a LAN bridge.

For red alarms, the user has an SNMP unreachable router or remote bridge, meaning that the manager cannot communicate with it. You must find out why the device is not responding. In some cases, more than one hub or bridge may be flagged as down (red) due to a down WAN link or relative positioning of the management station to the failing device in the network.

Yellow alarms do not exist for the HP routers.

SNMP Device Management

HP OpenView Interconnect Manager/DOS and Hub Manager/DOS provide features that help you manage SNMP devices from HP and other vendors. The management features are:

- Autodiscovery
- Background polling
- Telnet (Telnet-capable devices only)
- Graphing
- MIB browser

Autodiscovery

The manager software allows you to autodiscover any defined SNMP device. SNMP routers are discovered automatically as part of the discovery process. Autodiscovery can also discover NetWare clients and file servers.

Background Polling

The manager software background polls discovered defined SNMP devices and routers in the network. A red alarm is generated when the SNMP devices and routers do not respond to a poll packet.

Telnet

Telnet is a feature that can be selected for any SNMP device. The SNMP device must be a Telnet-capable device.

Graphing

The graphing feature will graph, log, and display text from an SNMP device. The only counter values selectable are standard MIB-II counters.

MIB Browser

The MIB browser feature allows you to retrieve standard MIB-II objects from any SNMP device. Also included in the MIB browser are proprietary MIBs for:

- SynOptics concentrators
- Cabletron concentrators
- Cisco routers
- Wellfleet routers

HP OpenView Network Management

Product Note

Troubleshooting Your Network

This product note discusses some ways in which you can use HP OpenView Hub Manager/DOS (HP 28686D), Interconnect Manager/DOS (HP 27256D), and Resource Manager/DOS (HP 27257D) to troubleshoot your network.

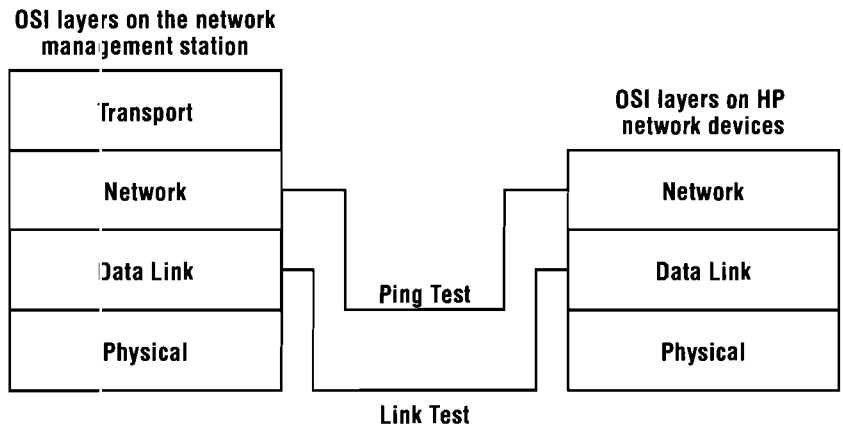
HP OpenView network management provides three categories of troubleshooting:

- active troubleshooting
- passive troubleshooting
- sentinel troubleshooting

Active Troubleshooting

Active troubleshooting tools temporarily change the operating state of your network devices. Active troubleshooting utilities include:

- link test
- ping test or IPX test



Use link test and ping test or IPX test to actively diagnose LAN problems. For example, if the network map displays a network device in critical condition (it cannot communicate), you can use the network management station to execute both the link test and ping test or IPX test between network devices surrounding the critical device.

Link test verifies connectivity between two network devices. It verifies that transceivers, LAN adapters, software drivers, and cable connections operate correctly. If you suspect a hardware problem, you can use the link test to verify the connection between a managed hub/bridge and the end node experiencing the problem. Link test uses IEEE 802.2 test packets to verify OSI layer 2 communications.

To verify the path between two network devices implementing IP or IPX protocol, you can use the ping test or the IPX test, respectively. Before you installed the HP OpenView network management products, you decided whether you would run the manager in IP mode or IPX mode on your network management station. In IP mode, the ping test is used. In IPX mode, the IPX test is used.

Since the ping or IPX test uses the network to verify the path, it also verifies the physical connection (transceivers, LAN adapters, software drivers, and cable connections) between the two devices. If you suspect an IP- or IPX-based network operating system, a network protocol problem, or network hardware problem, then use the ping or IPX test to verify the connection between a managed hub/bridge and the end node experiencing the problem. Ping test uses ICMP echo packets to verify OSI layer 3 communications. The IPX test uses Novell NetWare's Comcheck command.

Active troubleshooting tools place the network device in partial diagnostic mode. The network device continues to function (that is, a hub will continue to forward network traffic), but it also tests network communication.

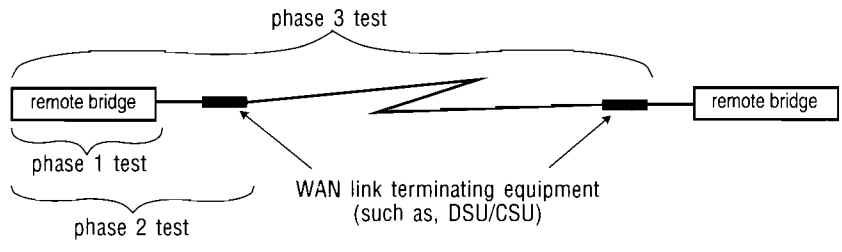
Although the network management station initiates link and ping tests, the network device manages the test and reports the results to the network management station when the test is completed. The management station can initiate multiple link and ping tests to execute simultaneously at distributed points throughout the network.

WAN loopback test. The WAN loopback test applies to the HP Remote Bridge RB only. The WAN loopback test can be used to determine the condition of almost any portion of the WAN link.

In order to execute the test you must put the WAN terminating equipment (DSU/CSU, for example) in loopback mode.

Perform the test in three phases. Perform the test in three phases.

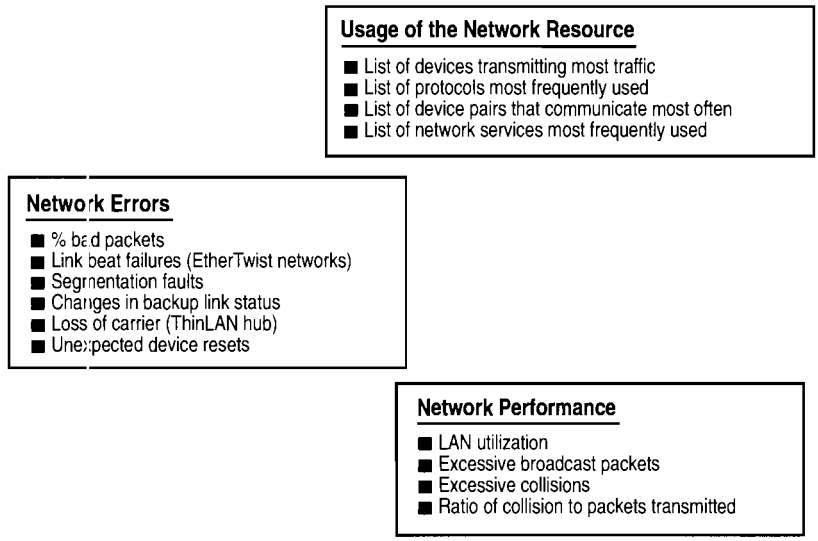
1. Test the remote bridge's WAN port by placing a 62-pin loopback connector on the WAN port.
2. Execute a remote bridge loopback test with the local WAN terminating equipment in loopback mode. This verifies that the local hardware is functioning properly.
3. Execute the loopback test with the remote WAN terminating equipment in loop back mode. This test verifies that the WAN link is functioning properly.



Passive Troubleshooting

The goal of passive troubleshooting is to monitor the network for errors without changing the operating state of the network device or affecting network performance. You can use passive troubleshooting to establish a history of network behavior. Comparing the network's past and current behavior can help locate network problems and may suggest solutions to the problems.

For HP hubs, and local LAN bridges, it is recommended that you monitor three types of information as shown below:



Usage of the Network Resource

HP OpenView Resource Manager/DOS (HP 27257D) is a helpful tool when diagnosing network problems and planning network growth. By monitoring and/or logging network usage, you can establish a history of utilization. Thus, it is easier to detect both anomalies and trends in network utilization. With HP OpenView Resource Manager/DOS, network usage information is gathered in real-time operation. You need only select the segment to monitor and the display format. The utilization information can be logged or displayed in several graph formats (bar, pie, stacked bar, and group bar charts).

Network Errors

In general, you should always monitor the percentage of bad packets on the network. If you observe more than 2% bad packets, verify that your cable and network hardware are in proper working order.

Link beat. Link beat is a signal (not a packet) that verifies the connection between two IEEE 802.3 Type 10Base-T network devices. Link beat is defined in the 10Base-T standard as a periodic 100-nanosecond pulse that occurs every 16 milliseconds and coexists with network traffic on the LAN cable connecting two network devices. Therefore, network performance is not affected when link beat is enabled. Network devices that adhere to the 10Base-T standard periodically transmit a link beat signal to directly connected devices. If link beat signals are not received, link beat fails, and the two network devices cannot communicate. Link beat failures indicate either cabling or internal hardware problems. A physical inspection is required to diagnose the problem further. Note that link beat failures can occur naturally when one of the two network devices is turned off. You should disable link beat on devices that don't support the 10Base-T standard.

Segmentation. HP hubs disable, or segment, ports when they detect excessive collisions. The hubs can enable segmented ports when a valid packet is transmitted from the segmented port. Segmentation faults may be due to cabling or internal hardware problems. A physical inspection is required to diagnose the problem further.

Backup link status. Redundant cable connections (backup links) can be configured between HP hubs to ensure reliable communication. One link remains active while the other is configured to act as a backup to the active link. In the event of failure, the backup link becomes active and resumes network operation until the error is diagnosed and corrected.

Loss of carrier. Loss of carrier is an error unique to the HP ThinLAN hub. It occurs when the hub no longer detects the data that it transmits. This error usually indicates that a LAN cable has become shorted or damaged, a ThinLAN port has failed, a transceiver has become disconnected from the AUI port, or no device is attached to the AUI port and that port is enabled. The hub automatically recovers when the corrective action is taken.

Unexpected resets. Unexpected device resets can be due to power failure, some configuration changes, or network management commands. Power failure and recovery may occur overnight. If you have set up the Action on Events function in Hub Manager/DOS or Interconnect Manager/DOS, the network management station may notify you of potential power problems even when you aren't in the office. The Action on Events function does not itself perform actions. Rather, the Action on Events function interfaces a user-supplied action file with Hub Manager's and Interconnect Manager's event monitoring capabilities. You specify the actions that will occur in the action file. The action file is the executable code that performs or initiates an action or actions. The user is responsible for creating an action file, which can be a program or a DOS batch file. From a security perspective, it is also wise to monitor the number of times a hub or bridge is reset. The network administrator should always be notified of changes in the operating state and availability of network devices.

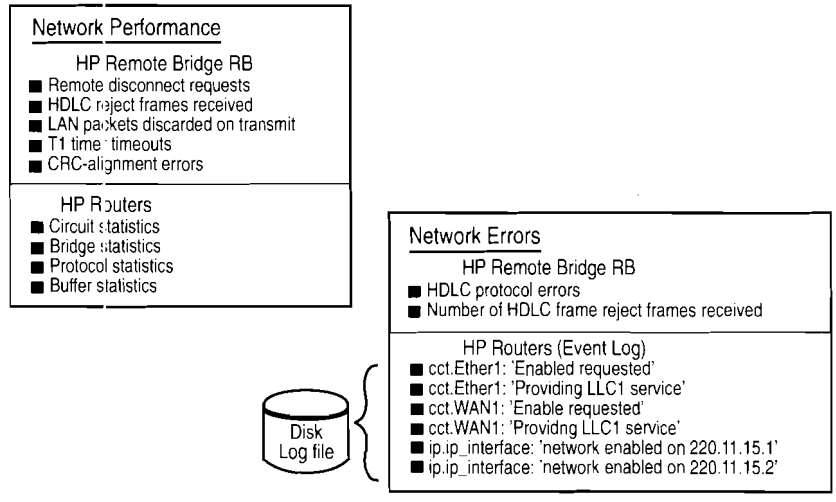
Network Performance

It is normal for network performance to degrade slightly as new devices are added to the network. It is recommended that you consider expanding the network to protect network performance when LAN utilization exceeds an average of 40% on any LAN segment. At 40% LAN utilization, the decline in network performance may become observable. This is an indication to expand and/or divide the network to facilitate growth.

Every network device receives broadcast traffic. Usually, a broadcast packet conveys non-critical information. If network devices have no use for the broadcast messages, they may be wasting valuable time processing unnecessary information. If the rate of received broadcast packets exceeds 50 packets per second, it is recommended that you consider optimizing the network. Refer to the *Network Management Reference Guide (DOS Version)* for additional information on optimizing your network.

Collisions are a normal occurrence in a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) environment. As network devices are added to the network, collisions will increase. It is recommended that you monitor collisions and transmitted packets together. If the ratio of collisions to transmitted packets exceeds 20%, there may be a problem with the LAN segment length, network topology, or device hardware.

Similar tasks (as mentioned above) are performed when monitoring the multisite LAN. The following tasks also apply to HP remote bridges and routers.



HP Remote Bridge RB

The remote bridge connects a LAN to a wide area network (WAN). With the exception of "LAN packets discarded on transmit", all of the error statistics listed above indicate a noisy or faulty cable connection. If the ratio of WAN errors to packets transmitted on the WAN link exceeds 1%, investigate cable noise and connection problems.

LAN and WAN data are transmitted at significantly different speeds. That is, LAN speeds transmit at 10 Mbit/s, and WAN link speeds can range from 9.6 Kbit/s to 2.048 Mbit/s. Use the "LAN packets discarded on transmit" to detect a performance bottleneck. As the network grows, the remote bridge may begin to receive LAN packets faster than it can forward them to the WAN. If the ratio of "LAN packets discarded on transmit" to packets forwarded onto the WAN exceeds 14%, you should consider increasing the WAN link speed.

HP Routers

There are four statistics that are used in establishing typical network performance and detecting performance anomalies on HP routers. They include: circuit statistics, bridge statistics, protocol statistics, and buffer statistics. The following are some very general guidelines. You should use the troubleshooting techniques presented in the *HP Router Reference Guide* and the *HP EtherTwist: Building the Multisite LAN* computer-based training to investigate and correct any performance anomalies.

Circuit statistics: If the ratio of LAN errors to packets transmitted or received exceeds 2%, you should investigate the performance problem further. If circuit statistics errors exceed 2%, investigate the following:

- Use the router's NCL (network command language) to analyze MIB error statistics.
- Check whether the router may be constantly transmitting routing tables.
- Check to see whether the network may require optimization or expansion.

Bridge statistics: The router will bridge packets if it receives a packet that it cannot route based on its supported (and enabled) protocols. Note that you can monitor this statistic only if the bridging function is enabled on the router. Flooding occurs when the bridging service forwards packets to every router port. Monitor the ratio of flooded packets to received packets to establish your router's typical behavior. If the router's bridging statistics exceed the normal number of flooded packets, investigate the following:

- Verify that the bridging address table is correct.
- Check for excessive broadcast or multicast traffic on the network.

Protocol statistics: Monitor the ratio of packets dropped to packets received to establish your router's typical behavior. Note that you can monitor only the statistics of protocols that you have enabled on your router. If protocol statistics show that dropped packets exceed the norm, investigate the following:

- Check whether the router receives an excessive number of corrupted packets.
- Check whether the packets are filtered based on user-defined traffic filters.
- Check whether the router receives packets encoded with unfamiliar protocols.

Buffer statistics: Monitor the number of packets missed to establish your router's typical behavior. If buffer statistics show that the number of missed packets exceeds the norm, investigate the following:

- Check whether packets are received on one port faster than they are transmitted on another port.

Network errors

HP Remote Bridge RB

On the remote bridge, you can monitor two WAN errors: HDLC protocol errors, and the number of HDLC frame reject frames received.

HDLC protocol errors indicate a serious link problem. Upon receiving this error, the remote bridge disconnects its session with the remote device and attempts to establish a new logical connection.

The number of HDLC frame reject frames received indicate a protocol error. Receipt of an HDLC command or response packet that is invalid or unknown can trigger this error.

HP Routers

HP routers maintain an event log. The event log is not the same as a network management event notification. The router event log is a status log and events are logged when:

- the router established a connection with a remote device
- the internal firmware modules are activated and deactivated
- the spanning tree topology changes (the bridging and spanning tree functions are enabled on the router)

The router's event log is a powerful tool when diagnosing internal router failures. Use the HP network management station to read the router's event log. Each router event has an associated severity level. There are five severity levels:

- ***fatal:*** major router disruption
- ***major:*** a service has appeared or disappeared
- ***performance:*** a service has upgraded or degraded
- ***warning:*** a service has behaved unexpectedly
- ***information:*** general system information

Sentinel Troubleshooting

You can configure HP network devices to act as a sentinel, monitoring the network for errors. Network devices notify the management station of errors using "event notification" packets. You can set a threshold value and a time interval for any counter located in any MIB object of HP hubs or bridges. If the value of the MIB object (for example, bytes received) exceeds the threshold value within the preset interval, the network device sends an "event notification" message to the network management station. The network management station changes the device status on the network map, sounds a warning bell, and logs the event notification message for future reference. Using the Action on Event feature, an event notification message can also activate a pager, a speaker system, or leave a voice mail message to inform you of the alarm.

Use HP network management to configure the HP hubs to monitor and report the following errors using event notification packets.

Use HP network management to monitor the following LAN bridge and remote bridge errors. Notice that the set of errors changes with spanning tree configuration. The spanning tree configuration also applies to the remote bridge.

HP 10:10 LAN Bridge MB spanning tree enabled	HP 10:10 LAN Bridge MB spanning tree disabled	HP Remote Bridge RB
Spanning tree topology changes	Loss of carrier errors	Received HDLC frame reject frames
Excessive temperature	Excessive temperature	HDLC protocol errors
Unexpected resets	Unexpected results	

This chart summarizes some general attributes to monitor on your network using HP OpenView network management.

General

Attribute to monitor:	...if attribute exceeds...	...then do this:
% of bad packets	2%	Verify that your cable and network hardware are in proper working order.
% of LAN utilization	40%	Consider using bridges to isolate traffic or divide the network into subnetworks.
received broadcast packets	50 packets/s	Consider optimizing your network. See the *Network Management Reference Guide (DOS Version)* for more information.
ratio of collisions to packets transmitted	20%	Check the segment length, network topology to see if maximum IEEE 802.3 topology rules have been exceeded. Also check the network device hardware.

HP Remote Bridge RB

Attribute to monitor:	...if attribute exceeds...	...then do this:
ratio of WAN errors to packets transmitted (on WAN link)	1%	Investigate cable noise and connection problems.
ratio of LAN packets discarded on transmit to packets forwarded on to the WAN	14%	Consider increasing WAN link speed.

Routers

Attribute to monitor:	...if attribute exceeds...	...then do this:
Circuit statistics: ratio of LAN errors to packets transmitted *OR* ratio of LAN errors to packets received	2%	Investigate the following: – Use the router's NCL to analyze MIB error statistics. – Check whether the router may be constantly transmitting routing tables. – Check to see whether the networkmay require optimization or expansion.
Bridge statistics: ratio of flooded packets to packets received	First, monitor ratio to establish typical behavior. If norm is exceeded...	Investigate the following: – Verify that the bridging address table is correct. – Check for excessive broadcast or multicast traffic on the network.
Protocol statistics: ratio of packets dropped to packets received	First, monitor ratio to establish typical behavior. If norm is exceeded...	Investigate the following: –Check whether the router receives an excessive number of corrupted packets. – Check whether the packets are filtered based on user-defined traffic filters. – Check whether the router receives packets encoded with unfamiliar protocols.
Buffer statistics: packets missed	First, monitor ratio to establish typical behavior. If norm is exceeded...	Check whether packets are received on one port faster than they are transmitted on another port.

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HP OpenView Network Management

Product Note

Software Compatibility Charts

What's New in Version D as of April, 1992:

- Integrated hub, bridge, and router managers into one product— HP OpenView Interconnect Manager/DOS (HP 27256D).
- Added support for both IP and IPX communication protocols on a single network management station.
- Added support for the HP 28692A ThinLAN Hub Plus to HP OpenView Interconnect Manager/DOS and HP OpenView Hub Manager/DOS (HP 28636D).

The following charts show the software versions and the supported network devices for each revision of the HP OpenView network management products.

HP OpenView Hub Manager/DOS Version D.01. 01 SNMP over IP/IPX network management protocol		
Supported Devices:	HP 28699A EtherTwist Hub Plus/48	Firmware D.01.xx
	HP 28688A EtherTwist Hub Plus	D.01.xx
	HP 28688B EtherTwist Hub Plus	D.01.xx
	HP 28682A Fiber-Optic Hub Plus	D.01.xx
	HP 28692A ThinLAN Hub Plus	D.01.xx
Supported Software:	Microsoft Windows 3.00a or 3.1 HP OpenView A.05.01 ARPA Services 2.1 version B.02.00 Novell NetWare client versions with non-ODI drivers: – IPX.OBJ v3.10 – NETX.COM v3.22 or EMSNETX.EXE v3.22 or XMSNETX.EXE v3.22 Novell NetWare client versions with ODI drivers: – IPXODI.COM v1.30 – NETX.COM v3.22 or EMXNETX.EXE v3.22 or XMSNETX.EXE v3.22 – LSL.COM v1.21 HP OpenView Interconnect Manager/DOS (HP 27256D) HP OpenView Resource Manager/DOS (HP 27257D) MS-DOS 5.0, 4.01,3.3, 3.2	

Note: Runs only in Windows standard and enhanced modes.

"SNMP over IP/IPX" means that the HP OpenView network management products and the HP managed devices (with firmware D.01.xx) can communicate with each other using either IP or IPX communications protocols.

Note: HP 27257D Resource Manager/DOS is not a stand-alone product. Resource Manager/DOS runs on top of HP OpenView Interconnect Manager/DOS (HP 27256D) or HP OpenView Hub Manager/DOS (HP 28686D)

HP OpenView Interconnect Manager/DOS
Version D.01. x01
SNMP over IP/IPX network management protocol

Supportec Devices:	HP 28699A EtherTwist Hub Plus/48	Firmware	D.01.xx
	HP 28688A EtherTwist Hub Plus		D.01.xx
	HP 28688B EtherTwist Hub Plus		D.01.xx
	HP 28682A Fiber-Optic Hub Plus		D.01.xx
	HP 28692A ThinLAN Hub Plus		D.01.xx
	HP 28673A 10:10 LAN Bridge MB		D.01.xx
	HP 28674B Remote Bridge RB		D.01.xx
	HP 27285A Router ER		D.01.xx
	HP 27286A Router TR		D.01.xx

Supported Software:
- Microsoft Windows 3.00a or 3.1
- HP OpenView A.05.01
- ARPA Services 2.1 version B.02.00
- Novell NetWare client versions with non-ODI drivers:
  - IPX.OBJ v3.10
  - NETX.COM v3.22 or EMSNETX.EXE v3.22 or XMSNETX.EXE v3.22
- Novell NetWare client versions with ODI drivers:
  - IPXODI.COM v1.30
  - NETX.COM v3.22 or EMXNETX.EXE v3.22 or XMSNETX.EXE v3.22
  - LSL.COM v1.21
- HP OpenView Hub Manager/DOS (HP 28686D)
- HP OpenView Resource Manager/DOS (HP 27257D)
- MS-DOS 5.0, 4.01, 3.3, 3.2

Note: Runs only in Windows standard and enhanced modes.

"SNMP over IP/IPX" means that the HP OpenView network management products and the HP managed devices (with firmware D.01.xx) can communicate with each other using either IP or IPX communications protocols.

HP OpenView Hub Manager (28686C)
HP OpenView Bridge Manager (28653C)
Version C.01.00 or C.02.00
SNMP over IP network management protocol

Supported Devices:	HP 28699A EtherTwist Hub Plus/48	Firmware	C.01.xx
	HP 28688A EtherTwist Hub Plus		C.01.xx
	HP 28688B EtherTwist Hub Plus		C.01.xx
	HP 28682A Fiber-Optic Hub Plus		C.01.xx
	HP 28673A 10:10 LAN Bridge		C.01.xx
	HP 28674A Remote Bridge		C.01.xx

Supported Software:
- Microsoft Windows 3.00a
- HP OpenView A.04.00
- ARPA Services 2.1 version B.01.00
- HP OpenView Hub Manager (HP 28686C)
- HP OpenView Bridge Manager (HP 28653C)
- MS-DOS 4.01, 3.3, 3.2

Note: Runs only in Windows standard and enhanced modes.

"SNMP over IP" means that the HP OpenView network management products and the HP managed devices (with firmware C.01.xx) can communicate with each other using the IP communications protocols.

HP OpenView Hub Manager (28686B)
HP OpenView Bridge Manager (28653B)
Version B.xx.xx
SNMP over LLC network management protocol

Supported Devices:	HP 28688A EtherTwist Hub Plus	Firmware B.01.xx
	HP 28673A 10:10 LAN Bridge	B.01.xx
	HP 28674A Remote Bridge	B.01.xx
Supported Software:	Microsoft Windows 3.0	
	HP OpenView A.03.00	
	HP OfficeShare B.00.02	
	HP OpenView Hub Manager (HP 28686B)	
	HP OpenView Bridge Manager (HP 28653B)	
	MS-DOS 3.3	

Note: Runs only in Windows real mode.

"SNMP over LLC" means that the HP OpenView network management products and the HP managed devices (with firmware B.01.xx) can communicate with each other using the logical link control protocol. LLC is a low-level access method for IEEE 802.3 and Ethernet devices. It operates at the data link layer (layer 2) of the OSI model.

HP OpenView Hub Manager (28686A)
HP OpenView Bridge Manager (28653A)
Version A.xx.xx
Proprietary network management protocol

Supported Devices:	HP 28688A EtherTwist Hub Plus	Firmware A.01.xx
	HP 28648A LAN Bridge	A.01.xx
	HP 28674A Remote Bridge	A.01.xx
Supported Software:	Microsoft Windows 2.1	
	HP OpenView A.01.02	
	HP OfficeShare B.00.02	
	HP OpenView Hub Manager (HP 28686A)	
	HP OpenView Bridge Manager (HP 28653A)	
	MS-DOS 3.2	

Note: Runs only in Windows real mode.

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HP OpenView Network Management

Product Note

Questions and Answers

General

Q. What is HP OpenView network management?

A. HP OpenView network management is a software tool that allows you to monitor , configure, secure, troubleshoot, and plan network growth from a single point—the network management station.

For the HP OpenView network management products (DOS version), the network management station is a dedicated PC. The management station can connect anywhere on the network using a PC LAN adapter card.

Q. What HP OpenView network management products (DOS version) are available?

A. There are three network management products available:

- HP 23686D Hub Manager/DOS
- HP 27256D Interconnect Manager/DOS
- HP 27257D Resource Manager/DOS

Each of the above products are MS-Windows applications and operate on a PC--the network management station using MS-DOS and MS-Windows.

Hub Manager/DOS manages hubs (such as EtherTwist, fiber-optic, and ThinLAN hubs). It is typically used in small networks consisting primarily of workgroup LANs.

Interconnect Manager/DOS manages hubs, bridges, and routers. It is typically used in larger networks, and will manage site and multisite LANs from a single, central management station.

Resource Manager/DOS performs traffic analysis on segments on your networks. It is used to identify top talkers, heavy users, communication pairs, and error sources. The traffic analysis data can be presented in pie, bar, stacked bar, and stacked group bar chart forms. Resource Manager/DOS must operate with either Hub Manager/DOS or Interconnect Manager/DOS.

Q. Why should I use the HP OpenView network management products?

A. HP OpenView Interconnect Manager/DOS and HP OpenView Hub Manager/DOS are tools that allow you to monitor, configure, secure, troubleshoot, and plan network growth from a single point — the network management station.

A single network management station can manage a centralized network environment or multiple stations can work together to manage a distributed network that span multiple sites, cities, and states.

Additionally, HP Resource Manager/DOS operates along with either Interconnect Manager/DOS and Hub Manager/DOS on the same network management station. From this station, you can select any segment on the network map and can view real-time sampling of traffic data.

Q. Can HP OpenView Interconnect Manager/DOS, Hub Manager/DOS, and Resource Manager/DOS software run on a PC Server?

A. No. We recommend HP OpenView network management software operate on a dedicated PC.

Q. What protocols do HP OpenView network management products use?

A. HP OpenView Interconnect Manager/DOS and Hub Manager/DOS use SNMP and MIB-II for network management communication, IP or IPX for OSI layer 3 communication, IEEE 802.3 for OSI layer 2 communication, and IEEE 802.3 for OSI layer 1 communication. Thus, the HP network management station can manage any device that also supports these standard protocols.

Q. What are SNMP and MIB-II?

A. Simple Network Management Protocol (SNMP) is the industry-standard network management protocol. SNMP uses the Management Information Base - II (MIB-II) standard definition to operate.

Q. What is referred to as the "agent"?

A. The network management station acts as a partner to manageable network devices such as hubs, bridges, and routers. Manageable network devices contain a network management software module called an agent. The agent obtains and maintains information describing network behavior. The agent also understands network management communication protocols so that it can respond to commands from the network management station.

Q. Where does the agent code reside?

A. All manageable network devices contain agent code or agent firmware. In HP hubs and routers, the agent code resides in flash EEPROM. In HP bridges, the agent code resides in battery-backed RAM. The agent code for HP managed devices can use SNMP/IP and SNMP/IPX protocols to communicate with the network management station. The agent also contains the HP EASE (Embedded Advance Sampling Environment) software that allows the hubs and bridges to perform trend analysis functions.

Q. Since HP OpenView network management supports both SNMP/IP and SNMP/IPX, can I use both of these communication protocols at the same time to manage my network?

A. No. On your network management station, you must decide whether you will operate HP OpenView Interconnect Manager/DOS or Hub Manager/DOS using SNMP/IP (via ARPA services) or SNMP/IPX (via Novell protocols). The managers can use either the IP transport protocol or the IPX transport protocol. They cannot use both IPX and IP at the same time on the network management station.

However, HP hubs and bridges can be managed using both protocols. That is, if you have one network management station using SNMP/IP and another using SNMP/IPX, both of these stations can manage the same hub or bridge (provided the hub and bridge are configured for IP operation). That is because the agent code (version D.01.xx) in HP hubs and bridges support both SNMP/IP and SNMP/IPX. The only exception is the HP 28688A EtherTwist Hub (with agent code version D.01.xx) The "A" version EtherTwist hub can support only one protocol at a time. When upgrading the agent code in the HP 28688A EtherTwist hub to D.01.xx, you must choose SNMP/IP or SNMP/IPX communications, but not both.

Q. Can HP OpenView Interconnect Manager/DOS manage hubs and bridges located on the other side of a router?

A. Yes. With versions "C" and "D" of HP OpenView network management products, you can specify routers in the network management station configuration. The routers must support the IP or IPX communication protocol. With versions "A" and "B" of HP OpenView network management products, you cannot discover or manage hubs and bridges on the other side of a router.

Q. If I am using Novell NetWare on my network, can I use HP OpenView Interconnect Manager/DOS or Hub Manager/DOS?

A. Yes. Version "D" (HP 27256D OpenView Interconnect Manager/DOS and HP 28686D OpenView Hub Manager/DOS) supports Novell's IPX communication protocol.

Upgrades

Q. I am currently using HP 28686C Hub Manager, how can I get an upgrade from my "C" version of Hub Manager to the "D" version?

A. If you have previously purchased versions of Hub Manager (HP 28686A, HP 28686B, or HP 28686C), you can purchase an upgrade of either HP OpenView Hub Manager/DOS (HP 28686D) or Interconnect Manager/DOS (HP 27257D) by calling:

- in the United States and Canada, 1-800-525-9283
- in Europe, Latin America, or Asia/Pacific, (303) 353-7650 or facsimile (303) 352-6800

When you are upgrading from a previous revision of Hub Manager, you will be instructed where to ship the old management software disks. Remember, you MUST always fill out the software registration card and mail it to the return address in order to receive subsequent software updates.

The same information also applies if you also have previously purchased versions of Bridge Manager (HP 28653A/B/C).

Q. When upgrading from the "C" version of Hub Manager to the "D" version of Hub Manager, what differences must I be aware of?

A. When you are upgrading from Hub Manager version 28686C to Hub Manager/DOS version 28686D, a decision to operate your network management station using IP (ARPA Services) or IPX (Novell) must be made.

To operate in IP mode, you need only to update your network management station. Upgrading the hub's firmware is not required, but it is advised to upgrade your hub firmware from C.01.xx to D.01.xx so that you can take advantage of the new hub features. HP 28686D Hub Manger/DOS can manage hubs that have firmware revision C.01.xx.

To operate in IPX mode, you must do the following:

- install Novell NetWare on the management station (if not already installed), and
- update the client NetWare programs on the management station to meet or exceed the versions listed below

If you are using non-ODI drivers:
- IPX.OBJ v3.10
- NETX.COM v3.22 or
  EMSNETX.EXE v3.22 or
  XMSNETX.EXE v3.22

If you are using ODI drivers:
- IPXODI.COM v1.30
- NETX.COM v3.22 or
  EMXNETX.EXE v3.22 or
  XMSNETX.EXE v3.22
- LSL.COM v1.21

You must update all hubs to revision D.01.xx by using the network management agent update disk.

Q. I am upgrading from my "A" version Hub Manager (HP 28686A) and "A" version Bridge Manager (28653A) to the "D" version of Interconnect Manager/DOS (HP 27256D), are there any major changes?

A. If you are upgrading from Hub Manager (28686A or 28686B) and from Bridge Manager (28653A or 28653B), there are three major changes that affect your network management station, your hubs, and your bridges.

1. Microsoft Windows must run in standard or enhanced mode. Expanded memory management is not needed. The extended memory manager provided by Microsoft Windows (himem.sys) must be used. Windows will automatically install it.
2. For management stations running in IP mode, the HP OfficeShare transport software must be replaced by ARPA Services software (included with the Interconnect Manager/DOS product) and an Internet Protocol address must be configured. For network management stations running in IPX mode, a matrix of current drivers that interface with Windows is provided in the installation manual and the drivers are provided on the Interconnect or Hub Manager installation disks.

3. All HP hubs and bridges in the network must be updated to revision D.01.xx firmware. This is done by connecting a PC to the console port of each hub or bridge and using the network management agent update disk (included with the Interconnect Manager/DOS product) to download new firmware.

Q. How can I upgrade the agent firmware in my HP hubs and bridges to the D.01.xx version?

A. A network management agent upgrade disk (3.5" and 5.25") is included with each product, HP OpenView Interconnect Manager/DOS (HP 27256D) and Hub Manager/DOS (HP 28686D). Attach a PC to the console (RS-232) port of each hub or bridge and run the update program. The D.01.xx agent firmware will be downloaded into the device.

Q. Can I download agent firmware to my HP hubs or bridges over the network?

A. Yes. Network downloadable agent firmware over the network is a new function that is provided in the "D" products of HP OpenView Interconnect Manager/DOS (HP 27256D) and the Hub Manager/DOS (HP 28686D) in conjunction with hubs and bridges with D.01.xx version agent firmware.

For future agent firmware enhancements to hubs or bridges, say E.01.01 or later, a download utility will be provided to download the agent firmware to hubs and bridges from the network management station.

Operations

Q. Which Novell client stations can I use for my network management station(s)?

A. You can use client stations that use NetWare 3.01 or later software. MS-Windows 3.00a requires NetWare 3.01 client software to run on NetWare 2.15 or later networks.

Q. How many total hubs and bridges can I manage with HP OpenView Interconnect Manager/DOS?

A. A practical limit of 200 managed devices (hubs, bridges, and routers) can be managed by HP OpenView Interconnect Manager/DOS.

Q. With HP OpenView Interconnect Manager/DOS or Hub Manager/DOS, can I discover the IP addresses of end nodes attached to hubs?

A. No, but HP OpenView network management can discover IPX or station addresses of end nodes attached to hubs. This includes NetWare clients and file servers.

Q. What features does HP OpenView Interconnect Manager/DOS have that the hub and bridge console interfaces don't have?

A. The key features include:
- A central location to control all hubs/bridges in the network.
- A central location to configure all routers (via telnet) in the network.
- A central location to perform diagnostics in the network
- User-friendly windows interface.
- Ability to automatically draw a network map.
- Ability to set alarm thresholds and show alarms on the map.
- Ability to graph and log network event and counters.
- Ability to perform multiple network management tasks.

Q. Can I have multiple network management stations managing my network?

A. Yes, HP recommends using multiple network management stations when managing a network that spans multiple sites, cities, or states. Each network site should have its own network management station. A single network management station is capable of managing a multisite network. However, it is convenient for the site network administrator to have his own station. Multiple stations are also quite helpful in diagnosing inter-site network problems.

Q. Can I have a remote network management station and run HP OpenView Interconnect Manager/DOS or Hub Manager/DOS through a modem?

A. No. Your network management station must be connected to the network in order to communicate with (manage) your hubs, bridges or routers. If your network management station is at a remote site, you can connect your station to the network by using an HP remote bridge or an HP router and a WAN link.

Addressing Schemes

Q. How are IPX addresses assigned to my hubs and bridges?

A. When using the Novell NetWare network operating system, the IPX addresses of a network device consists of a network number and a host number. In IPX networks, the IPX address for each IPX-supporting network device is generated automatically. Since the IPX agent firmware is always active in HP hubs and bridges, you don't have to manually assign and configure IPX addresses.

The host number is the hub or bridge's station address (also known as the MAC address, Ethernet address, or physical address). This address is a unique number assigned to the network device by the manufacturer.

Q. How are IP addresses assigned to my hubs and bridges?

A. You must assign an IP address for each HP hub and bridge through the console port and the IPconfig command. (You cannot assign IP addresses over the network using HP OpenView Hub Manager/DOS or Interconnect Manager/DOS.)

If your IP network will be connected with other IP networks worldwide, you must use assigned IP addresses. Otherwise, you can build your own IP addressing scheme. (See the next three questions.)

Q. Do I have to get assigned IP addresses from the DDN Network Information Center in Menlo Park, California?

A. Hewlett-Packard strongly recommends that if you intend to expand, integrate, or connect your IP network to other IP networks, you use an assigned address. There is a formal process to obtain assigned unique IP addresses to networks worldwide. Contact the DDN Network Information Center by phone or mail. They will provide instructions and the necessary documents to assign and register your IP addresses.

Telephone	in U.S. only:	1-800-235-3155
	worldwide:	415-859-3695
Mailing Address	Hostmaster DDN Network Information Center SRI International 333 Ravenswood Avenue Menlo Park, California 94025	

Q. Can I build my own IP addressing scheme?

A. If your network is isolated and will not be connected to any other IP networks, you can build your own IP addressing scheme. If you use your own addressing scheme, be aware that any connection to another IP network could cause communication problems on both networks. The IP addresses on the two networks must be compatible. Each address must be unique.

Q. What is a class C addressing scheme?

A. Class C addresses allow up to 254 IP devices to be configured. If you have more than 254 IP devices to configure, see the reference document (listed below) and use a class B addressing scheme. (Class B allows 65,534 IP devices to be configured.)

Here is an example of class C addresses. The IP address format is X.X.X.X, where each X is an integer between 1 and 255. The integers are separated by decimal points. For a given network with its own class C addressing scheme, the first three integers of each address must be the same. The fourth integer must be unique for each IP addressed device. (Do not use 0 or 255 in the fourth position. They are reserved integers.)

For three hubs, two bridges, and an HP OpenView network management station on your IP network, the class C addresses might be:

management station	192.1.1.1
first hub	192.1.1.10
second hub	192.1.1.11
third hub	192.1.1.12
bridge one	192.1.1.20
bridge two	192.1.1.21
etc.	etc.

The following documents have detailed descriptions on how to build your own IP addressing scheme:

- *HP OpenView EtherTwist Network Management Reference Guide (DOS version)* (HP part number 5091-3635E)
- *HP ARPA Services 2.1/MS-DOS Installation and Tuning Guide* (HP part number D1812-90014)
- *Interconnecting With TCP/IP: Principles, Protocols, and Architecture*
  Author: Douglas E. Come; Publisher: Prentice-Hall, Inc.

Network Health

Q. Can HP OpenView network management discover the end nodes on the thin coaxial segments from my ThinLAN hub?

A. Yes, the HP ThinLAN hub keeps a table of station addresses for all end nodes that have transmitted data on each of its ThinLAN ports. The network management station can retrieve the address table information to discover and lay out end nodes on each thin coaxial cable segment.

Q. On my network map, what do the different colors indicate on my HP hubs and bridges?

A. The color of a hub or bridge icon on the network map quickly shows you its status. For non-HP SNMP devices, only red and green are valid.

Blue—the status of the device is unknown.

Green—the network management station is able to communicate with the device and no events have occurred.

Yellow—one or more events have occurred on the device since you last read the event log. Click on the Monitor menu, Show Event Log for a list of events that occurred. If a device icon is yellow, clicking on Show Event Log will change the device icon to green.

Red—the network management station is not able to communicate with the device over the network. A device icon that is red on the network map may be one of the following:

- defective
- disconnected or powered off
- unreachable (the network is too busy or the network is down)

If a device has been replaced by another during repair, the network map must be updated to show the replacement device's IP address (or IPX address) or a critical alarm will be generated (the device icon will turn red).

Purple—the bridge is acting as a backup bridge (spanning tree topology) in the network.

Q. On my network map, what do the different colors indicate on the end nodes?

A. End nodes such as PCs, and workstations connected to hub ports will have the following colors:

Green—the end node attached to the hub's port is OK. Note that a hub port that is turned on but has link beat turned off cannot detect whether an end node is really attached, so the port's end node will automatically be green on the network map.

Purple—the status of the end node is one of the following:

- link beat for the port is turned on but not detected
- the port is turned on but segmented
- the port is turned off

Q. When should I begin planning network growth or optimization?

A. When LAN utilization exceeds 40%, you should consider using a bridge or router to help divide and isolate network traffic.

Q. When monitoring the ratio of collision to transmitted packets, at what ratio value should I investigate network problems?

A. If the ratio of collisions to transmitted packets exceeds 20%, there may be a problem with the LAN segment length, network topology, or device hardware.

Q. What is the recommended maximum rate of broadcast packets received per second?

A. 50 packets/second.

Q. What percentage of bad packets is acceptable in a healthy network?

A. If you observe more than 2% bad packets, verify that your LAN cable and network hardware are in proper working order.

Q. Can I program HP OpenView Hub Manager/DOS or Interconnect Manager/DOS to call my pager when an event threshold on my hub has been exceeded?

A. Yes. The new Action on Events feature of Hub Manager/DOS and Interconnect Manager/DOS allows actions to be initiated automatically when events occur. The Action on Events function does not itself perform actions. Rather, the Action on Events function interfaces a user-supplied action file with Hub Manager's and Interconnect Manager's event monitoring capabilities. You specify the actions that will occur in the action file. The action file is the executable code that performs or initiates an action or actions. The user is responsible for creating an action file which can be a program or a DOS batch file.

Graphs

Q. What is the Graphs function?

A. The Graphs function executes timed retrievals of device counter data for real-time graphical display, real-time text display, and data logging. Graphs retrieves standard MIB-II counters and HP proprietary counters. Graphs can retrieve counter values from any multi-vendor device that supports SNMP/IP or SNMP/IPX and the standard MIB-II interface group counter objects. Graphs can also display LAN traffic in percentage rate, bytes/second, or packets/second, depending on the user's selection.

Q. How often does the Graphs function sample?

A. The Graphs function has its own sample rate algorithm that is adjustable from 1 second to 1,193,000 hours. The default sample rate is 20 seconds.

Q. How many devices can I graph at a time?

A. Up to six counters of a single or multiple devices can be plotted on one graph. That is, the Graphs function allows you to graph any combination of counter or devices on a single graph.

Q. Can I open multiple graph screens concurrently?

A. Yes, you can open up to seven graph screens. However, the number of graph screens convenient to view concurrently is dependent on your monitor's size. For example, two graph screens will cover 50% of the OpenView network map on a 14-inch monitor. If more than one graph is enabled, you can minimize them until you need to view them.

Resource Manager/DOS

Q. Can I use HP OpenView Resource Manager/DOS (HP 27257D) as a stand-alone product?

A. No. Resource Manager/DOS runs on top of HP OpenView Interconnect Manager/DOS (HP 27256D) or Hub Manager/DOS (HP 28686D) on the network management station. Resource Manager/DOS uses the same network map that is autodiscovered by Interconnect Manager/DOS and Hub Manager/DOS.

Q. What is HP EASE?

A. HP EASE (Embedded Advanced Sampling Environment) is a new software technology used in the HP OpenView Resource Manager/DOS product. The HP EASE software combines statistical-sampling techniques with an instrumentation agent that resides in managed HP hubs and bridges (with D.01.xx agent firmware versions). The real-time sampling and analysis capability identifies and stores only the most critical network data—including top talkers, heavy users, error sources—and discards millions of useless packets.

Q. Is HP Resource Manager similar to a protocol analyzer?

A. HP Resource Manager/DOS is primarily used as a planning tool. From a centralized location (the network management station), Resource Manager software can detect the five most active network nodes (senders and receivers), communication pairs, broadcast packet sources, multicast packet sources and error sources on the network. It also monitors trends based on IP, IPX or station address traffic on the network. Rather than collect and report back data on all packets passing through a hub or bridge, as a protocol analyzer would, Resource Manager simplifies the task of analyzing the collected data and presents easy-to-understand network usage patterns. A protocol analyzer is generally used as a troubleshooting tool. It provides protocol encoding and decoding that is needed to further analyze network problems.

Resource Manager continuously monitors the network, while protocol analyzers are conditional monitoring tools. For example, if a problem condition occurs, a protocol analyzer can be used to pinpoint the problem. Resource Manager provides a more thorough view of network use over a long time period.

Q. Can I use HP Resource Manager to analyze traffic from other vendor network products?

A. Multivendor devices can be connected to any port of an HP managed hub or bridge (with firmware version D.01.xx) in order for Resource Manager/DOS to gather information from them. The HP managed hub or bridge collects and filters samples of packets that flow through its ports. The samples are then sent to the network management station to be analyzed by Resource Manager.

Third-Party Products

Q. What is the MIB browser used for?

A. HP's MIB (Management Information Base) browser allows you to extract information from SNMP devices. The MIB browser extracts standard MIB-II objects and vendor-proprietary MIB objects. Proprietary MIB objects are data values that a third-party vendor defines as valid device information.

Q. What is included with the HP MIB browser?

A. HP has provided MIB files that you can load and will retrieve data. The MIB files provided are:

- Standard MIB-II
- Hewlett-Packard's MIBs (for HP hubs, bridges, and routers)
- Cisco's router MIBs
- SynOptics' concentrator MIBs
- Cabletron's concentrator MIBs
- Wellfleet's router MIBs

The standard MIB-II files can be used on most SNMP devices, since most vendors have implemented parts of MIB-II.

Q. What third-party LAN adapter cards can I use in the network management station?

A.

- 3Com EtherLink II (3C503TP)
- 3Com EtherLink/MC 93C523) – PS/2 10BASE-T Card
- 3Com EtherLink (3C503)
- Western Digital EtherCard PLUS 10T
- Western Digital EtherCard PLUS 10T/A – PS/2 10BASE-T Card
- Western Digital ThinLAN Interface WD8003E

Q. Can HP OpenView Interconnect Manager/DOS or Hub Manager/DOS manage other third-party hubs, bridges, and routers that also use SNMP with IP or IPX communications?

A. Yes. Interconnect Manager/DOS has features that provide management capability for third-party devices. The features are autodiscovery, graphing, online map status, Telnet, and MIB Browser.

Q. Can other third-party SNMP-based software products manage the HP hubs, bridges, and routers?

A. In order for HP hubs, bridges, and routers to be managed by other SNMP-based software, the third-party software require the following:

- MIB-II system objects
- RFC 1066 SNMP objects
- HP device-specific extension to MIB-II

Q. With HP OpenView Interconnect Manager/DOS or Hub Manager/DOS, can I manage SynOptics' networks to the port level?

A. With Interconnect Manager/DOS or Hub Manager/DOS, you can observe SynOptics' hubs at the port level; however, you cannot configure or alter the ports. You cannot set alarms or events, but you can observe events and statistics with the MIB Browser. With the graphing function, you can see all the standard MIB-II counters.

Q. Does HP OpenView Interconnect Manager/DOS manage 3Com hubs and bridges?

A. As long as the hub or bridge is SNMP/IP- or IPX-compatible, Interconnect Manager/DOS will be able to autodiscover it. You will be able to observe status as far as whether the device is "up" or "down" (can background poll it) and graph MIB-II counters on the devices.

Q. Does HP OpenView Hub and Interconnect Manager/DOS support 802.5 token ring (4 or 16 MB/second)?

A. No, Hub and Interconnect Manager/DOS and the SNMP agents (in HP hubs, bridges, and routers) do not understand token ring packets.

Technical Reference Guide

Advanced Topics

LAN Products

Introduction

Advanced Topics

This section contains product notes on various HP EtherTwist family of network products. Some topics apply to multiple products, other topics provide additional technical details on the HP EtherTwist network products. There are two reference documents available that provide technical details specifically on HP OpenView network management products and on HP routers. They are:

- *HP OpenView EtherTwist Network Management Reference Guide (DOS Version)* (HP part number 5091-3635E)
- *HP Router Reference Guide (HP Router ER and HP Router TR)* (HP part number 5091-2236E)

The product notes provided in this section are organized in this order:

Advanced Topics

Product Note

HP EtherTwist Name Changes

If you are familiar with, or have purchased previous HP EtherTwist products, you will notice some minor name changes to a few of the HP EtherTwist network products. In this list we also show new products in the HP EtherTwist family

HP EtherTwist PC LAN Adapters

HP Product Number	Old Name	New Name
27248A	EISA Adapter Card/32	EISA LAN Adapter/32 TP
27247A	Adapter Card/16	(no change)
27269A	Adapter Card/16 6-Pack	(no change)
27246A	Micro Channel Adapter Card/16	MC LAN Adapter/16 TP
27245A	Adapter Card/8	PC LAN Adapter/8 TP
27267A	Adapter Card/8 6-Pack	PC LAN Adapter/8 TP 6-Pack
*27247B	(none)	PC LAN Adapter/16 TP Plus
*27269B	(none)	PC LAN Adapter/16 TP Plus 6-Pack
*27252A	(none)	PC LAN Adapter/16 TL Plus

HP Bridges

HP Product Number	Old Name	New Name
28691A	10:10 LAN Bridge LB	(no change)
28673A	10:10 LAN Bridge	10:10 LAN Bridge MB
28674A	Remote Bridge	(no change)
*28674B	(none)	Remote Bridge RB

HP Routers

HP Product Number	Old Name	New Name
27285A	Router ER	(no change)
*27286A	(none)	Router TR

*new products

Advanced Topics

Product Note

High-Performance Low-Cost PC LAN Adapters

Introducing two new high-performance low-cost PC LAN adapters—the HP 27247B and the HP 27252A.

The HP 27247B and the HP 27252A are two new additions to the HP EtherTwist LAN adapter family. Both these cards offer market-leading performance along with a host of desirable features at a competitive price. Both cards provide boot ROM support for diskless PC applications, LEDs for diagnostics, and an AUI port for attachment to other media such as optical fiber. These cards are completely software configurable through HPLANSet, an intelligent, easy-to-use configuration and diagnostic program.

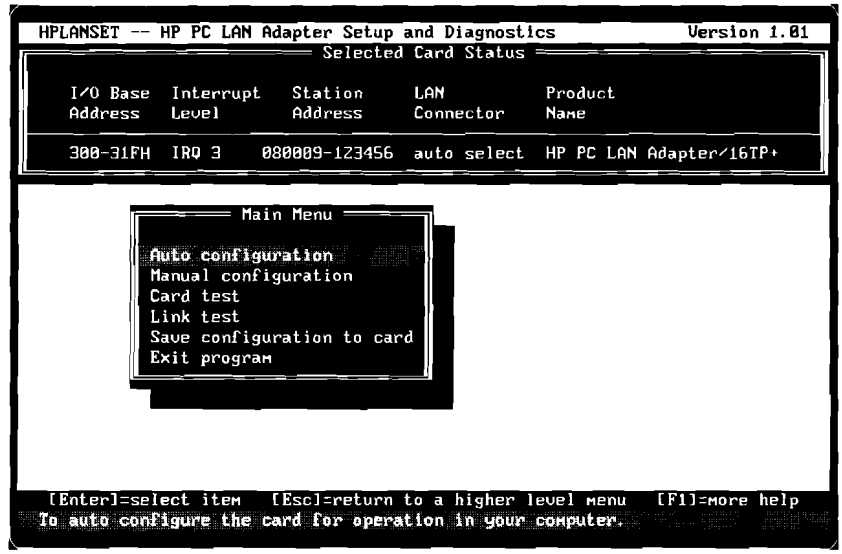
The HP 27247B is a 16-bit ISA card that provides the IEEE 802.3 Type 10Base-T (twisted-pair) LAN connection through an 8-pin modular RJ-45 jack. The HP 27269B is a 6-pack option for the HP 27247B. The HP 27252A is a 16-bit ISA card that provides the IEEE 802.3 Type 10Base2 (thin coax) LAN connection through a BNC connector.

Highlights

- pipelined architecture for market-leading performance
- highly integrated hardware design to achieve low-cost and high reliability
- 32 Kbytes of static RAM for Transmit and Receive packet buffers
- boot ROM support for diskless applications
- automatic selection of LAN connector
- LEDs for status and diagnostics
- fully software configurable; no jumpers or switches to be set in hardware
- two modes of operation: memory mapped or I/O mapped mode
- efficient drivers to optimize performance for various network operating systems such as Novell NetWare and Microsoft LAN Manager
- fully compliant with Ethernet/IEEE 802.3 standards
- meets FCC Class A and CISPR Class A regulations for radiated emissions
- lifetime warranty on the hardware

HPLANSet Auto-Configuration

Using HPLANSet you can install the new adapters in a matter of a few seconds—even the LAN connector is automatically selected. And you have no hardware jumpers or switches to worry about. If you cannot use the default values, configuring the Adapter/16 Plus cards is as easy as 1, 2, 3.



1. Run HPLANSet configuration program.
2. Press A to auto configure the card.
3. Press E to exit HPLANSet.

Of course, you can manually customize every configuration on the card. Or you can run HPLANSet in batch mode and read the configuration from a file.

HPLANSet Diagnostics

HPLANSet also provides two categories of easy-to-use diagnostics:

- On-board diagnostic that verifies the card hardware.
- On-network diagnostic that verifies the card's ability to communicate with other stations. Using HPLANSet you can automatically locate a station on the network that can respond to 802.2 test packets sent by your card.

Two Modes of Operation

The HP LAN Adapter/16 Plus cards can be configured to operate in one of two modes—I/O mapped mode or memory mapped mode.

In I/O mapped mode, the card uses the standard I/O channels to communicate with the computer. Using HPLANSet you can auto-configure the Adapter/16 Plus cards in this mode. This mode ensures compatibility in almost all computers.

In memory mapped mode, the card uses a block of 2 Kbytes of memory address space to communicate with the computer. This block of addresses is mapped to the registers/RAM on the card. Using HPLANSet, configuring the card for memory mapped mode is almost as easy as auto-configuration in the I/O mapped mode. HPLANSet guides you to select an address space that does not conflict with anything else in your computer.

As memory cycles are shorter than I/O cycles, in general, memory mapped mode offers higher performance. However, even in the I/O mapped mode, the Adapter/16 Plus cards offer enviable performance that exceeds that of many memory mapped adapters in the market. The 2 Kbytes of memory address space used by the Adapter/16 Plus cards in the memory mapped mode, is one of the lowest in the industry. Many other adapters require 8K to 32K. In fact, you can configure multiple Adapter/16 Plus cards in your computer to use the same block of memory address space in memory mapped mode.

Driver Support Overview

Efficient drivers to optimize performance for various Network Operating Systems such as Novell NetWare and LAN Manager are available for both these adapters. The table below provides driver compatibility and availability information.

Network Operating System	HP EtherTwist Adapter Cards HP 27247B (Adapter/16 TP+) HP 27252A (Adapter/16 TL+) HP 27269B (TP+ 6 pack)
Novell NetWare 286 v2.15, v2.2	C-IPX S-IPX S-ATALK1 S-ATALK2
Novell NetWare 386 v3.0, v3.1x	C-ODI S-ODI
Microsoft DOS LAN Manager v2.0, v2.1	NDIS 2.0 (a)
IBM/Microsoft OS/2 1.x, LAN Manager v2.0, v2.1	NDIS 2.0 (a)
HP LAN Manager DOS, OS/2 1.x	NDIS 2.0 (a)
HP LM/X Support	NDIS 2.0 (b)
3Com 3+Open v1.1 XNS (d)	NDIS 2.0
DEC Pathworks v4.0	NDIS 2.0
SCO UNIX v3.2.x	– (expected in fall 1992)
Banyan Vines (c)	NDIS 2.0
FTP Inc. PC/TCP Plus	NDIS 2.0
Hughes ProLink	NDIS 2.0

Legend:

–	Presently not available.
S-ODI	NetWare 386 3.11 Open Data-link Interface (ODI) Server
C-ODI	NetWare ODI DOS Client
S-IPX	NetWare 2.2 Server
S-ATALK1	NetWare 2.2 Server with AppleTalk Phase 1 functionality
S-ATALK2	NetWare 2.2 Server with AppleTalk Phase 2 functionality
C-IPX	NetWare IPX DOS Client

Notes:

(a)	NDIS 2.0 driver supports both server and client unless otherwise noted.
(b)	HP LM/X Support: NDIS 2.0 clients running under LAN Manager 1.0 or 1.1 on the PC can communicate with HP 9000 LM/X servers.
(c)	Requires Banyan Vines version 4.00 (2) with patch release 2NNN, or later versions.
(d)	Only the XNS protocol driver is supported.

Boot ROM Option

Both adapters offer boot ROM support for Novell NetWare and Microsoft LAN Manager for diskless workstations. The product numbers are listed below:

HP 27260A (boot ROM for Novell NetWare)
HP 27261A (boot ROM for Microsoft LAN Manager, available fall 1992)

How To Define the Performance of a LAN Adapter

There are two major factors to be considered when evaluating the performance of a LAN adapter.

- the throughput in Kbytes/second over the LAN
- the percentage CPU utilization for the data transfer

Throughput defines how fast the adapter hardware and software, both working together, can process data. The "percentage CPU utilization" (henceforth called CPU utilization) denotes the CPU intervention required for the adapter to complete the data transfer. For example, if the CPU utilization for an adapter is 60 percent, only 40 percent is available for use by other applications.

The CPU utilization also determines the number of cards that can be installed in the same server to communicate with different LANs. For example, if the CPU utilization for an adapter is 60 percent, you can not have more than one adapter in the server without starving the LAN to which the adapter is connected.

Most adapters in the market are capable of delivering high throughput. However, the CPU utilization for the adapters varies significantly depending on the hardware architecture and the efficiency of the drivers. A performance index that we can use to measure the performance of a LAN adapter is the ratio throughput/CPU utilization. This also provides a framework to compare the performance of different adapters. In general, this ratio and the price are all you need to select the adapter that fits your requirements.

Novell NetWare Performance

Results of Tests Done by National Software Testing Labs (NSTL)

In April 1992, NSTL conducted benchmark tests comparing the server performance of the new HP adapters against 10Base-T adapters from Intel, 3Com, SMC/Western Digital, RACAL InterLAN, and Novell. The objective was to determine the throughput and the CPU utilization for the standard Novell Perform3 benchmark suite and compare the relative performance index and price of the various adapters.

The Perform3 tests conducted transferred files ranging in size from 4096 bytes to 128 bytes with a step size of 128 bytes between the server and the client. The aggregate throughput in Kbytes/second and the CPU utilization for the transfer are provided by NetWare Monitor program.

Test Configuration

The tests were run on a 10Base-T network with eight clients and a server. Novell NetWare 3.11 was the NOS used on the LAN. The following cards were tested on the server.

HP 27247B PC LAN Adapter/16 TP Plus
3Com EtherLink 16TP (3C507)
3Com EtherLink II 16TP (3C503)
SMC Elite 16TP
Racal InterLAN NI6510BT
Intel EtherExpress 16TP
Novell NE2000TP

Server Configuration

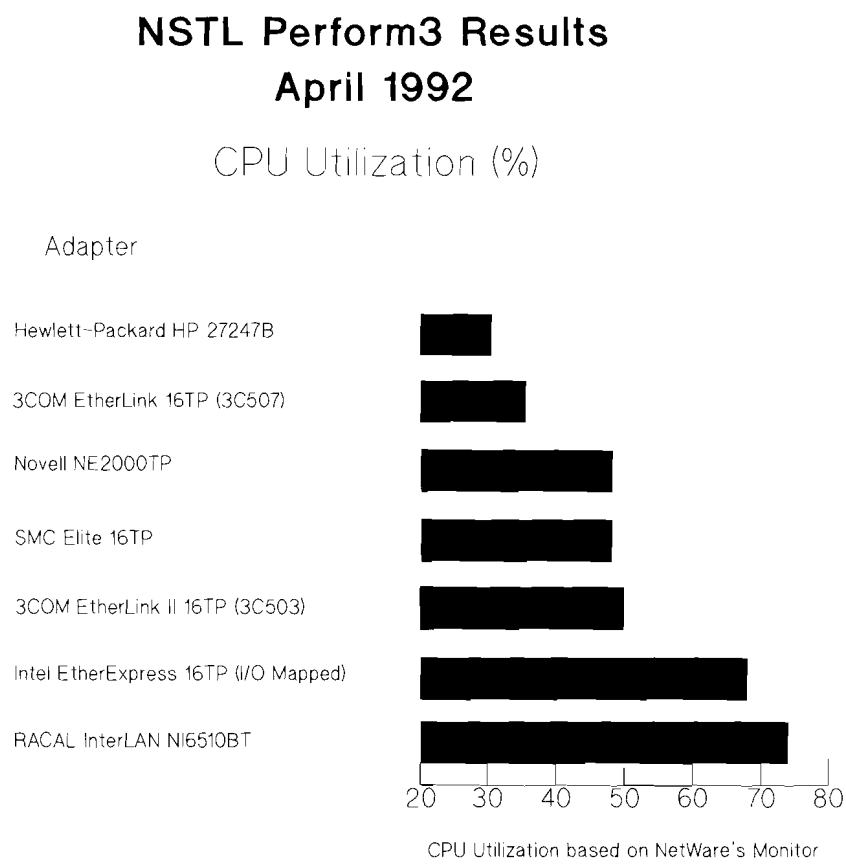
ALR Power/Business VEISA 486 running at 33 MHz
64K cache
8 MB of RAM
212 MB hard disk

Client Configuration

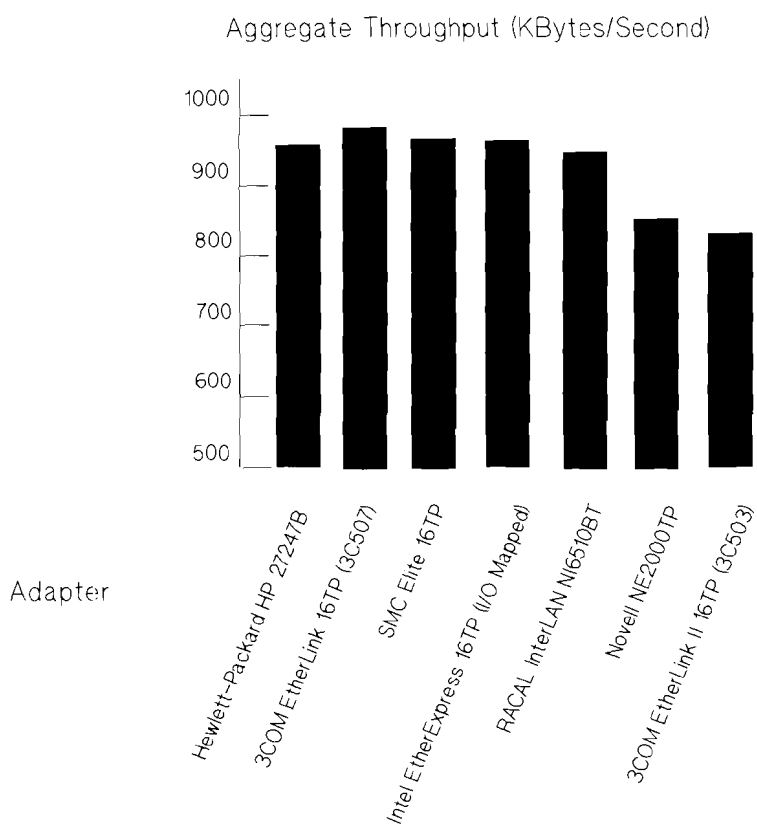
286 ISA computer running at 16 MHz
1 MB of RAM
1 floppy drive

Test results

The figure below plots the CPU utilization from the Perform3 benchmark suite for the adapter cards tested. It is evident that the HP 27247B PC LAN Adapter/16 TP Plus had the lowest CPU utilization during the data transfers. The CPU utilization for the Intel EtherExpress 16TP card was more than twice that of the HP LAN Adapter/16 TP Plus. Also, the CPU utilization for the 3Com EtherLink 16TP was 34% while it was only 30.5% for the HP LAN Adapter/16 TP Plus.

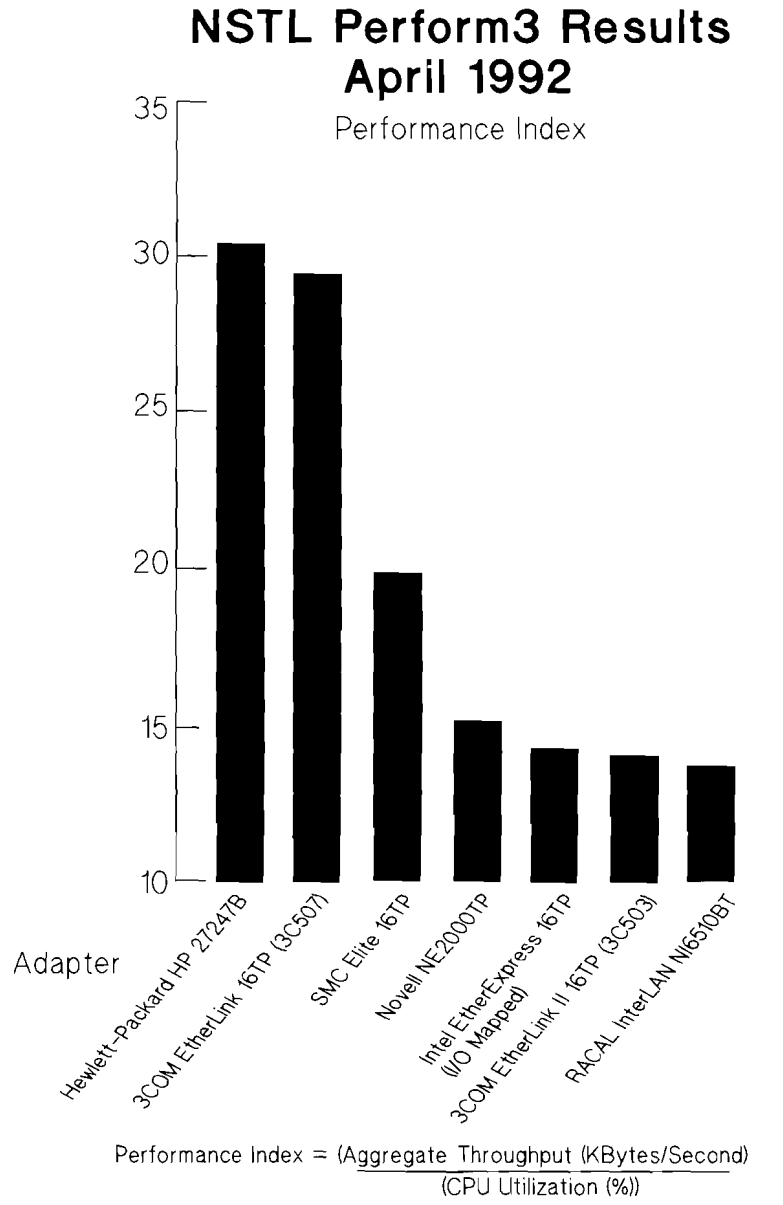


The following figure plots the aggregate throughput for the adapters during the Perform3 tests. On throughput alone, the more expensive 3Com EtherLink 16TP was less than one percent faster than the HP 27247B PC LAN Adapter/16 TP Plus.

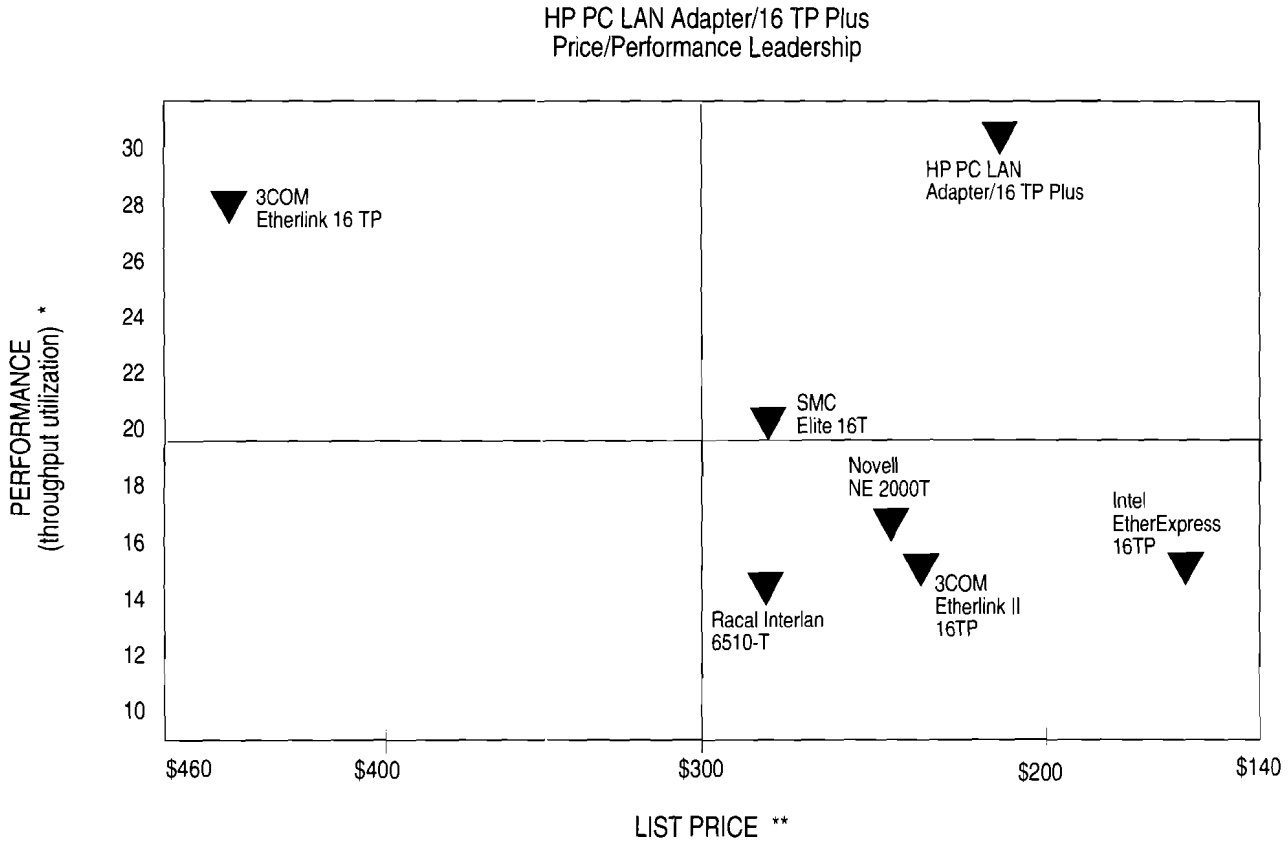


Aggregate Throughput Based on Perform3 Results for 4096 Byte Block Size

The figure below plots the performance index against the list price for all the adapters. The performance index throughput/CPU utilization, clearly shows that the HP LAN Adapter/16 TP Plus has overall superior performance relative to all the other adapters tested. The HP LAN Adapter/16 Plus emerges the clear price/performance leader.



The figure below summarizes the list price per performance comparisons of the LAN adapters. This clearly shows that the HP PC LAN Adapter/16 TP Plus is the market leader.



* Measured by NSTL, Inc., using Perform 3, April, 1992.
** Per card list price of 5-pack or 6-pack bundles as of May, 1992.

HEWLETT PACKARD

Advanced Topics

Product Note

HP 28688A and HP 28688B Differences

This product note discusses the differences between the HP 28688A ("A" version) EtherTwist Hub Plus and the HP 28688B ("B" version).

Background

The differences in the products are due to the improved hardware and increased memory in the "B" hub. The increased memory in the "B" hub allows for future network management enhancements. Both hubs use flash EEPROMs that allow you to download network management firmware upgrades into the hub. This firmware code is also referred to as agent firmware or agent code. The agent code version (in the hub) must match the version of HP OpenView network management that you are using. For example, to use HP OpenView Hub Manager/DOS (HP 28686D) or HP OpenView Interconnect Manager/DOS (HP 27256D), your HP managed hubs must have firmware version D.01.xx. (You only need to check the first letter of the version number.) The reason that the version letters must match is that there are new and unique network management features included with the D version. If your hubs have C.01.xx firmware version, you can still use HP OpenView Hub Manager/DOS (HP 28686D) or HP OpenView Interconnect Manager/DOS (HP 27256D). However, you won't be taking advantage of the new functions available in the "D" version of HP OpenView network management. Use the Network Management Agent Software Upgrade that comes with both the HP 28686D or HP 27256D products to upgrade your hub's agent code to the D.01.xx version.

The Network Management Agent Software Upgrade

Attached to the carton of your HP OpenView Hub Manager/DOS (HP 28686D) or HP OpenView Interconnect Manager/DOS (HP 27256D) is the Network Management Agent Software Upgrade, consisting of:

- two disks, one 3.5" and one 5.25", labeled "Network Management Agent Update Software"
- *Network Management Agent Software Upgrade Guide* (5181-8648).

Because the "B" hub has more memory and is different hardware than the "A" hub, there are separate agent code files provided for each hub with the Network Management Agent Software Upgrade.

To upgrade an "A" hub to operate with HP OpenView Hub Manager/DOS (HP 28686D) or HP OpenView Interconnect Manager/DOS (HP 27256D), use the software found under the subdirectory for HP 28688A.

To upgrade a "B" hub, use the software found under the subdirectory for HP 28688B.

"A" Hub and "B" Hub Functions

This table outlines the functions available with each hub with firmware version D.01.xx.

Console Interface Commands	"A" hub D.01.xx	"B" hub D.01.xx
Disconnect	Yes	Yes
Speed	Yes	Yes
Password	Yes	Yes
Reset	Yes	Yes
Port (on/off)	Yes	Yes
Linkbeat (on/off)	Yes	Yes
Thinwatch (on/off	Yes	Yes
IP Config	Yes (1)	Yes
Backup	No (2)	Yes
Loopback	Yes	No
Testlink	Yes	Yes
Ping	No	Yes
Counters	No (3)	Yes
Status	Yes (4)	Yes (4)
Output of Status	Port status Linkbeat status # of packets/port # of collisions/port	Port status Linkbeat status MAC address connected
Output of Counters	—	# of packets/port # of collisions/port # of CRC errors/port # of alignment errors/port # of giant packets/port # of broadcast packets/port

Notes:

(1) The "D" version of HP OpenView network management software can support SNMP/IP or SNMP/IPX communication. Before upgrading your "A" hub's agent code, you must decide whether you will run your HP OpenView network management using IP or IPX communications. When upgrading the "A" hub, you can choose only one communication protocol. The "B" hub has enough memory to support both SNMP/IP and SNMP/IPX communication protocols simultaneously.

(2) The Backup command is not available on the "A" hub; however, an "A" hub can be used as a "remote hub" in a backup link scenario. That is, the "A" hub can respond to the 802.2 test packets being sent by the "monitoring hub". See the Product Note, "Backup Link with HP EtherTwist Hubs for Fault Tolerance" in this section for more information.

(3) The Counters command is not available on the "A" hub; however, some results provided by the Counters command can be found with the Status command on the "A" hub.

(4) The Status command is not identical on both hubs.

Advanced Topics

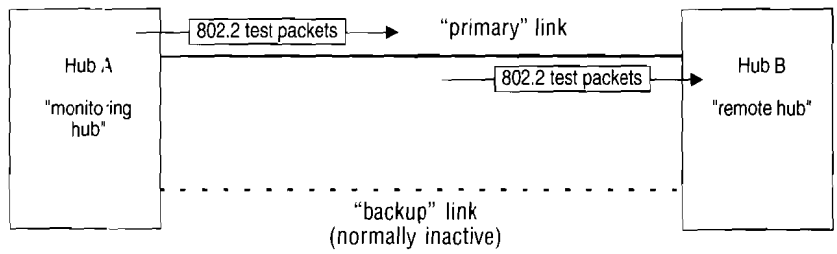
Product Note

Backup Link with HP Hubs for Fault Tolerance

Description

In some network configurations, you may need a backup link to provide fault tolerance on your network. For example, you may have two workgroup LANs that regularly share or exchange data over the network and it is critical that network communications between them be maintained.

HP Hub Pluses, including the HP 28688B EtherTwist Hub Plus, the HP 28699A EtherTwist Hub Plus/48, the HP 28692A ThinLAN Hub Plus, and the HP 28682A Fiber-Optic Hub Plus, provide a backup link function. The backup link function allows you to support a single backup link between any two hubs. A backup link is a separate cable installed between two hubs. The backup link automatically becomes enabled if the designated primary link connection between the two hubs fails.



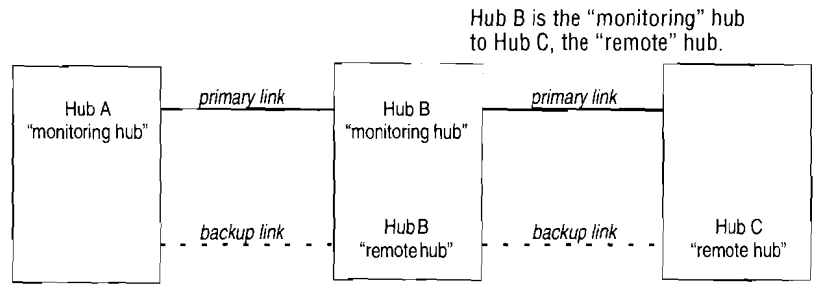
Using the hub's console port backup command, simply configure a port for the primary link and another port for the backup link on only one hub. This hub will be responsible for monitoring the primary link; hence it is the "monitoring hub". In the figure above, Hub A is the monitoring hub and is configured with a primary link and backup link. No configuration is required on Hub B (labeled "remote hub").

Hub A monitors the primary link by sending 802.2 test packets to Hub B and waits for a response. (The backup link normally carries no data traffic.) If the primary link fails and no response is received from Hub B, the backup link will automatically be enabled. The port LED that corresponds to the backup link's port will also light. When the primary link fails, it is automatically disabled until it can be repaired and re-enabled.

After the primary link has been repaired, you must re-enable the primary port again. (It is not re-enabled automatically.) Use the console port's PORT n ON command or reset the hub with the Reset command or power cycle the hub. When the primary port is re-enabled, the backup port is automatically returned to backup mode.

Limitations

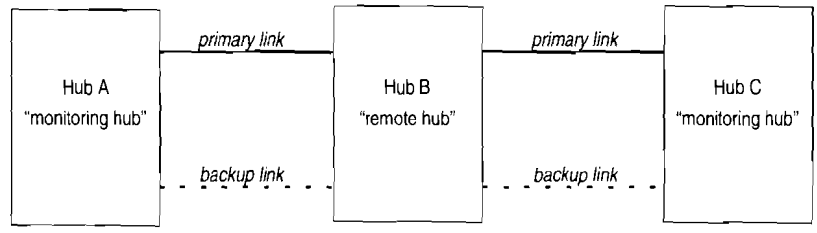
- Each hub can monitor a single backup link (only one backup link can be configured on each hub). However, the hub may be at the remote end of one backup link and at the monitoring end of a backup link to a different hub.



Hub B is the "remote" hub to Hub A, the "monitoring" hub.

- A given hub should be connected to the remote end of no more than two backup links. If it is functioning as the remote hub in more than two backup links, it may not be able to respond to the test packets fast enough when there is a high level of data traffic on the network segments.

  This limit may be exceeded by increasing the time between test packet transmissions on the monitoring hubs. For all the backup links in which the remote hub is involved, the time configured on the monitoring hubs for those links should be increased by one second for each additional backup link beyond two links. Add one link if the remote hub is also functioning as a monitoring hub in a different link.



A given hub should be connected to the remote end of no more than two backup links.

- All HP Hub Pluses must have the D.01.xx software version in order to use the backup link function. Older hubs must be updated to D.01.xx software.
- The HP 28688A EtherTwist Hub Plus (updated with D.01.xx software version) cannot be used as a monitoring hub; you can use it only on the remote end of a backup link. Not enough memory is available on the HP 28688A to allow monitoring of backup links, but it can respond to 802.2 test packets. Non-managed hubs, such as the HP 28691A EtherTwist Hub/8 and the HP 28684A EtherTwist Hub cannot be used with backup links.

Additional Notes

- Any port on the hubs (including the ThinLAN and AUI ports) can be used for either the primary link or the backup link.
- Any combination of media types can be used. For example, a thin coaxial link from the ThinLAN port can act as a backup link to a twisted-pair link using one of the EtherTwist hub's twisted-pair ports. A transceiver attached to the hub's AUI port can provide a primary or backup link over any type medium (twisted-pair, coaxial, or fiber-optic cable).
- The primary link and the backup link cabling should be run over different paths (through different conduits, for example) to reduce the possibility that damage will occur to both cables simultaneously.

Configuration and Installation Sequence

If a hub is installed in a network that includes two connections to another hub, until one of the connections can be configured as a backup link, a loop in the network exists causing some network performance degradation. For this reason, it is better to configure the backup link on the hub before the hub is installed in the network. It is best to follow these steps:

1. Attach a console to the hub's console port and start a console session.
2. Use the Backup command (BA) to set up the backup link configuration. (Because the network cables are not connected, the primary port will not receive responses to the test packets it sends, and will therefore be disabled. You will re-enable it in a later step.)
3. Complete the network cable connections between the monitoring hub and the remote hub.
4. Enable the primary port with the Port command (enter PO n ON, where n is the primary port's ID.) This step is necessary because, without the cables connected, the primary link was disabled shortly after you set it up in step 2. Once you enable the primary port, it assumes the active role.
5. On the remote hub, make sure that the ports connected to both the primary and backup links are enabled (PO n ON). On the monitoring hub, the status of the primary and backup ports is controlled by the hub's firmware; you do not need to explicitly enable the monitoring hub's port.

Backup Command

When you enter the Backup command, you are prompted for these values:

Backup Port: The port used for the backup link. Enter the port id, or enter 0 if you wish to remove an existing backup link configuration.

Primary Port: The port used for the primary link. Enter the port id.

Remote Station Address: The 12-digit hexadecimal station address of the hub at the remote end of the backup link.

Seconds Between Test Packets: How often you want the hub to send IEEE 802.3 test packets to the remote hub over the primary link.

Consecutive Failures: The number consecutive test packet response failures that will trigger activation of the backup link. For example, enter 5 to activate the backup link after the fifth failure.

Backup Link Status

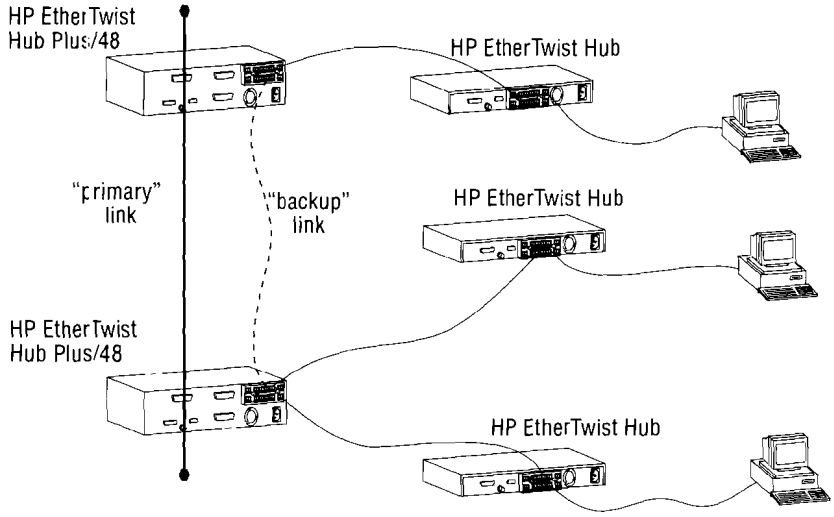
Using the console interface, use the Status command to view the current backup link configuration. The port that is connected to the primary link is labeled "PRI". The port that is connected to the backup link is labeled "BKUP".

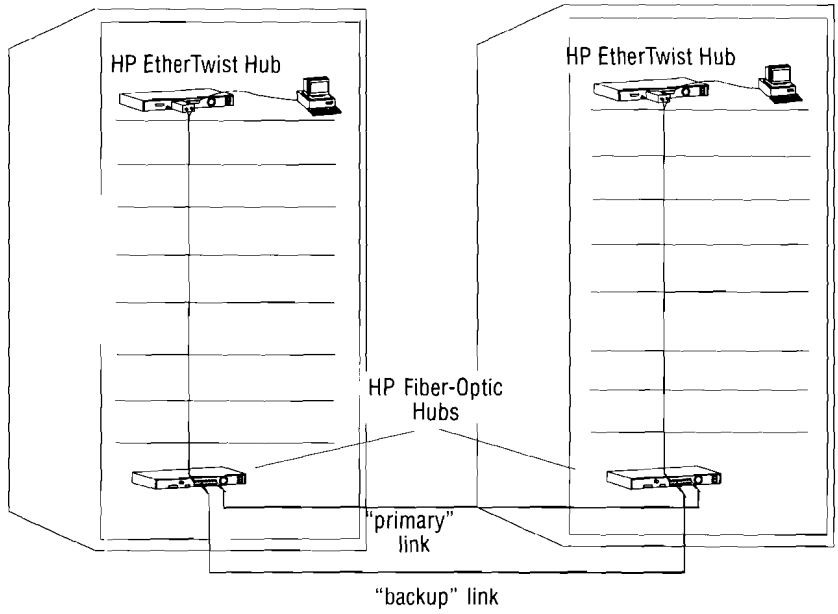
HP OpenView Network Management

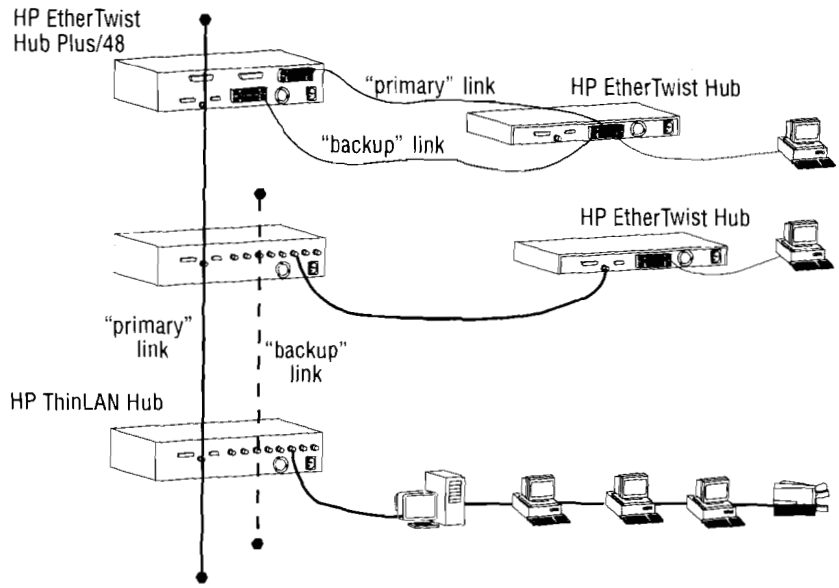
It is not required to have HP OpenView network management products when using the hub's backup link feature. However, if you have a network management station you can easily monitor status of the primary and backup links.

After the backup link is configured (via console port) on the hub, new maps created with Autodiscovery will show the backup link as a dotted line between the two hubs. *Note that you can configure hub backup links only via the console port.*

When there is a change in the state of the backup link (enabled or disabled), a notification is sent to the network management station (if present) indicating the port number of the backup link and the new state. Using HP OpenView Interconnect Manager/DOS (HP 27256D) or HP OpenView Hub Manager/DOS (HP 28686D), you can view the backup link's port status at any time. You can also set alarms to trigger when such an event occurs.


HP EtherTwist
Hub Plus/48
HP EtherTwist Hub
"primary"
link
"backup"
link
HP EtherTwist Hub
HP EtherTwist
Hub Plus/48
HP EtherTwist Hub


HP EtherTwist Hub
HP EtherTwist Hub
HP Fiber-Optic
Hubs
"primary"
link
"backup" link


HP EtherTwist
Hub Plus/48
"primary" link
HP EtherTwist Hub
"backup" link
HP EtherTwist Hub
"primary"
link
"backup"
link
HP ThinLAN Hub

Advanced Topics

Product Note

Software Update Access

HPNN and CompuServe provide the latest software updates to drivers and firmware for HP EtherTwist family of network products. Files on HPNN are available to HP authorized dealers. Files on CompuServe are available to all CompuServe subscribers.

Support Disk Files on HPNN

The following are the latest support disk subdirectory files available on HPNN for the HP EtherTwist family of PC adapters.

Support Disk File	HPNN Archive Reference #
HP 27245A PC LAN Adapter/8 TP	L0003787
HP 27246A MC LAN Adapter/16 TP	L0003788
HP 27247A PC LAN Adapter/16 TP "A" version	L0003789
HP 27248A EISA LAN Adapter/32 TP	L0003790

As of the printing of this document, HPNN archive reference numbers are not yet available for the files for the HP 27247B PC LAN Adapter/16 TP Plus ("B" version) and the HP 27252A PC LAN Adapter/16 TL. Please refer to the *Support Update* newsletter for new HPNN archive reference numbers. (The *Support Update* newsletter is available to all HP authorized dealers.)

Firmware Files on HPNN

The following are the firmware files available on HPNN for various HP EtherTwist hubs and bridges.

	HPNN Archive Reference #
C.0x.xx firmware for:	L0003791
HP 28688A EtherTwist Hub Plus	
HP 28673A 10:10 Bridge	
HP 28674A Remote Bridge	
B.01.05 firmware for:	L0002956
HP 28688A EtherTwist Hub Plus	
A.01.02 firmware for:	L0003792
HP 28673A 10:10 Bridge	
HP 28674A Remote Bridge	

As of the printing of this document, the HPNN archive reference number was not available for the D.01.xx firmware files. Please refer to the *Support Update* newsletter for new HPNN archive reference numbers. (The *Support Update* newsletter is available to all HP authorized dealers.)

Support Disk Files on CompuServe

The following are the latest support disk subdirectory files available on CompuServe for the HP EtherTwist family of PC adapter cards. These files are located in HP System Forum, under the Network Library.

Support Disk File	CompuServe Filename
HP 27245A Adapter Card/8	27245.exe*
HP 27246A Micro Channel Adapter Card	27246.exe*
HP 27247A Adapter Card/16 "A" version	27247.exe*
HP 27248A EISA Adapter Card/32	27248.exe*
Patch for 2.15 EISA driver	hpshes32.exe *

* To extract files, type 2724_.exe /x. (/x retains the subdirectory structure).

As of the printing of this document, CompuServe file names are not yet available for the HP 27247B PC LAN Adapter/16 TP Plus ("B" version) and the HP 27252A PC LAN Adapter/16 TL.

Firmware Files on CompuServe

The following are the firmware files available on CompuServe for various HP EtherTwist hubs and bridges. These files are located in HP System Forum, under the Network Library.

	CompuServe Filename
D.0x.xx firmware for:	DEVFWD.exe
HP 28688A EtherTwist Hub Plus	
HP 28688B EtherTwist Hub Plus	
HP 28699A EtherTwist Hub Plus/48	
HP 28681A Fiber-Optic Hub Plus	
HP 28692A ThinLAN Hub Plus	
HP 28673A 10:10 Bridge MB	
HP 28674A Remote Bridge RB	
HP 28674B Remote Bridge RB	
C.0x.xx firmware for:	DEVFWC.exe
HP 28688A EtherTwist Hub Plus	
HP 28673A 10:10 Bridge	
HP 28674A Remote Bridge	
B.01.05 firmware for:	DEVFWB.exe
HP 28688A EtherTwist Hub Plus	
A.01.02 firmware for:	DEVFWB.exe
HP 28673A 10:10 Bridge	
HP 28674A Remote Bridge	

Router Software

Note that software product releases for the HP 27285A Router ER and the HP 27286A Router TR are not available on CompuServe or HPNN. The latest router software releases are available through the HP Software Update Service product numbers listed below.

For HP 27285A or HP 27286A:	
DDS	27285A + S13
3.5" floppy disk	27285A + S45
5.25" floppy disk	27285A + S42
0.25" cartridge tape	27285A + S22
1600 BPI tape	27285A + S51

You can also purchase the HP Router ER/TR Update Kit, version 5.70.04 from Hewlett-Packard's Support Materials Operation (SMO). The update kit contains the firmware update utility version 5.70.04 and a set of the most current router product manuals. The HP update kit part number is 5062-9561.

Advanced Topics

Product Note

Firmware Updates to HP Hubs, Bridges, and Routers

HP EtherTwist hubs (including the HP 28699A, 28688A/B, 28692A, 28682A), bridges (HP 28673A, 28674A/B), and routers (HP 27285A, HP 27286A) contain firmware that can be updated without physically replacing the ROM or EPROM. Usually, firmware updates to HP hubs and bridges are associated with the network management agent firmware. Updates to HP router firmware are associated with the router operating system. In order to be managed by HP OpenView Interconnect Manager/DOS (HP 27256D) or HP OpenView Hub Manager/DOS (HP 28686D), all HP hubs, bridges, and routers must be updated if the firmware is not version D.01.xx.

The Agent Upgrade program is a software program that is used to download firmware to HP hubs, and bridges. The Agent Upgrade program runs on a PC or an HP Portable Plus under DOS.

The "Network Management Agent Update Software" is shipped with the HP OpenView Interconnect Manager/DOS (HP 27256D) and the HP OpenView Hub Manager (HP 28686D) products. The disk contains the Agent Upgrade program plus the valid (most current) firmware code version for HP EtherTwist hubs, bridges, and routers.

You can also obtain a copy of the Agent Upgrade program and firmware from HPNN and CompuServe. (See the Product Note—"Software Update Access for Firmware and Drivers" for details.)

The files included with Agent Upgrade program include:

- `\README.TXT`, contains instructions for using the program
- `\RELEASE.TXT`, contains firmware revision history
- `\UPDATE.EXE`, contains Agent Upgrade executable program
- `\HPxxxxxx\UPDATE.BIN`, contains the HP product's firmware, version D.01.xx

The "HPxxxxxx" will vary depending upon which product is being updated. For example, if the HP 28682A Fiber-Optic Hub Plus is to be updated, the binary file containing the new hub firmware code (D.01.xx) would be under the \HP28682A subdirectory.

Save your Current Configuration

Whenever you perform a firmware update to a Hub Plus or bridge, you should first save the device's current configuration (which is stored in the firmware) by using the Interconnect Manager/Hub Manager's Upload command. This command will save all the configuration parameters you have defined on your hub or bridge (except for its password, IP configuration parameters, and the Interconnect/Hub Manager system strings—system contact, system name, and system location.)

See the Product Note on "Saving your Router Configuration" for information on saving your router's configuration.

How to Use the Agent Upgrade Program

To update the firmware in your Hub Plus, bridge, or router perform the following steps:

1. Notify all users connected to the hub/bridge/router to be updated. (During the firmware updating process, the hub/bridge/router will be inaccessible to the network.)
2. Check the CONFIG.SYS file on your PC for the ANSI.SYS driver. This driver must be in your CONFIG.SYS file before you can run the Agent Upgrade program. For example, if the ANSI.SYS driver is in the C:\DOS directory, the line in your CONFIG.SYS file would be:

   ```
   DEVICE = C:\DOS\ANSI.SYS
   ```

3. Make a cable connection between the console port of the hub/bridge/router and the console (RS-232-C) port of your PC (or HP Portable Plus). You can use a direct cable connection or a modem connection.
4. The Agent Upgrade program has several options that you may choose. If you choose not to use any options, the program may prompt you for some necessary information. The program options are as follows:

   ```
   update [-c com port] [-b baud] [-f] [-u]
   ```

   - `-c` which COM port (1,2, or 3) to use. 1 and 2 are the only valid options for a PC. COM3 is the internal modem on an HP Portable Plus. Default is 1.
   - `-b` baud rate (300, 1200, 2400, or 9600) if using modem. Default is 9600.
   - `-f` performs 19,200 baud rate download for routers only. Routers must be at 9600 baud to download at 19,200; switches back to 9600 when done.
   - `-u` user-specified download file name. This option is provided for future multiple download versions for the same type of device.

   The Agent Upgrade program will provide further instruction on the screen.
5. If you are downloading directly (no modem), insert the "Network Management Agent Update Software" disk in drive A of your PC and type:

   ```
   a:
   cd \
   update
   ```

6. If you are downloading over a modem, insert the "Network Management Agent Update Software" disk in drive A of your PC and type:

```
a:
cd \
update -b baud
```

   Baud is the baud rate the modem is set to. Valid speeds for the update utility are: 300, 1200, 2400, and 9600 baud. Substitute the appropriate rate (for example, `update -b 1200`).

7. Follow the Agent Upgrade program instructions that appear on your screen.

8. If the download completes successfully, the following message is displayed:

   `"Firmware update completed successfully"`

   If the download fails, retry.

Restore your Hub/Bridge Configuration

To restore your hub/bridge's original configuration, use Interconnect/Hub Manager's Download command. Remember to set a password, the IP parameters (if necessary), and the Interconnect/Hub Manager system strings—system name, system contact, and system location.

Caution

A few HP 28688A EtherTwist Hub Pluses (older "A" version products) may not complete the firmware update process successfully. Check for the following two symptoms:

- While using the Agent Upgrade program on the hub, the "white bar" indicating forward progress will consistently stop at the same point. The following error message is reported:
  `Updating...Download Failed, Errors occurred during update.`
- The second symptom will occur (if the firmware update failed) when you access the hub's console port command menu. The upper left corner of the screen will display:
  `"No Download Code"`

Try to download again. If you experience both of these symptoms repeatedly, contact your local Hewlett-Packard authorized dealer or Hewlett-Packard service representative for further information.

Even though the firmware update did not complete, the hub retains its repeater capability to pass network traffic. Link Beat and all hub ports can be enabled/disabled via the console port. If a firmware update does not complete, the HP 28686D Hub Manager/HP 27256D Interconnect Manager cannot be used to manage the hub. Additionally, a portion of the hub's console port commands become unavailable.

Network Download

There is a new update function provided in the "D" version of HP OpenView network management that allows you to use the network to download agent firmware into any HP Hub Plus or bridge. For any future agent firmware upgrades to hubs or bridges, say E.01.xx or later, you can use your network management station to update your hub's and bridge's agent firmware over the network from a single point. It is not necessary for you to use the hub/bridge console port to download firmware upgrades.

Advanced Topics

Product Note

Console Port Configuration Questions and Answers

With the exception of the HP 28691A EtherTwist Hub/8 and the HP 28681A 10:10 LAN Bridge LB, all HP hubs, bridges, and routers have a console (RS-232) port. The console port can be used to configure HP EtherTwist devices, and is also used for out-of-band management. That is, you can view statistics and counters on HP EtherTwist devices. Here are some common questions and answers on the console port.

Q. Can I access other hubs/bridges on the network from one hub's console port connection?

A. No. You can access only the hub/bridge that you are physically connected to. Accessing more than one hub/bridge on a network from a single point can be done only from a network management station.

Q. Can I access other routers on the network from one router's console port connection?

A. Yes, as long as the other routers on the network have the Telnet function and IP services configured. You can establish a Telnet session to any router on the network.

Q. What modems can I connect to the console port?

A. The console port supports modem speeds of 300, 1200, 2400, 4800, and 9600 baud. The console port works with Bell 212, V.22, and V.22BIS standards and has been tested with these modems:

- Black Box V.32 (9600 bps)
- Hayes 1200 Smartmodem - HP 92205A (300/1200 bps)
- HP 37212B Support Link (300/1200/2400 bps)
- Racal Vadic MAXWELL 2400 VP (300/1200/2400 bps)
- HP 50759A Support Link (300/1200/2400 bps)
- HP 35031A Support Link II (300/1200 bps)

See the hub's, bridge's, or router's manual for modem configuration details.

Q. What kind of terminals can I connect to the console port?

A. For HP hubs and bridges, any terminal that can communicate using the ASCII TTY driver mode can be connected to the console port. (A PC emulating an ASCII terminal can also be used.)

Some specific terminals that have been tested are:
- HP 262X HP Series 700
- VT100
- WYSE 50/60
- TVI 900 Series

For HP routers, use an ANSI or VT100 terminal (or PC emulating an ANSI or VT100 terminal).

Q. How should my terminal be configured when being used to connect to the console port?

A. For ASCII terminals connected to an HP hub/bridge console port, the following configuration should be used:
- 8 bits/character
- 1 stop bit
- no parity
- Xon/Xoff handshaking
- baud rate of 9600 or less

For ANSI or VT100 terminals connected to an HP router console port, the following configuration should be used:
- screen size of 24 lines
- 8 bits/character
- 1 stop bit
- no parity
- Xon/Xoff handshaking
- baud rate of 57600, 38400, 19200, 9600, 4800, 2400, 1200, or 300

HP routers will auto-sense the baud rate that you are using on the console port.

Q. Which console port cables should I use?

A. To connect a terminal or PC to the console port, you can order the following RS-232-C "crovssover" cables:
- HP 13242G or HP 40242G (25-pin female)
- HP 13242H (25-pin male)
- HP 24542G (9-pin male)
- HP 92221P for HP 110 (9-pin female)

To connect a mode to the console port, you can order the following RS-232-C "straight-through" modem cables:
- HP 13242M, HP 13242N, or HP 17355M (25-pin female)
- HP 31391A (25-pin male)

Advanced Topics

Product Note

Long Cable Option on the HP 28685B EtherTwist Transceiver

The HP 28685B EtherTwist Transceiver has a "Long Cable" switch that allows the transceiver to be used with high-grade, low-crosstalk twisted-pair cable in lengths over 100 meters. The factory setting is DISABLE. When the Long Cable switch is set at DISABLE, the transceiver operates at standard 10Base-T levels, and can typically support a distance of 100 meters of unshielded twisted-pair (UTP) cable.

When the Long Cable switch is set to ENABLE, the receiver threshold is lowered by 4.5 dB, allowing the transceiver to be used over extended lengths with high grade, low-crosstalk cable.

In order to use the Long Cable option, there are two requirements:

1. The device on the other end of the twisted-pair cable must have the same Long Cable capability. The Long Cable function is currently available only on HP 28685B EtherTwist Transceivers.
2. The UTP cable must have crosstalk attenuation greater than 25 dB.

The following chart shows the cable specifications and distances used for standard 10Base-T operation and for Long Cable operation. Level 3 cable is a term used to describe UTP cable that meets the standard 10Base-T cable specifications. Level 4 cable has different specifications for high performance UTP cable (as shown in the following table).

As cable type and specifications differ, the actual distance limit varies from one cable manufacturer to another. The HP 28687A Wire Test Instrument can be used to measure the signal attenuation (at 5-10 MHz) on the cable between the devices, as well as the near-end crosstalk attenuation.

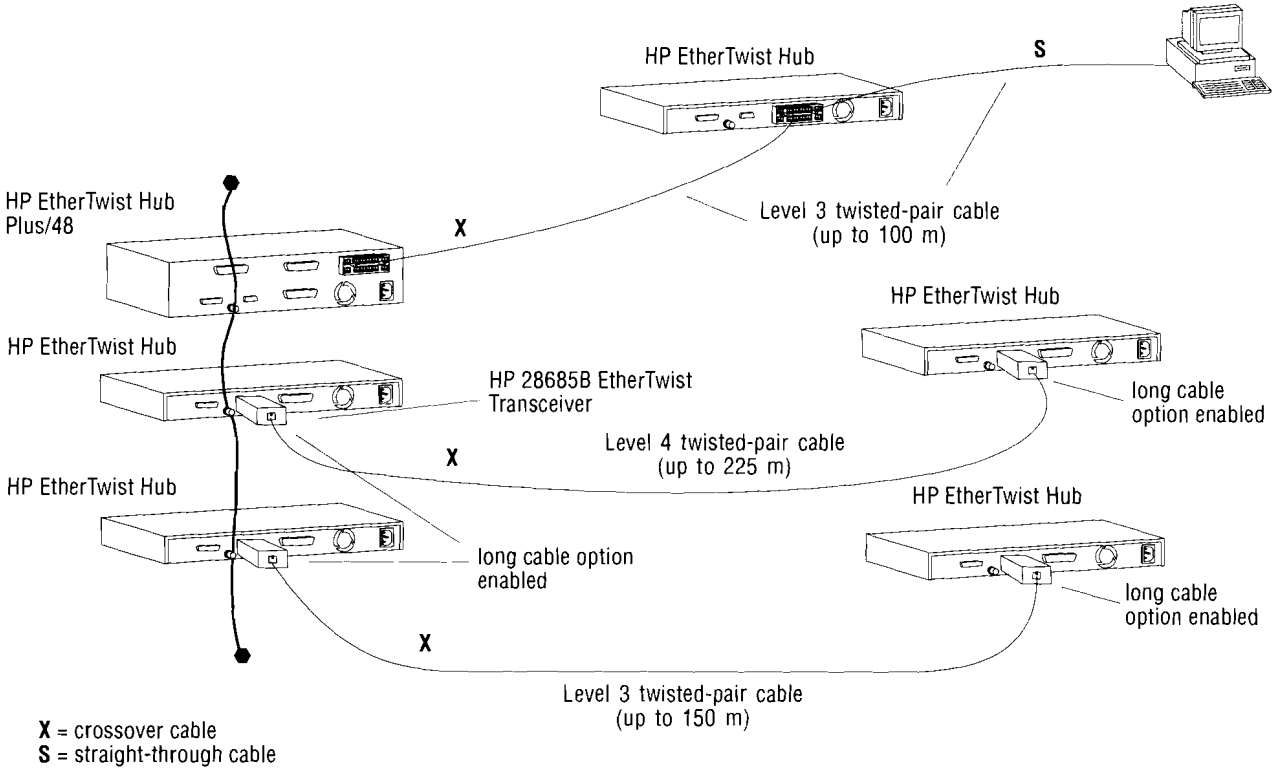
	Standard 10Base-T Limits (Level 3 cable)	Long Cable Limits (Level 4 cable)
HP EtherTwist Transceiver configuration	Long Cable enabled	Long Cable enabled
Signal attenuation between devices	< 11.5 dB	< 16 dB
Near-end crosstalk attenuation	> 23 dB	> 25 dB
Maximum cable distance *	up to 150 meters	up to 225 meters

* Note that these cable distances are specified for Level 3 and Level 4 UTP cable distances that are used only between two HP 28685B EtherTwist transceivers, each with the Long Cable option enabled.

You can also use Level 3 and Level 4 UTP cable between two HP EtherTwist transceivers with the Long Cable option disabled. The maximum length would be 100 meters. That is because the transceivers are operating at levels specified for the 10Base-T standard.

Since the Long Cable option is currently available only on HP 28685B EtherTwist transceivers, you can use long Level 4 UTP cables (up to 225 meters) only between two HP 28685B transceivers. Remember to cross over the transmit and receive pairs on the UTP cable between two transceivers. 225 meters of Level 4 cable cannot be used between the following devices:

- Two EtherTwist hubs
- One HP 28685B EtherTwist transceiver and one EtherTwist hub
- One EtherTwist hub and a PC LAN adapter



Advanced Topics

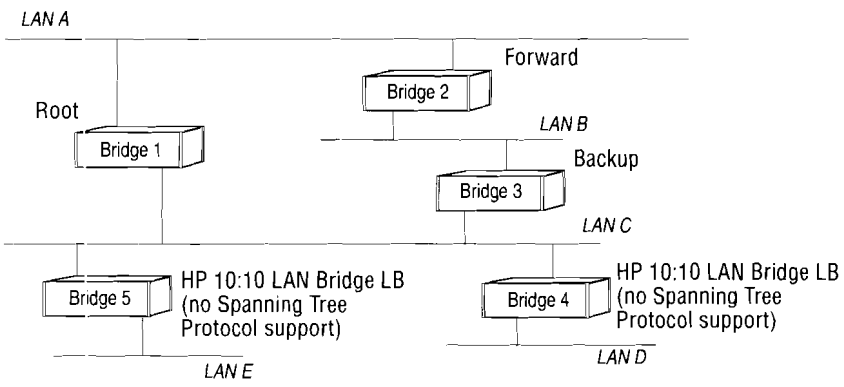
Product Note

Spanning Tree Protocol Support on HP Bridges

The HP 28673A 10:10 LAN Bridge MB and HP 28674A Remote Bridge RB both support the IEEE 802.1 Spanning Tree Protocol (STP). Note that the HP 28681A 10:10 LAN Bridge LB does not support STP. If the network topology contains loops, you will need to enable STP on all bridges in the loops' path. HP bridges are shipped from the factory with the operating state: Learning, (no STP).

STP ensures that there is only one active path between any two nodes in the network. If STP is not enabled in a network with loops, packets will be forwarded continuously around the loop until the network becomes overloaded and fails.

The following example shows how STP works in a network topology containing loops. Bridges not in the loop's path are not required to have STP enabled. Also, bridges that do not support STP can be used outside the loop as shown in the example.



Bridge 1 (also the root bridge, explanation following) provides the active path between LAN A and LAN C. Bridge 2 is a forwarding bridge, and provides the active path between LAN A and LAN B. If Bridge 1 or the active path between LANs A and C fails, then Bridge 3 automatically becomes a forwarding bridge. Together with Bridge 2, they form an alternative, or backup path for traffic between LANs A and C. Since the root bridge (Bridge 1) failed, the STP will automatically determine which bridge in the network will become the new root bridge.

STP Explanation

All bridges with STP enabled communicate with each other by exchanging "hello" packets. Note that bridges not in the loop or bridges with STP disabled will ignore the STP hello packets. The Spanning Tree Protocol works by selecting a root bridge as a reference point and then determining active network paths relative to the root bridge. The selected active paths are those that provide the lowest root path cost from each LAN to the root bridge while maintaining a loop-free topology. The root path cost takes into account the number of hops along the path, favoring paths with fewer links, as well as the speed of the links in the path, favoring higher speed links.

Root Bridge. There is only one root bridge in the network. This bridge forwards traffic between the two networks it connects. It is the starting bridge for determining which of the other bridges in the network are forwarding bridges and which are backup bridges.

Forwarding Bridge. These bridges forward traffic between the networks they connect.

Backup Bridge. Backup bridges are held in reserve and do not forward traffic. If a forwarding bridge fails, the bridges will use STP to automatically reconfigure themselves. As a result, a backup bridge may become a forwarding bridge. When a bridge is functioning as a backup bridge, all received packets (except those explicitly addressed to the bridge) are discarded. That is, it operates in the learning mode and builds/maintains an address table, but does not filter or forward packets on the network.

The IEEE 802.1 standard, for Spanning Tree Protocol support, recommends that there be no more than seven forwarding bridges in the active path between any two nodes in the network. For HP Remote Bridges, this means that there should be, at most, three WAN links (with a remote bridge at each end) in the path.

The actual limit for your network depends on the amount and type of traffic being transmitted. With careful network and traffic analysis, the number of bridges could be higher.

The HP bridges are pre-configured with the IEEE recommended values for the STP parameters. To extend your network beyond the seven-bridge limit without encountering errors due to excessive transmission time, you may need to modify the STP parameters. Such modification can be performed through HP OpenView Interconnect Manager/DOS.

Routers with Bridge Function

HP routers with the learning bridge service also support the IEEE 802.1 Spanning Tree Protocol. As compared to the HP bridges with two network ports, the HP Router ER has four network ports (the HP Router TR has three) that can be configured with the learning bridge function. HP routers can provide redundant paths. In the event of a primary link failure, a backup link takes over, thereby ensuring continued data transmission between all reachable network segments.

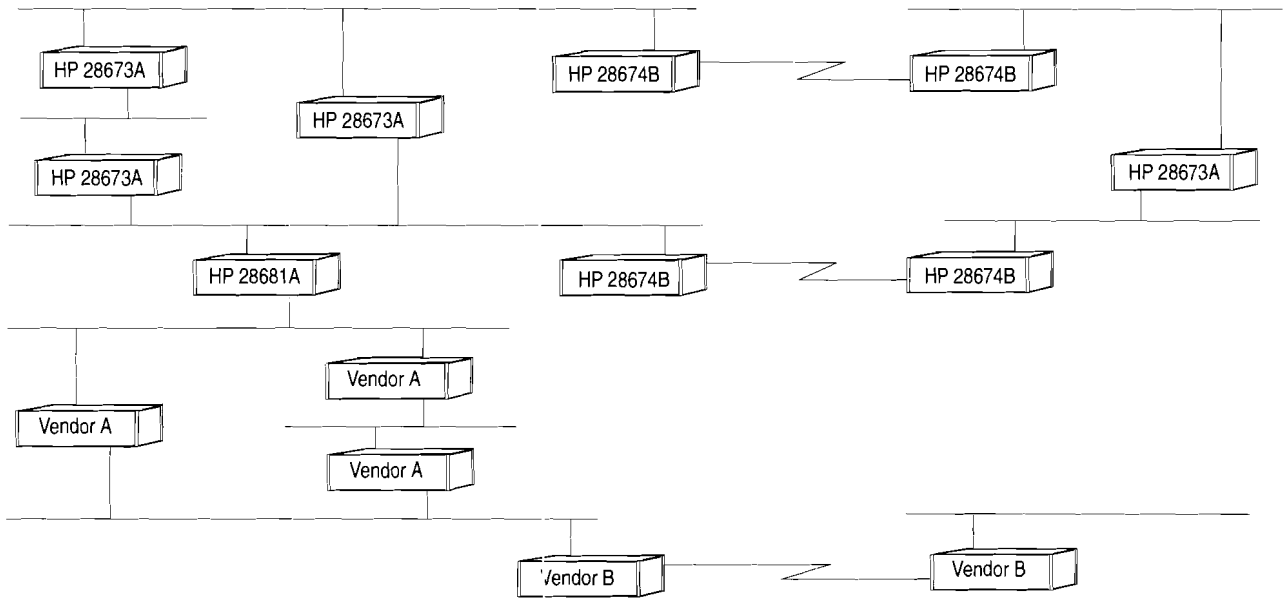
Advanced Topics

Product Note

Mixing Bridges in a Spanning Tree Configuration

If you wish to have a redundant path (or parallel path) as a backup for your network (via Spanning Tree Protocol), you should always use bridges from the same vendor in the network loop.

For example, if you have various vendors' bridges and your network topology contains loops, it is recommended that you group like vendor bridges together in the same loop. The reason for this is that STP implementation may vary between vendors. To avoid network problems in the redundant path, it is best that bridges from the same vendor communicate with each other. The example below shows how different bridges can co-exist in redundant paths.



Advanced Topics

Product Note

Bridge Operating State and Address Table

Bridge Operating State

The HP 28681A 10:10 LAN Bridge LB has one operating state: Learning. The HP 28673A 10:10 LAN Bridge MB and the HP 28674A Remote Bridge RB have five possible operating states:

- Learning
- Learning/STP
- Secure
- Secure/STP
- Bridge off

The default operating state is Learning (no STP). For the "MB" and "RB" bridge, the current operating state can be changed through the bridge console interface, or through HP OpenView Interconnect Manager/DOS (HP 27256D).

Learning. The bridge automatically learns the addresses of the nodes communicating through the bridge and which side of the bridge each node is on. The bridge learns the node addresses from the source address fields in the packets it receives. It learns which side the node is on by noting which port receives the packet. The bridge adds entries to the bridge address table for each new address it sees.

Learning/STP. The bridge functions the same as under the Learning operating state, and it supports the Spanning Tree Protocol (STP). With STP, the bridge can operate as a backup bridge (or provide backup ports) in a network with multiple possible paths between nodes on the LANs.

Secure. The bridge allows communication only between those nodes whose addresses are manually entered in the address table (static addresses).

Secure/STP. The bridge functions the same as under the Secure operating state, and it supports the Spanning Tree Protocol (STP).

Bridge Off. The bridge discards all received packets except for those packets that are explicitly addressed to the bridge (for example, HP OpenView Interconnect Manager/DOS packets). Use this operating state when you are performing certain diagnostic tests on the bridge.

Bridge Address Table

Bridges identify nodes on a network using station addresses. (A station address is also commonly called MAC address, Ethernet address, or physical address.) Station addresses are unique and are set by the network equipment manufacturer for each network device (such as a hub, bridge, etc.) When a bridge receives a packet, it examines the source and destination station addresses and uses this information to create and update an address table and to determine how to process the packet. The address table keeps track of which nodes are located on which side (through which port) of the bridge and is kept up to date automatically by the bridge.

Dynamic Addresses. Dynamic addresses are the node addresses that the bridge learns after it is connected to the network. These addresses are used to prevent the bridge from forwarding packets to the opposite LAN when the source and destination nodes are on the same LAN.

Permanent Addresses. These addresses come pre-configured into the address table and cannot be deleted or changed. The HP 28681A 10:10 LAN Bridge LB has one permanent address table entry in its table, the network broadcast address, FFFFFF-FFFFFF.

The HP 28673A 10:10 LAN Bridge MB and the HP 28674B Remote Bridge RB have 20 permanent addresses if STP is enabled on your bridge (bridge operating state is Learning/STP or Secure/STP). If not, there are 19 permanent addresses. These permanent addresses include the bridge MAC address (or station address), specific broadcast and multicast addresses, spanning tree broadcast addresses, and reserved 802.1 addresses. Packets with broadcast addresses are forwarded. Packets with the 802.1 addresses are discarded. Packets with other permanent addresses are used by the bridge for various network management purposes. The bridge operating state has no effect on the handling of packets with these addresses.

Static Addresses. Static addresses are entries that you manually add to the address table. (Note that static addresses only apply to the HP 28673A 10:10 LAN Bridge MB and the HP 28674B Remote Bridge RB.) Static addresses remain in the address table until you intentionally delete them. The effect of these addresses varies depending on the operating state of the bridge:

- In learning mode (either Learning or Learning/STP operating states), you add static entries to the table to prevent communication to specific nodes. In learning mode, if a packet is received with a destination address that matches a static entry in the address table, the packet is discarded. *In learning mode, there is a limit of 256 static entries.*
- In secure mode (either Secure or Secure/STP operating states), you add static entries to the table only for those nodes allowed to communicate across the bridge. In secure mode, a packet will be forwarded only if it has both source and destination addresses that match address table static entries. *In this mode, the limit of static entries is the total table size (512) minus the number of permanent entries.*

Address Table Size

The HP 28673A 10:10 LAN Bridge MB address table can hold up to 512 entries. Each entry contains a station address (also known as MAC address or Ethernet address), the port ID associated with the station address, and an indication of the type of address it is: dynamic, permanent, or static. Address table changes can be made through the bridge console interface or through HP OpenView Interconnect Manager/DOS (27256D).

The HP 28681A 10:10 LAN Bridge LB address table holds up to 256 addresses. One of these addresses is the network broadcast address, FFFFFF-FFFFFF. This address is a permanent entry in the table. The other 255 table spaces are for dynamic or learned addresses.

Address Table "Aging"

Aging is a function in the bridges that clears out entries in the address table every 300 seconds (5 minutes). That is, an address is "aged out" of the table if the bridge does not receive any packets from that address for 5 minutes (300 seconds). Aging helps to assure that the address table accurately reflects a current list of the active nodes and their locations in the network. To illustrate this point, consider an address table that never aged. Once a node address location was learned, it would stay in the table forever. If that node was then physically moved to the other side of the bridge, the bridge would be very confused because, according to its table, it would still think that the node was in its original location (on the "first" side of the bridge). This would mean that no nodes could talk to that moved node from the other side of the bridge. If the moved node then transmitted, the bridge would see that node on the new (correct) side, but now that node would be entered in the table as existing on both sides of the bridge. Consequently, packets would be unnecessarily forwarded. This could create LAN problems. One of the safeguards against this scenario is to "age out" individual addresses after five minutes of inactivity.

If the address table is full, packets will still get forwarded. Data is never lost. On the HP 28681A 10:10 LAN Bridge LB, a full address table means that within the previous five minutes the bridge has seen packets from at least 255 different nodes on the two attached LAN segments. On an HP 28673A 10:10 LAN Bridge MB or HP 28674B Remote Bridge RB, a full address table means that the bridge has seen packets from at least 492 (512 minus the permanent entries) different nodes within the previous five minutes.

When the address table is full, a pointer begins cycling through the table starting with the oldest address. When a packet with an unknown source address is received, the address currently pointed at is removed from the table to make room for the new address.

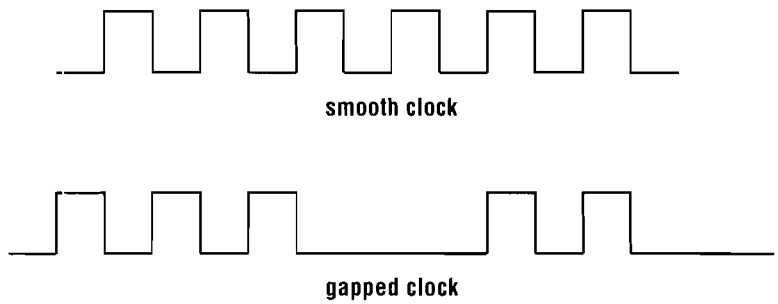
As soon as the table entry ages out, leaving room in the table, the pointer stops cycling. New addresses are added to the table in place of the addresses that age out. If the table fills up again, the pointer resumes cycling starting from the address where it stopped before.

Advanced Topics

Product Note

DSU/CSU Gapped Clocks with HP Routers and Remote Bridges

The clock signals sent from DSU/CSUs (to routers or remote bridges) are either gapped or smooth. A smooth clock is one in which a rising clock signal edge occurs every 1/line rate, or example, 1/56000th second. A gapped clock is one that has brief periods of time in which no clock signals are present. When clock signals do occur they are faster than the actual line rate, for instance, at the rate of 64000 per second. However, there are never more than the line rate number of clock signals every second.



An article in the April 1991 issue of "Data Communications" warned of possible problems for remote bridges and routers when used with DSU/CSUs with gapped clocks.

The SGS-Thomson MK5025 WAN link controller used in the HP Routers and HP Remote Bridges is designed to be used with DSU/CSUs regardless of whether smooth or gapped clocks are used. Therefore, HP Routers and HP Remote Bridges will operate properly regardless of whether smooth or gapped clock signals are sent by the DSU/CSU.

Advanced Topics

Product Note

Saving Your Hub and Bridge Configurations

Saving a copy your hub or bridge configuration can be useful in the following instances:

- Before you update the revision of your hub/bridge firmware, keep a current copy in case something goes wrong with the update.
- If you have multiple hubs or bridges that share the same configuration, downloading a copy of the configuration file into each hub/bridge will save you time.

Upload

HP OpenView Interconnect Manager/DOS provides the upload function that allows you to save the current configuration of your HP hub or bridge (that is stored in flash EEPROM or battery-backed static RAM, respectively). The Upload command will save all the configuration parameters you have defined, except the password, IP configuration parameters, and HP OpenView network management systems strings (such as system name, system contact, and system location). The configuration file is saved as a .CFG file in your network management station.

Download

To restore the hub/bridge's configuration parameters, use the HP OpenView Interconnect Manager/DOS Download command. Remember to define a unique password, IP parameters (if needed), and network management system strings for each hub or bridge.

Config-Clear Reset on HP Bridges

One of the four bridge reset mechanisms that is noteworthy is the Config-Clear Reset. (This is different from using the Clear button to delete your bridge password.) Note that the Config-Clear Reset function is available only on the HP 28673A 10:10 LAN Bridge MB and the HP 28674B Remote Bridge RB. If for some reason (for example troubleshooting the bridge) you need to perform the Config-Clear Reset, you should first save your bridge configuration by using the HP OpenView Interconnect Manager/DOS (27256D) Upload command.

Caution: One of the effects of the Config-Clear Reset is that it erases the changes you have made to the bridge configuration (including address table entries, any wildcard filters, and bridge operating state.) It restores to the bridge all the default (factory-set) configuration values.

It also affects any updated firmware code that resides in the battery-backed RAM. If you have previously downloaded a new version of firmware into your bridge and you performed a Config-Clear Reset, you must download the new version of firmware again. Unlike the bridge configuration parameters, you cannot save firmware execution code by using the HP OpenView Interconnect Manager/DOS Upload command. The Upload command can save only your bridge configuration parameters (such as, bridge password, address table entries, wildcard filters)

Pressing the bridge's Reset button, cycling power on the bridge, or using the console interface Reset command does not affect updated firmware (in RAM). That is because these reset mechanisms cannot erase the contents of the non-volatile RAM.

To perform a Config-Clear Reset:

1. Simultaneously press the two buttons labeled Reset and Clear on the bridge (located to the left of port 1). The Clear button is recessed (to prevent accidental pressing). To press it, use a non-conducting pointed implement like a toothpick.
2. Release the Reset button while continuing to press the Clear button until the self-test LED begins to flash.
3. Release the Clear button. The bridge proceeds to perform a self-test and then resets itself.

Advanced Topics

Product Note

Saving your Router Configuration or Operating Code

Two NCL (network command language) commands work in conjunction with the Trivial File Transfer Protocol (TFTP) and IP routing to provide TFTP *server* capability for read requests and TFTP *client* capability for read or write requests. This means that you can download the HP router's operating code or configuration from another HP router or host on the network, and can copy its operating code or configuration to a host for storage and later downloading. You can also redirect the output of any NCL command that displays data on the console screen to a file on another host (that supports TFTP). These network transfers operate over any of the router's network interfaces: LAN, point-to-point, or X.25.

The two NCL commands available are:

Command	Function
Fget	Initiate a TFTP read request from a specific host or router for the configuration or operating system.
Fput	Initiate a TFTP write request to a specific host for the configuration or operating system or display command output.

Fget

Use the router console port or the HP OpenView Interconnect Manager/ DOS Telnet command to access the router's console main menu. Use NCL's Fget command with TFTP to download router operating code or a configuration from another router on an attached network, using TFTP. The routers must have IP routing and TFTP configured and enabled. The TFTP parameters can be left at their defaults. You can either configure the TFTP Auto Enable parameter to be Yes, or, for more security, keep Auto Enable's default setting to No and then use NCL's Enable tftp before the Fget command and use Disable tftp after Fget.

Syntax

`fget X.X.X.X os file`
download router operating code

`fget X.X.X.X config file`
download router configuration

`X.X.X.X`
is the IP address of the remote router or host in dotted decimal notation

`file` is one of the following on the remote node:

`-os`	is the operating system code on the HP routers.
`-config`	is the configuration on the HP routers.
`-filename`	is the name of the configuration or operating code file on the remote host.

Examples

```
fget 15.3.0.97 os os
fget 15.3.0.97 config config
```

In response, you will be informed of the progress and successful or unsuccessful completion of the transfer.

To download operating code, you will first be asked to enter the current router password (if a password exists), and to verify that you want the EEPROM changed. If downloading the operating code fails, the router will be operating as a learning bridge (by default) and most of the protocols and circuits will be disabled; only the circuit used for TFTP will remain enabled. After downloading the operating code is successfully completed, the router will automatically reboot and burn the new code into EEPROM (which may take five minutes), and all of the protocols and links will be disabled momentarily.

After downloading a new configuration is completed, you may modify it. You must reboot the router for the new configuration to take effect.

Fput

Use NCL's Fput command to copy router operating code, the router's configuration, or the output of an NCL display command (for example, Help, Time and Date with no arguments, Summary, Browse, Config, Crash, Stamp, Log, List, Get, or a command beginning with Rget) to a file on a remote host attached to the network using TFTP. You cannot use Fput to put the operating code or configuration on another HP Router ER or TR; Fget must be used from the other router. The local router must have IP routing and TFTP configured. TFTP parameters can be left at their defaults. If you keep Auto Enable's default setting to No, then you can use NCL's Enable tftp command before the Fput command and use Disable tftp command after Fput, for more security.

Syntax

`fput X.X.X.X os filename`
transfer router operating system code

`fput X.X.X.X config file`
transfer router configuration

`fput X.X.X.X NCL-command filename`
store display command output

`X.X.X.X` is the IP address of the remote node in dotted decimal notation

`filename` is the name of a file on the remote node to store the output from this router. Some TFTP servers on remote nodes require that the file already exist.

`NCL-ccmmand` is an NCL display command string on this router. Possible commands are listed above. If the command has parameters and thus includes a space, then enclose the command string in double quotes.

Examples

```
fput 15.3.0.97 os rok
fput 15.3.0.97 config account.cfg
fput 15.3.0.97 "browse"er1cfg.txt
fput 15.3.0.97 "rgetr10.1.2.1 public" er1table.txt
```

In response, you will be informed of the progress and successful or unsuccessful completion of the transfer. All protocols and links on this router remain enabled.

Using PC Modem Access to Transfer Configuration and NCL Data Display

With an IBM-compatible personal computer (PC host) connected to the HP router's console port, the NCL commands Zput and Zget use the Zmodem protocol to do the following:

- Copy a router configuration to the PC host for storage.
- Copy a router configuration from the PC host to the original router or to other routers.
- Copy the displayed output of certain NCL commands into a PC host file.

The PC must be operating as a VT100 or ANSI terminal, and can be connected either directly or via a modem to the router's console port. Also, the PC must be running a Zmodem-compatible terminal emulation program such as PROCOMM PLUS. (PROCOMM PLUS is a product of Datastorm Technologies, Inc.)

Command	Function
Zput	Copies NCL command output and the router configuration from the router to a PC console file. That is, Zput copies to a PC file either the router configuration or the output of an NCL command that normally writes data to the console display.
Zget	Copies a router configuration from a PC console file to the router.

For examples and additional information on Zput and Zget commands, refer to the router operator's guide.

Recommended Hardware Connections

For a direct connection between the PC host and the router, use an HP 24542G serial cable.

For a modem connection, use an HP 24542M serial modem cable to connect the PC host to its modem, and an HP 17355M serial modem cable to connect the router console port to its modem.

Advanced Topics

Product Note

Setting Network Security with HP Bridges

HP bridges (HP 28673A 10:10 LAN Bridge MB, HP 28674B Remote Bridge RB) provide three unique ways to add security to your networks:

- Adding static entries in the bridge learning mode
- Using the bridge secure mode
- Using the bridge wildcard filters.

This level of security is implemented at the data link layer (layer 2 of the OSI model). This means that the bridge observes a packet's station address (or any portion of the data packet) and operates independently of higher-level protocols. Note that the security functions are not available on the HP 28681A 10:10 LAN Bridge LB.

Static Entries in Bridge Learning Mode

HP bridges provide five possible bridge operating states. They are: Learning, Learning/STP, Secure, Secure/STP, OFF. The "/STP" designation means that Spanning Tree Protocol is enabled in that operating state.

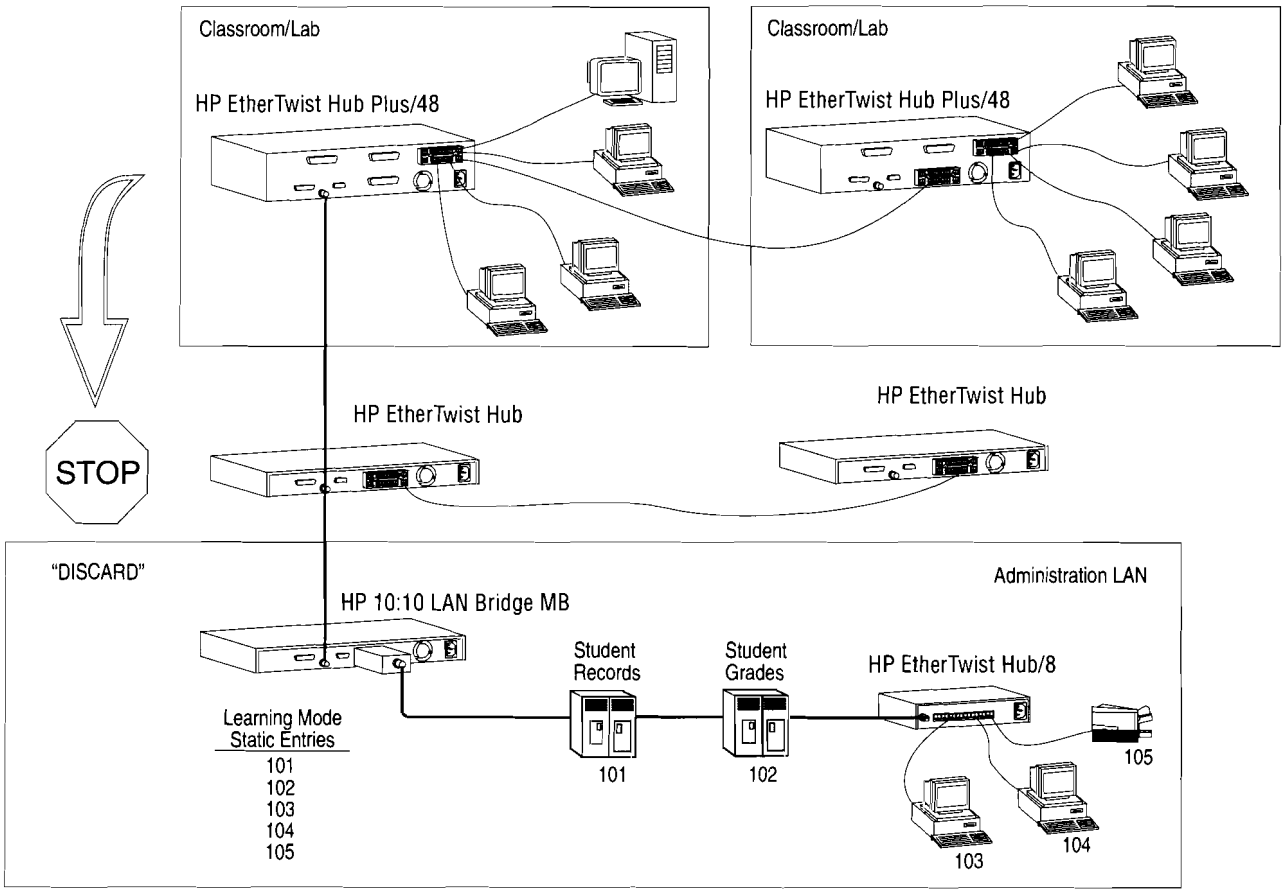
Using either the bridge's console port or HP OpenView Interconnect Manager/DOS (HP 27256D), you can add static entries to the bridge address table to prevent communication to specific nodes. Static entries are station addresses that you manually add to the address table. These addresses remain in the address table until you intentionally delete them.

In the learning operating states, the bridge will automatically learn the addresses of the nodes communicating through the bridge and which side of the bridge each node is on. The bridge learns the node addresses from the source address fields in the packets it receives. It learns which side the node is on by noting which port receives the packet. The bridge adds entries to the address table for each new address it sees.

When you add static entries to the bridge address table in learning mode, the destination address of a received packet is compared with the static entries. If the packet's destination address matches a static entry in the address table, the packet is discarded.

The figure below illustrates an example of using static entries in the bridge's learning mode. To prevent any student from accessing the school's administration records, a bridge separates the administration's network from the campus backbone. The bridge is configured for the learning operating state and the station address of the administration computers are added as static entries into the bridge address table.

In this example, the station addresses of the administration computers are 101, 102, and 103. (For illustration purposes, these numbers represent a 12-digit hexadecimal station address.) Enter 101, 102, and 103 as static entries in the "ADMIN" bridge's address table. If any students try to reach any of these destination addresses, their packets (requests) will be discarded by the bridge.



Bridge Secure Mode

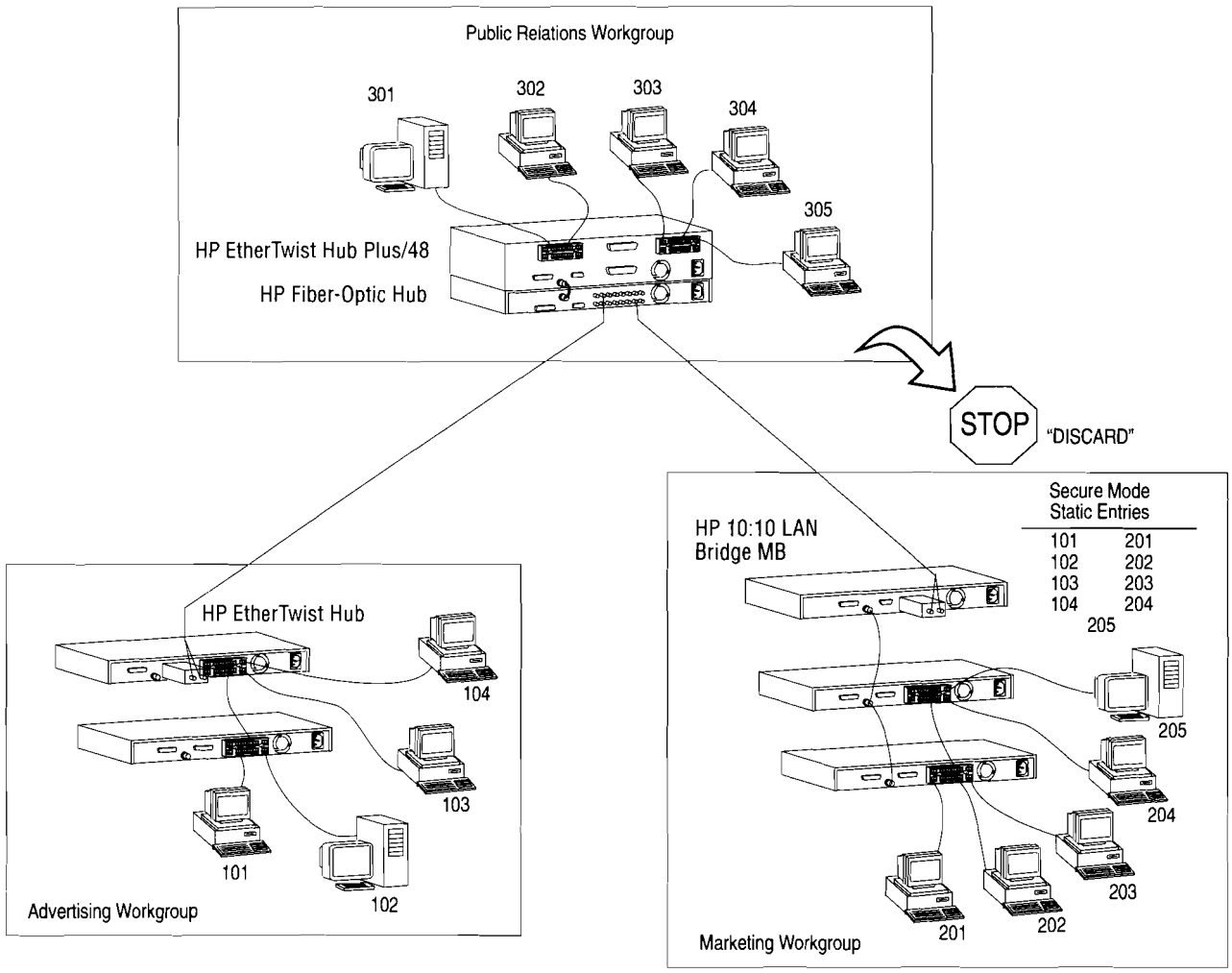
Using either the bridge's console port or HP OpenView Interconnect Manager/DOS (HP 27256D), you can choose the bridge Secure or Secure/STP operating state. (The default bridge operating state is Learning.)

Once you've chosen the secure mode, then you can add static addresses to the address table for those nodes allowed to communicate across the bridge. A packet will be forwarded only if it has both source and destination addresses that match static entries in the address table. Static entries are station addresses that you manually add to the bridge's address table. These addresses remain in the address table until you intentionally delete them. The exception is multicast and broadcast traffic. Even though multicast and broadcast packets don't specify a destination address, they are forwarded by the bridge.

In the example following, you want only the advertising workgroup to have access to the marketing information. A bridge is used to isolate the marketing workgroup from the rest of the network. The bridge is configured for the secure operating state and the station addresses of computers on the advertising and marketing LANs are entered as static enters into the bridge address table.

Station addresses 101, 102, 103, 104, 105, 201, 202, 203, etc. are entered as static entries into the address table. (For illustration purposes, these numbers represent a 12-digit hexadecimal station address.)

If a user at station address 302 (from the public relations workgroup) tries to access the marketing files, the bridge will not allow any information to cross the bridge. That is because the station address entry (302) is not in the bridge's address table.


Public Relations Workgroup
301
302
303
304
305
HP EtherTwist Hub Plus/48
HP Fiber-Optic Hub
STOP
"DISCARD"
HP EtherTwist Hub
104
103
101
102
Advertising Workgroup
HP 10:10 LAN
Bridge MB
Secure Mode
Static Entries
101 201
102 202
103 203
104 204
205
205
204
203
201
202
Marketing Workgroup

Using Wildcard Filters

The wildcard filter allows the bridge to filter out certain packets. That is, the received packet is discarded if it matches the wildcard filter's binary pattern.

The filter can be applied to any section of an IEEE 802.3 or Ethernet packet: source or destination addresses, packet length (for 802.3 packets), packet type (for Ethernet packets), data field. Because it is possible to specify patterns within the data fields, wildcard filters can also be used for protocol filtering.

You can specify up to two wildcard filters. The bridge applies each filter to the received packet independently.

Wildcard Filter Explanation

The wildcard filter is specified as a 32-bit binary pattern, followed by a space, followed by the byte offset. The byte offset is the distance in bytes from the beginning of packet to the start of the section where the wildcard filter is to be applied.

The wildcard filter format is:

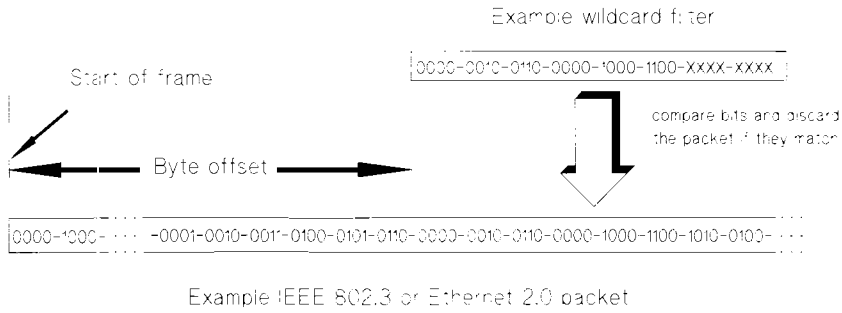
```
bbbb-bbbb-bbbb-bbbb-bbbb-bbbb-bbbb-bbbb NNNN
```

For each bit position b, enter either 1, 0, or X (don't care). At least one bit must be specified as "1" or "0"; up to 31 bits may be don't care ("X").

Enter the byte offset NNNN, a one- to four-digit decimal value. The offset value may range from 0 to 1513 bytes.

The bridge compares the wildcard filter to the bits in the specified section of the packet. The packet is discarded if the bit patterns match.

The bridge has no wildcard filters specified as its default configuration. Note that, because of the extra processing required, the use of wildcard filters may reduce bridge performance slightly.



Example IEEE 802.3 or Ethernet 2.0 packet

Wildcard Filter Examples

The following examples assume that a 48-bit (6-byte) scheme is being used for the address fields in the IEEE 802.3 or Ethernet packets.

Example 1. Filtering on Vendor Code in the Destination Address.

The first three bytes of the station address are consistent for each vendor. For all HP network devices, the first three bytes of the station address are 080009 (in hexadecimal).

The destination address is the first field that is analyzed by the bridge in IEEE 802.3 and Ethernet packets, so the byte offset is 0. (The bridge strips off the Preamble and Start Frame Delimiter fields.)

To use the vendor code in the destination address field to discard packets going to HP network devices, the wildcard filter to enter is:

```
0000-1000-0000-0000-0000-1001-XXXX-XXXX 0
```

The first six 4-bit entries represent 080009 in binary. Note that only the first 24 bits of the wildcard filter's 32 bits are needed to match the vendor code, but all 32 bits must be specified. X's are used for the last 8 bits since a specific match in those bit positions is not needed.

Example 2. Filtering on Vendor Code in the Source Address.

The source address is the second field in IEEE 802.3 and Ethernet packets, so the byte offset is 6.

To use the vendor code in the source address field to discard packets from HP devices, the wildcard filter to enter is:

```
0000-1000-0000-0000-0000-1001-XXXX-XXXX 6
```

Example 3. Filtering on Ethernet "Packet Type".

In Ethernet packets, the third field is a 4-digit hexadecimal number that is used to identify the packet as a specific type. The byte offset for this field is 12. To discard packets that have a packet type of B47D, for example, the wildcard filter would be:

```
1011-0100-0111-1101-XXXX-XXXX-XXXX-XXXX 12
```

The first four 4-bit entries represent B47D in binary.

(A list of packet types and vendor codes can be found in the appendix of the bridge's installation and reference manual.

Advanced Topics

Product Note

Setting Network Security with HP Routers

HP routers (HP 27285A Router ER and HP 27286A Router TR) provide traffic filters to help control information flow in the network for security reasons. For example, you may wish to restrict access to a server in the payroll department from unauthorized users.

There are two different types of filters in the router:
- packet filters
- router information filters

Unlike bridges, the level of security in routers is implemented at the network layer (layer 3 of the OSI model). This means that the router examines the network layer addresses (IP addresses, for example) of each packet.

Packet filters examine all packets passing through the router and discard ones that meet the criteria set by the network designer. Router information filters apply to the information that routers exchange between themselves regarding the configuration of the network. These filters prevent the router from telling other routers all that it knows.

For more information, refer to the *HP Router Reference Guide* for examples on filtering and an explanation on how filters work.

Supported Filters

HP routers support a variety of filters for a particular protocol or a specific need. Here is a short summary of the supported filters.

IP

Global filters for source and destination IP addresses. The addresses can be masked before comparison to filter entire sub-networks or more.

Circuit-group-specific TCP/UDP port number filters. Since TCP/UDP applications typically initiate connections on one particular well known port, this is a convenient way to disallow particular applications.

Import route filters. These are used to ignore routing table information from an untrusted router.

Export route filters. Used to restrict the information that would otherwise be broadcast to other routers from a specific router. Other (untrusted) routers will thus be unable to route packets to networks they don't know about.

IPX

SAP table information. Filter by server name, by network number, or by server type. This reduces the size of SAP updates between routers.

NetBIOS broadcasts. Filter all NetBIOS broadcasts on a per-interface basis, drop broadcasts of specific server names, or direct them over one interface only instead of flooding them out all interfaces. Use this filter to reduce broadcast traffic flooding throughout the network or to hide servers (as the SAP information filters do also).

Learning Bridge

Filter on source station address, destination station address, Ethernet type, protocol id, DSAP/SSAP (IEEE 802.2 Destination or Source Service Access Point), or user-defined field. These filters are assigned on a per-circuit group basis, and all are configured for a range of values from a low bound to a high bound.

Load balancing. This filter directs specific types of packets to a specified circuit.

Future

A future software release will provide "uniform traffic filters" that provide additional filtering capability and a common design across all protocols. Uniform filters extend packet filtering to the AppleTalk and DECnet protocols as well as enhancing the capabilities of packet filtering for IP and IPX.

Advanced Topics

Product Note

HP LaserJet Printers and HP DesignJet Plotters Connected to Hubs

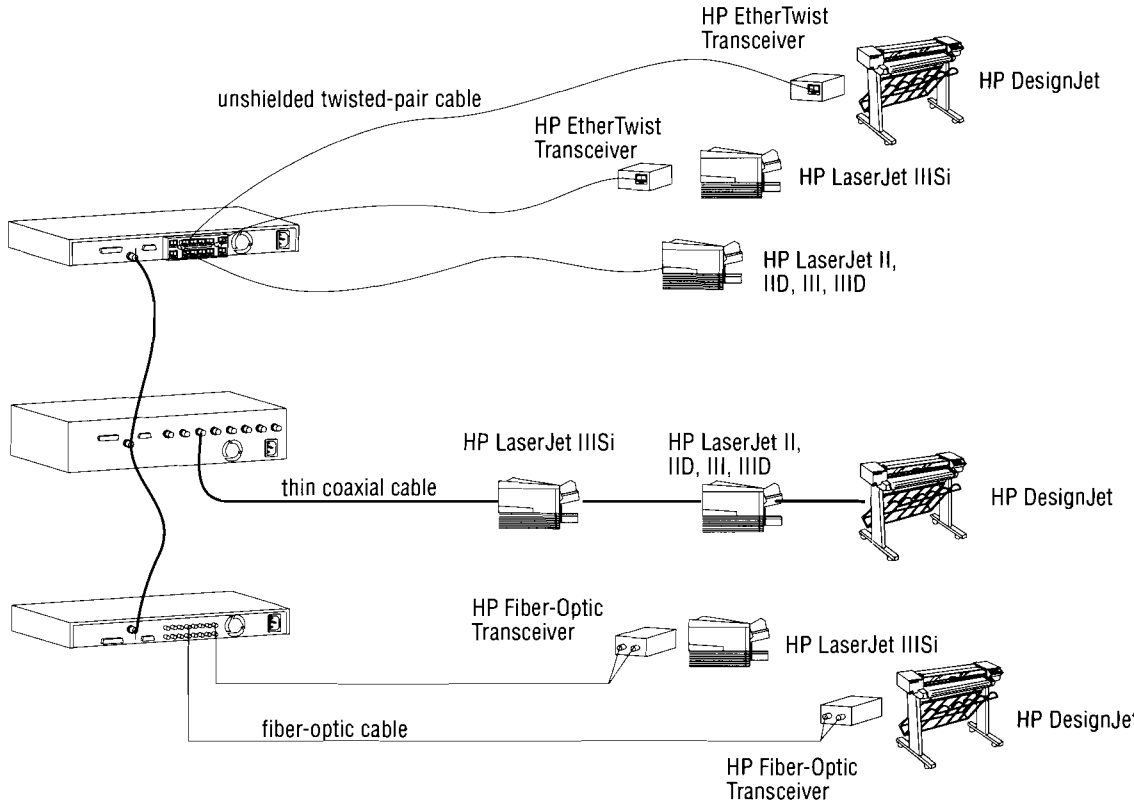
HP LaserJet printers and HP DesignJet plotters can be located anywhere on your network by connecting them to any HP EtherTwist hub, ThinLAN hub, or fiber-optic hub.

HP JetDirect cards provide the LAN interface between the printers/plotters and the network. Software for various popular network operating systems (NOSs) is provided with each HP JetDirect card. See the table at the end of this Product Note for a list of interfaces and software available for HP LaserJet printers and HP DesignJet plotters.

To connect an HP LaserJet IIISi Printer or an HP DesignJet Plotter to an HP EtherTwist hub, ThinLAN hub, or fiber-optic hub, use an HP 28685E EtherTwist Transceiver, an HP 28648B ThinLAN Transceiver, or an HP 28685A Fiber-Optic Transceiver respectively. The transceivers can attach directly to the AUI connector on the printer or plotter's HP JetDirect card.

To connect HP LaserJet II, IID, III, or IIID printers to an HP EtherTwist hub, use an HP JetDirect card with a built-in RJ-45 connector. Unshielded twisted-pair (UTP) cable connects the printer directly to an EtherTwist hub. Similarly, there are HP JetDirect cards with a built-in BNC connector. Use this card to connect HP LaserJet II, IID, III, or IIID printers to an HP ThinLAN hub. Use a BNC "T"connector and attach the thin coaxial cables.

The figure on the next page illustrates the different ways to connect HP LaserJet printers and HP DesignJet plotters to HP hubs.



This table shows the interfaces and software available for HP LaserJet printers and HP DesignJet plotter.

	Product Number	Product Name	LAN Connector
HP LaserJet IIISi printer	C2059A	HP JetDirect Card for Novell NetWare	AUI/BNC (10Base2)
	C2059B	HP JetDirect Card for LAN Manager (3Com 3+Open, IBM LAN Server, Microsoft LAN Manager)	AUI/BNC (10Base2)
	C2059E	HP JetDirect Card for EtherTalk	DIN8
	C2059F	HP JetDirect Card for LocalTalk	DIN8
	C2059T	HP JetDirect Card for UNIX	AUI/BNC (10Base2)
HP LaserJet II, IID, III, IIID printers	C2071B	HP JetDirect Card for Novell NetWare	RJ-45 (10Base-T)
	C2071D	HP JetDirect Card for LAN Manager (3Com 3+Open, IBM LAN Server, Microsoft LAN Manager)	RJ-45 (10Base-T)
	C2071S	HP JetDirect Card for UNIX	RJ-45 (10Base-T)
	C2071A	HP JetDirect Card for Novell NetWare	BNC (10Base2)
	C2071C	HP JetDirect Card for LAN Manager (3Com 3+Open, IBM LAN Server, Microsoft LAN Manager)	BNC (10Base2)
	C2071T	HP JetDirect Card for UNIX	BNC (10Base2)
HP DesignJet plotter	C2059A	HP JetDirect Card for Novell NetWare	AUI/BNC (10Base2)
	C2059T	HP JetDirect Card for UNIX	AUI/BNC (10Base2)

	Product Number	Product Name	LAN Connector
HP PaintJet LX300 printer	C2059A	HP JetDirect Card for Novell NetWare	AUI/BNC (10Base2)
	C2059B	HP JetDirect Card for LAN Manager (3COM 3+Open, IBM LAN Server, Microsoft LAN Manager)	AUI/BNC (10Base2)
	C2059E	HP JetDirect Card for EtherTalk	DIN8
	C2059T	HP JetDirect Card for UNIX	AUI/BNC (10Base2)

For the HP PaintJet XL300 only, you must order the HP EtherTwist 10Base-T Twisted-Pair Adapter Kit (C1647A). The adapter kit includes an HP 28685B EtherTwist Transceiver, an AUI retainer and a voltage adapter. The voltage adapter provides power to the EtherTwist transceiver.

Advanced Topics

Product Note

IP Addressing Scheme

This product note briefly discusses how you can assign IP addresses on your network.

If your IP network will be connected with other IP networks worldwide, you must use assigned IP addresses. Otherwise, you can build your own IP addressing scheme.

Hewlett-Packard strongly recommends that if you intend to expand, integrate, or connect your IP network to other IP networks, you use an assigned address. There is a formal process to obtain assigned unique IP addresses for networks worldwide. Contact the DDN Network Information Center by phone or mail. They will provide instructions and the necessary documents to assign and register your IP addresses.

Telephone	in U.S. only:	1-800-235-3155
	worldwide:	415-859-3695
Mailing Address	Hostmaster DDN Network Information Center SRI International 333 Ravenswood Avenue Menlo Park, California 94025	

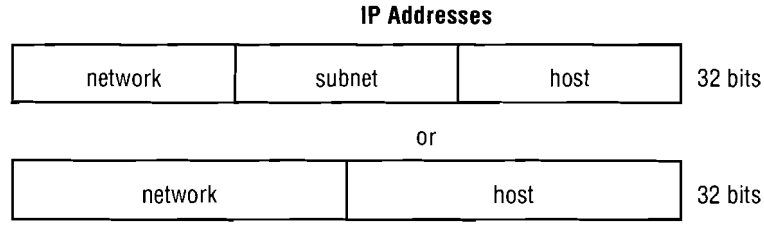
If your network is isolated and will not be connected to any other IP networks, you can build your own IP addressing scheme. If you use your own addressing scheme, be aware that any connection to another IP network could cause communication problems on both networks. The IP addresses on the two network must be compatible. Each address must be unique.

The following documents have detailed descriptions on how to build your own IP addressing scheme:

- *HP OpenView EtherTwist Network Management Reference Guide (DOS Version)*
  (HP part number 5091-3635E)
- *Interconnecting With TCP/IP: Principles, Protocols, and Architecture*
  Author: Douglas E. Comer Publisher: Prentice-Hall, Inc.

IP Addresses

An IP address consists of 32 bits divided into two or three fields: network number and host number OR network number, subnet number, and host number. (An IP network generally comprises a single company or location. The interconnection of IP networks is an internet. The most widely used internet is the Internet (note the capital "I"). The Internet includes many public and private IP networks. At the destination network, the subnet number (if there is one) is used to send the packet to the correct subnetwork. After that, the packet is sent to the correct host number. (A host is a node or network device that supports IP communication on the network.)



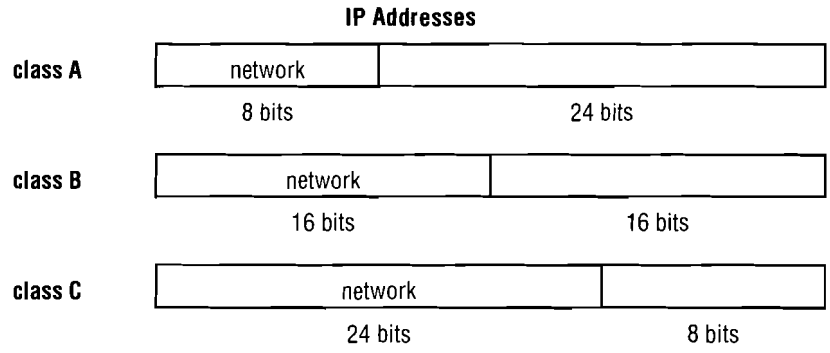
Field Length

The address field length of an IP address depends on the address class.

A class A address assigns 8 bits to the network field and a total of 24 bits to the rest of the address. This address class can address almost 17 million different nodes on an IP network. A class A address is used for very large networks.

A class B address assigns 16 bits to the network field and a total of 16 bits to the rest of the address. This can address over 65,000 different nodes on a network.

A class C address assigns 24 bits to the network field and 8 bits to the rest of the address. This can address 254 different nodes on a network.



Address Assignment

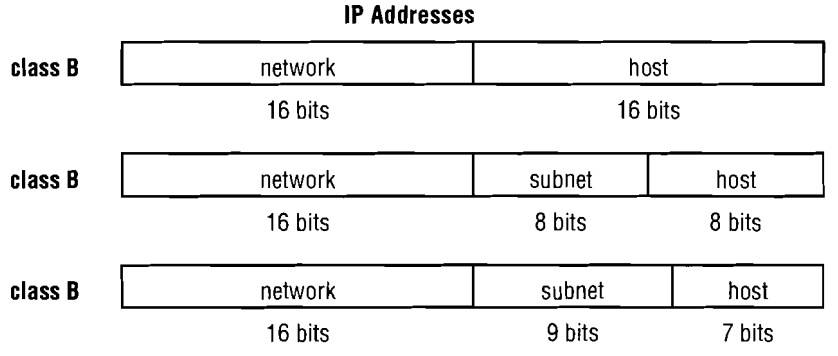
After you have selected the address class and network number, the rest of the address bits are allocated to the host field or subdivided into subnet and host fields. The field lengths chosen for these fields will depend on how the network is subdivided. For example, a class B address could have 8 bits assigned to the subnet field and 8 bits to the host field. This would allow up to 254 subnetworks with up to 254 hosts on each. Or it could have 9 subnet number bits and 7 host number bits. This would allow about 500 subnetworks with up to 126 hosts on each.

Dividing the network into subnetworks helps with the administration of a large network.

When selecting the lengths for the subnetwork and host fields, consider the total number of subnetworks that will potentially be needed on the network and the total number of nodes in each subnetwork. Make sure that the lengths of each field will accommodate these projected totals.

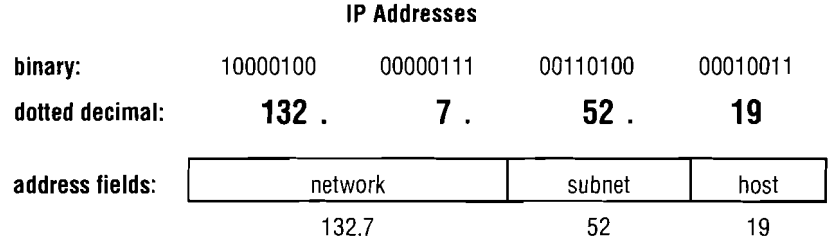
The actual subnet and host number values are assigned by the network administrator. Neither the subnet or host number can be all 1s or all 0s (255 or 0). These are reserved addresses.

You might want to consider using a network number assigned by the DDN Network Information Center even if you are not currently connecting to the Internet. If you do this now, you will not have to reconfigure your IP network if you connect to the Internet later.



Dotted Decimal Notation

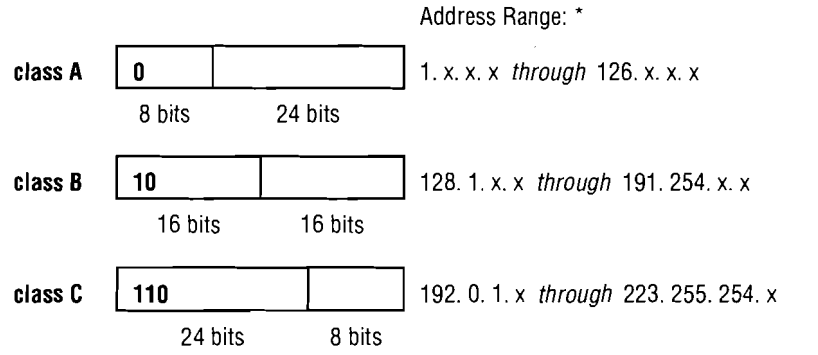
IP addresses are written in dotted decimal notation. Each decimal group (between the decimal points) is the decimal equivalent of 8 bits of the binary address. Notice that the dotted decimal divisions do not exactly correspond to the network, subnet, and host field divisions of the address. One address field may cover more than one dotted decimal division. Or, the division between address fields may not fall in the same place as a dotted decimal division. It is recommended that subnet/host fields be allocated at a dotted decimal division point (at a "byte boundary") whenever possible.



Class Range

The address class can be determined by the first decimal number. This is because the left-most bits are assigned according to the address class.

- For a class A address, the first digits are in the range 1 through 126 (left-most bit is 0).
- For a class B address, the first digits are in the range 128 through 191 (leftmost bits are 10).
- For a class C address, the first digits are in the range 192 through 223 (leftmost bits are 110).



* Some addresses are reserved and are not included in the ranges listed.

Subnet Mask

When assigning IP addresses, you will also assign subnet masks. A subnet mask tells you the total length chosen for the network and subnet fields. It is constructed as follows: (1) A "1" is assigned to each network and subnet bit. (2) A "0" is assigned to each host bit. (3) Each group of 8 bits is converted to its decimal equivalent to obtain dotted decimal notation.

For example, the subnet mask for an IP address with field lengths of network=16, subnet=8, host=8 is 255.255.255.0. The subnet mask for an IP address with field lengths of network=8, subnet=8, host=16 is 255.255.0.0.

Notice that the field division may not correspond neatly to the dotted decimal divisions as in the above examples. For example, the subnet mask for an IP address with field lengths of network=16, subnet=7, host=9 is 255.255.254.0.

IP Addresses

binary:	11111111	11111111	11111111	00000000
subnet mask:	**255 .**	**255 .**	**255 .**	**0**
address fields:	network		subnet	host
	16 bits		8 bits	8 bits

Technical Reference Guide

Glossary

Glossary

AARP

The AppleTalk Address Resolution Protocol, similar to ARP, used to translate network-layer addresses into station addresses.

active path

The path along which packets travel in a spanning tree topology. In a spanning tree topology, there can be only one active path between any two nodes.

address class

A method of categorizing IP addresses that defines the length of the network field of the address.

address filtering

The ability of a bridge to forward or discard packets based on the location (address) of the source and destination nodes. Address filtering minimizes excess traffic on the LANs connected by the bridge.

address table

A table kept by a bridging service (or device) that keeps track of the network nodes located on each of the bridge's connected LANs.

address resolution

A means for mapping network layer addresses onto data link layer (station or MAC addresses) addresses. See ARP.

adjacent node

A DECnet node that is no more than one hop distant from a router. A WAN link will have at most one adjacent router. All nodes on an Ethernet LAN are adjacent.

agent

In the client-server model, the part of the system that performs information preparation and exchange on behalf of a client or server application. In SNMP, the word agent refers to network management firmware within a managed device or system.

age out; aging out

Age out or aging out refers to how long an address table entry stays in a bridge's address table. If the bridge does not see a packet with a given source address for 300 seconds, that address is deleted from the address table.

ANSI

American National Standards Institute. ANSI is a member of the International Organization for Standardization (ISO).

AppleTalk protocol

A protocol family, developed by Apple Computer, Inc., using a model that subdivides a network into smaller networks and zones.

application layer

The top-most layer in the OSI Reference Model, providing such communication services as electronic mail and file transfer.

ARP	Address Resolution Protocol. A protocol used by the IP routing service to translate IP addresses into Ethernet station addresses.
ARPA	Advanced Research Projects Agency. Now called DARPA, the U.S. government agency that funded the ARPANET.
ARPANET	A packet-switched network developed in the early 1970's. The "grandfather" of today's Internet. ARPANET was decommissioned in June 1990.
attenuation	The difference between transmitted and received power due to transmission loss through equipment, lines, or other communication devices.
autonomous system	A group of IP networks that is centrally administered and has its own autonomous system number (ASN). The ASN is assigned by the DDN Network Information Center (NIC). (The ASN is not the same as the assigned IP address).
auto-segmentation	Automatic isolation of a faulty node of LAN segment from the network.
backbone	Common LAN cabling to which small networks (or subnetworks) connect. The backbone LAN may encompass a building or a campus of buildings.
backup ports	The bridge ports in a spanning tree topology through which packets are not forwarded.
backup link	A feature of HP EtherTwist (managed) hubs that allows a second cable connection between two hubs for backup purposes.
bandwidth	The difference between the upper and lower frequency limits of a communications channel. A higher bandwidth makes faster data transmission possible.
baseband	Characteristic of any network technology that uses a single carrier frequency and requires all stations (nodes) attached to the network to participate in every transmission.
battery-backed RAM	The bridge memory that contains a copy of the bridge configuration and operating firmware. If power is removed from the bridge (by unplugging the power cord or from a power outage), this memory is preserved by power provided by the bridge's internal battery.
bridge	A device, operating at the data link layer of the OSI mode, that connects otherwise independent LANs .
bridge priority	A spanning tree bridge parameter that influences the choice of root bridge.
broadcast address	The station address (MAC address) FFFFFF-FFFFFF. Packets intended for all nodes on a network use this address as the destination address.
broadcast packet	A packet sent to all nodes on a network or subnetwork.
caching	A memory access method in which information learned during a previous transaction is used to process later transactions.
CCITT (Consultative Committee for International Telephony and Telegraphy)	An international organization of communication carriers responsible for developing telecommunication standards by making recommendations.

circuit	A logical communication channel between two devices on a network. Each physical circuit (or cable) on an HP router is assigned to a logical circuit.
clock	The source of timing signals used in synchronous transmission.
collision	The result of two or more nodes on a network transmitting at the same time.
Configuration Editor	An HP router configurator that allows you to set any available parameter. This is generally used after the minimum parameters have been set with Quick Configuration.
connection ID	A unique decimal number assigned to parallel virtual circuits used when connecting to a packet switching network with an X.25 point-to-point link.
console	The ASCII, ANSI, or VT100 terminal (or a PC emulating these terminal types) that is connected to HP EtherTiwst hubs, bridges, and routers for configuration and monitoring.
console port	The serial or RS-232 port on HP EtherTwist (managed) hubs, bridges, and routers.
cost	A number assigned to a port of a bridge or router reflecting the media speed of the connected network link.
CRC (cyclic redundancy check)	An error detection scheme used by the HP EtherTwist hubs, bridges, and routers to ensure that received packets have not been corrupted during transmission from the source node.
cross-connect block	A central termination point for twisted-pair wire. It allows devices connected to twisted-pair wire to be re-routed without having to rewire the building.
CSMA/CD	CSMA/CD stands for carrier sense multiple access with collision detection. This protocol is also known as IEEE 802.3 and it manages the OSI layer 1 communications.
data link layer	Layer 2 of the OSI model. It defines the way network devices access the medium and the way data transmissions are protected against loss or corruption.
dBm	Decibel referenced to one milliwatt. Commonly used as a measure of signal power for fiber-optic cables.
DCE	Data communications equipment. A designation given to the device at one end of an HDLC point-to-point circuit. Conventionally, one end of the circuit is designated DCE. The other end of the circuit is designated DTE (data terminal equipment).
DECnet protocol	A protocol family, developed by Digital Equipment Corporation, using a hierarchical model based on the division of a network into areas.
dedicated virtual circuit	A virtual circuit crossing a packet switching network that is activated at initialization and remains active even when not being used.
designated router	The DECnet router that traffic from that LAN goes to first. This router then begins the level 1 routing procedures.
distance vector protocol	A routing protocol that issues periodic broadcasts that propagate routing tables across the network. RIP is a distance vector protocol.

dotted decimal notation	The format of an IP address that converts each eight bits of the address into the equivalent decimal number. The decimal numbers are separated with decimal points.
DSU/CSU (data service unit/channel service unit)	A device (or separate DSU and CSU device) that provides the interface between a remote bridge, terminal, or router and the WAN link. This device converts the synchronous signal from the device to the signal format used on the WAN link. The DSU/CSU also provides for loop-back testing of the WAN link. This device is sometimes referred to as a T-carrier modem or a CEPT converter. See also WAN link terminating equipment.
DTE	Data terminal equipment, see DCE.
duplex fiber-optic cable	Communication cable made with a core of glass or other light-transmitting filaments. (Duplex means that there are two cables.) The cable uses a signal-encoded light beam, and depends on internal reflection for transmission. Because it does not use electrical or magnetic fields, it is unaffected by environmental conditions like lightning and interference from other electrical devices.
dynamic addresses	Station addresses that the bridge learns after it is connected to the network. Dynamic addresses are regularly aged out of the bridge's address table.
EGP (Exterior Gateway Protocol)	A protocol used to communicate between IP autonomous systems.
end node	An input or output device, usually a computer, that can communicate on a LAN.
Ethernet/802.3	Two similar local area network (LAN) protocols that transmit at 10 Mbit/s on a logical bus topology using the CSMA/CD access method.
event log	A list of system events that shows the success or failure of configuration and initialization steps.
extended LAN	A network consisting of two or more LANs that are connected by bridges, routers, or other similar devices. Resources on the LANs can be accessed by users located on any of the LANs within the security restrictions defined by the network administrator.
FDDI (Fiber Distributed Data Interface)	An emerging high-speed networking standard. The underlying medium is optical fiber, and the topology is a dual-attached, counter-rotating token ring.
fiber-optic transceiver	An 802.3/Ethernet transceiver that connects a node's AUI port to fiber-optic cable.
50-pin connector (25-pair Telco connector)	A cable connector used with 25-pair twisted-pair cables. Such cables are often used for telephone and LAN wiring.
filter	The ability of a bridge or router to forward or discard packets based on a particular characteristic of the packet, such as its source or destination address.
flash EEPROM (electronically erasable programmable read only memory)	A memory storage device that allows the contents to be written over electronically.

flood	A bridge function in which a packet is sent to all connected LANs (except the source LAN). This occurs when the bridge does not know which LAN the destination node is located on.
forward	A bridge or router function in which a packet is sent along a particular connected network link.
HDLC (high-level data link control)	An international, data-link level (level 2), full-duplex, data communications protocol defined by the European Computer Manufacturing Association (ECMA).
hop count	The number of router-to-router hops that a packet passes through along a given path between two routers.
HP EtherTwist devices	A full range of HP networking components for Ethernet/IEEE 802.3 network environments.
HP OpenView network management	An HP network management (software) tool based on HP OpenView Windows, and supporting SNMP (simple network management protocol) and MIB-I, and MIB-II (management information base) objects. This software tool can operate from one station over local and remote network links.
HPNN	Hewlett-Packard News Network. HPNN is an electronic bulletin board service available to HP authorized dealers.
hub	A multiport repeater. See repeater.
IEEE 802.3 FOIRL	An IEEE 802.3 standard for 10 Mbit/s fiber-optic inter-repeater links.
IEEE 802.3 standard	Part of the Institute of Electrical and Electronics Engineers 802 family of LAN standards. The 802.3 standard defines the physical layer (layer 1) and part of the data link layer (layer 2) of the ISO OSI reference model for a CSMA/CD network. The IEEE 802.3 standard evolved from Ethernet, but the two networks are not fully compatible with each other.
IGP	Interior Gateway Protocol. The protocol used to exchange routing information between TCP/IP routers. RIP and OSPF are examples of IGPs.
IGRP	Internet Gateway Routing Protocol. A proprietary IGP used by Cisco Systems' routers.
internet	A collection of networks interconnected by routers that allow them to function as a single large network. A collection of IP networks is an IP internet.
Internet	(Note the capital "I".) The most widely used IP internet is the Internet. The Internet includes many public and private networks (such as MILNET, NSFNET, and CREN) and many regional and local campus networks all over the world. The Internet uses the TCP/IP protocol suite. To be on the Internet you must have IP connectivity—that is, be able to Telnet to, or ping, other systems. Networks with only e-mail connectivity are not actually classified as being on the Internet.
Internet Protocol (IP)	A network layer protocol that uses a hierarchical model based on the interconnection of networks subdivided into subnetworks. This is also referred to as IP or DOD IP and is part of the TCP/IP protocol family.

interrupt channel (IRQ)	A communication channel allowing an interface card to signal the computer that it needs attention. Each interface card in a personal computer must use a different interrupt channel.
I/O base address	The starting memory address position for input/output storage used by an interface card in a computer. Each interface in a personal computer must use a unique range of I/O address. Even if the base addresses are different, the total address space used must not overlap.
IP address	The network layer address, written in dotted decimal notation, used by the IP protocol. An IP address has three fields: the network number, the subnet number, and the host number.
IPX protocol	A protocol family (the Internetwork Packet Exchange Protocol) that is the Novell, Inc., implementation of XNS (Xerox Network Systems Internet Transport Protocols). Both use a model based on the unique identification of each network section by a network number.
IPX test	The IPX test is a test of the path between the managed device and another device on an IPX (Internetwork Packet Exchange) network that responds to XNS (Xerox Network Systems) protocol Echo Request packets. During the IPX test, the managed device sends XNS protocol Echo Request packets to another node; the specified destination node must be capable of receiving and responding to XNS protocol packets. The IPX test is implemented in HP OpenView network management products by using Novell NetWare's Comcheck command.
IRQ	See interrupt channel.
ISDN	Integrated Services Digital Network. An emerging technology that is beginning to be offered by the telephone carriers of the world. ISDN combines voice and digital network services in a single medium, making it possible to offer customers digital data services as well as voice connections through a single "wire". The standards that define ISDN are specified by CCITT.
ISO	International Organization for Standardization. Best known for the 7-layer OSI Reference Model. See OSI.
LAN	Local area network. A data communications network that interconnects devices within a limited geographical area. Transmissions on an Ethernet/802.3 LAN are broadcast over the entire LAN and processed only by the destination nodes.
learning bridge	A bridge that learns the location of nodes on the network by examining the source addresses of incoming packets.
level 1 routing	The method used by DECnet routers to route packets within an area.
level 2 routing	The method used by DECnet routers to route packets among areas.
link beat	Link beat is Hewlett-Packard's implementation of the IEEE 802.3 Type 10Base-T standard's link test pulse. See link test pulse.
link test	A data link layer (layer 2 of the OSI model) test of the connection between this device (a "local" device) and a designated remote device. Link test is available in HP OpenView network management products.

link test pulse	A signal transmitted between a 10Base-T hub, transceiver, or interface adapter card that informs it of the presence of the other. This tests the integrity of the link between two 10Base-T hubs, transceivers, or interface adapters, informing each one of the presence of the other. Link test pulse is the name used in the 10Base-T standard; HP refers to it as link beat.
load sharing	The process of sharing the network traffic load on multiple paths in a network in order to improve performance.
loopback connector	A port connector used to loop signals back to their origin in order to test transmit and receive circuitry.
MIB	Management Information Base. A structure of variables for SNMP devices that can be accessed by SNMP network management (such as HP OpenView). MIB objects represent data that is used within a device.
MIB-I	Management Information Base version 1 defines a set of data maintained in manageable network devices such as routers, bridges, and hubs. The network management station reads and sets MIB data or objects when managing a device.
MIB-II	Management Information Base version 2 is a superset of MIB-I. MIB-II defines a set of data that the network management station reads and sets when managing a device.
MIB object	MIB object is another name for the data defined within the MIB. Example of MIB objects include: *bytes received, CRC errors,* and *collisions.* The network management station reads and sets MIB objects when managing a device.
modem	A device that converts signals between digital and analog data transmission formats for use over analog telephone lines.
modular adapter	A twisted-pair modular adapter connects to a 50-pin port on an HP EtherTwist hub, providing 12 individual RJ-45 connectors for twisted-pair cables.
modular jack	An 8-pin connector for twisted-pair cable used in LAN connections.
multicast	A special form of broadcast where copies of the packet are delivered to a subset of all possible destinations. See broadcast.
multiprotocol routing	The ability of a router to recognize and route packets of different network layer protocols. HP routers support the TCP/IP, Novell IPX, AppleTalk Phase 4, and Xerox XNS protocol families, and DECnet.
multisite LAN	The network resulting from the connection of site LANs, generally over wide area (WAN) links.
NCL	Network Control Language. A command-line control language, used on HP routers, that is used to perform configuration, verification, and device management tasks.
NDIS (network driver interface specification)	A standard interface between adapter card hardware and network software that eliminates the need to write separate drivers for adapter/protocol pairing.
network download	The ability to download firmware updates over the network to HP EtherTwist (managed) hubs, bridges, and routers from a single PC running a download program.

network layer	Layer 3 of the OSI model. It defines the way data can be relayed or routed from the source node to the destination through the various communications devices on the network.
network layer address	A formatted number that identifies a specific network device at the network layer of the OSI model.
network layer protocol	A set of rules governing data transfer around devices on a network at the network layer of the OSI mode.
network map	A drawing showing the network topology or layer of the network. With HP OpenView network management products, you can use the Autodiscovery feature to draw a pictorial representation of your network—the network map.
network operating system	Software used by computers to access a network.
NIC	The DDN Network Information Center, SRI International, in Menlo Park, California, which supplies network numbers for the IP Internet.
node	A computer or another addressable device on a network, including PCs, workstations, hubs, and bridges, routers, network peripherals, and mainframes. A node has a station address (MAC address).
OSI	Open Systems Interconnection. An international standardization program to facilitate communications among computers from different manufacturers. See ISO and CCITT.
OSI Reference Model	A communications model with seven layers defined by the International Standards Organization (ISO). Each layer specifies functions for a part of the communication process. The seven layers consist of the following: physical layer, data link layer, network layer, transport layer, session layer, presentation layer, and application layer.
OSPF	Open Shortest Path First. A routing protocol that can base its routing decisions on user-configurable cost and delay factors. It is more efficient than RIP in communicating routing information and accommodating to changing topologies.
packet	A bit stream consisting of predefined fields that contain data, addresses, and control information. In the IEEE 802.3 environment, this structure is often referred to as the MAC (media access control) frame. "Packet" is used in the Ethernet environment and is used in this document because it is the more commonly understood term. Different protocols have different packet and frame specifications.
packet life	The maximum number of hops that a packet can take before it is discarded.
packet switching network (PSN)	A type of data communications network in which data is broken into packets for transmission individually through the network.
parallel link	A second line between two network devices. A parallel link between two routers can provide a backup link, or it can be used for load sharing.
path	The route taken by a packet from one point to another in a network.
PDN	Public data network. A packet switching network available to any subscribers.

permanent address

These addresses come pre-configured into the bridge's address table and cannot be deleted or changed. They include the bridge's station address (MAC address), specific broadcast and multicast addresses, spanning tree broadcast addresses, and reserved 802.1 addresses.

physical layer

The OSI layer that provides the means to activate and use physical connections for bit transmission. This layer provides the procedures for transferring a single bit across a physical medium.

ping test

A program used to test reachability of destinations by sending them an ICMP echo request on an IP network and waiting for a reply. Ping stands for "packet internet groper".

point-to-point link

A network line that connects two network devices.

presentation layer

The OSI layer that determines how application information is represented (that is, encoded) while in transit between two end systems.

Probe

An AppleTalk protocol that generates random node IDs and ensures that each is unique to the area.

propagation delay

The time it takes for a signal to travel from one point to another in a network.

protocol

A set of rules that governs data transfer among devices on a network. A protocol identifies the handshake type, packet size and format, timing, error recovery scheme, word size or other characteristics of each transfer, depending on the system it is part of.

Quick Configuration

An HP router feature allowing a router to be configured with a minimum set of parameters to get started quickly. The full Configuration Editor can be used later to set additional parameters.

remote bridge

A device used in pairs to enable communication between two remotely located LANs. Each remote bridge connects a LAN to a WAN link.

remote extended LAN

A network consisting of two or more LANs that are interconnected by a WAN link.

repeater

A repeater is a network device that receives signals, sometimes regenerates them, and then retransmits them to all ports except the one they were received on.

RFC

Request For Comments. The document series, begun in 1969, that describes the TCP/IP suite of protocols and related experiments.

RIP

Routing Information Protocol. A routing protocol in which decisions are based on hop count.

root bridge

The bridge in a spanning tree topology that provides a reference for determining active network paths. There is exactly one root bridge in a spanning tree topology.

router

A device providing an intelligent connection among multiple networks. Routers operate at the network layer on the OSI mode. Routers are responsible for making decisions about which of several paths network traffic will follow. To do this they use a routing protocol to gain information about the network, and algorithms to choose the best route based on several criteria known as routing metrics.

routing protocol	The communication and decision-making method used by routers to learn and maintain the routing tables used to select paths for packets. RIP and OSPF are examples of routing protocols.
routing table	A table used by a router to keep track of the locations of other networks and subnetworks.
RS-232-C	A standard published by the Electronics Industry Association (EIA) in the U.S. that covers the mechanical and signal interface between DTE (data terminal equipment) and DCE (data communication equipment) using serial binary data interchange.
RS-422-A	A standard published by the Electronics Industry Association (EIA) in the U.S. that uses a technique called balanced transmission. RS-422-A uses two separate wires for each signal to allow greater speed in data transmission and to eliminate ground potential problems.
RS-449	A standard published by the Electronics Industry Association (EIA) in the U.S. that is intended to replace the functional portion of the RS-232-C standards, including mechanical specification of the plugs and sockets. RS-449 uses two connectors instead of one.
SAP	Service Advertising Protocol. A protocol used by the IPX routing application to gather and store information about the services available on the network.
seed router	A router on an AppleTalk network that communicates configuration information to other AppleTalk routers.
seed router port	A router port that is acting as a seed router for the directly-connected AppleTalk network.
segment	A segment is the connection between two or more devices.
session layer	The OSI layer that provides a means for dialogue control between end systems.
server	A computer, attached to a network, that runs software for managing network resources used by stations (or clients) on the network.
site LAN	The network comprising the workgroup LANs on a particular site.
site survey worksheets	HP router worksheets providing basic planning information for each network link and each bridging and routing service to be sued.
SNMP	Simple Network Management Protocol. A standard network management protocol.
source routing	An OSI data link layer protocol for token ring networks in which the originating stations select paths for packets.
source routing bridge	An OSI data link layer protocol for token ring networks in which a bridge participates with other (host) stations to select paths for a network.
Spanning Tree Protocol	The IEEE 802.1 algorithm allowing bridges and routers (with bridging functionality) on a LAN to identify the best transmission path through the forwarding bridges on the LAN.
star topology	A physical (network) layout where cabling runs to and from a central point, such as a hub.

static addresses	Entries that you manually add to the bridge's address table. These addresses remain in the address table until you intentionally delete them.
static route	A predetermined network path that certain packets are required to follow.
station address (MAC address)	A formatted number that identifies a specific network node and allows messages to be directed to that node only. These numbers are permanently coded in the circuitry of the hardware. Because the IEEE has assigned identifiers for each hardware manufacturer, no two pieces of equipment have the same station address. The address assigned according the the IEEE plan is referred to as a device's globally administered MAC address. Some devices provide an option for the user to assign a different station address that will override the original. This type of address is referred to as a locally administered station address. HP hubs, bridges, and routers use a globally administered station address only. The station address is also commonly called a link or MAC address, hardware address, LAN address, Ethernet address, or physical address.
subnet mask	The bit mask defining which portion of an IP address is the subnet address, written in dotted decimal notation.
subnetwork	A network subdivision containing a group of nodes.
synchronous pass-through	An HP router feature allowing synchronous non-LAN based communications (such as IBM SNA) across HP router networks.
TCP	Transmission Control Protocol. The major transport protocol in the TCP/IP suite of protocols providing reliable, connection-oriented, full-duplex streams.
Telco connector	See 50-pin connector.
Telnet	A protocol allowing a virtual terminal connection to a remote device over the network. Once a connection is established, Telnet passes keystrokes from your node to the remote device.
10Base-T	An IEEE 802.3 standard that describes a 10 Mbit/s baseband, CSMA/CD, unshielded twisted-pair (UTP) LAN.
Thinwatch	Thinwatch is a function on all HP managed hubs (EtherTwist, ThinLAN, and fiber-optic hubs). Thinwatch affects the blinking of the Fault LED and the corresponding ThinLAN port LED. The default setting on HP managed hubs is disabled. Thinwatch should be enabled if the ThinLAN port(s) of the hub is being used.
token ring	An OSI data link layer protocol based on a logical ring topology and using the token-passing access method.
topology	The physical layout of the network.
transceiver	Transmitter-receiver. The physical device that connects a host interface to an Ethernet or 802.3 LAN. Transceivers contain electronics that apply signals to the attached cable and sense collisions.
transport layer	The OSI layer that is responsible for reliable end-to-end data transfer between end systems.
T1	T1 is a type of WAN link service that telephone companies can provide for data communication at 1.544 Mbit/s.

25-pair cable	A cable consisting of 25 unshielded twisted pairs that can provide 12 sets of the two-pair circuits needed for a 10Base-T LAN connection. The 25-pair cable reduces the number of cables required from 12 to 1 and is less expensive to install.
V.35	A CCITT standard that defines a high-speed, wide area, data communications interface.
virtual circuit	A logical communication channel established between two devices in a packet switching network.
WAN link, wide area network link	The long-distance telecommunications connection between two remotely located sites.
WAN link terminating equipment	Devices that provide the interface between the WAN link and the user's equipment. These devices will vary depending on the type of WAN link being connected to. They include, for example, DSU/CSUs, modems, and multiplexers.
WAN port	The 62-pin port of the HP Remote Bridge RB and HP routers that connects to the WAN link.
workgroup LAN	A small LAN of networked computers. Workgroup LAN users generally share common projects, objectives, and network resources.
wiring closet	A dedicated room or closet that houses transmission electronic devices (such as hubs, bridges, and routers), cross-connect blocks, patch panels, and sometimes telephone communications equipment. It is also called a telecommunications closet.
X.121 address	An address assigned to network devices accessing a packet switching network. An X.121 address is a decimal number of up to 14 digits.
X.25	A protocol that defines the interface between a network device and a packet switching network.
X.21	A protocol used between a network device and digital telephone network for placing and receiving calls and for sending and receiving data using full-duplex synchronous transmission.
XNS protocol	A protocol family (the Xerox Network Systems Internet Transport Protocols) that uses a model based on the unique identification of each network section by a network number.
zone	A group of AppleTalk nodes that share the same network resources.

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Printed in U.S.A. M0792
P/N 5091-3237E