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Choosing the Cable Infrastructure

When you are building a network, you need to know about the different cable types for the cable infrastructure. You have several networking cables that you can select such as fiber or twisted-pair. This chapter describes the available cables for you cabling infrastructure that will work in your work-group network. It presents:

- general comparison of network table types
- cabling recommendations
- physical descriptions of cable types
- special situations with cable
- handling adds, moves, or changes

General Comparison of Network Cable Types

The following table provides a quick comparison of several important characteristics of the five cable types.

Network Cable Types

	Twisted-pair cable	**Fiber-optic cable**	**Stacking cable**	**Thin coaxial cable**
Cable description	Copper, 4 or 25 twisted pairs	Glass, 2 fibers	Proprietary	Copper, 2 conductors, 5-mm diameter
Connector type	RJ-45 or 50-pin telco	ST or SC	Proprietary	BNC
Maximum segment length	10Base-T, Cat 3, 4, 5:100 m, 100Base-TX, Cat 5: 100 m, 100VG, Cat 3, 4: 100 m, 100VG, Cat 5: 200 m	100Base-FX: 412 m, half-duplex 2000 m, full duplex 10Base-F: 1000 m 100Base-FX: 2000 m 100VG fiber: 2000 m	Depends on product, usually around 30 cm	10Base2: 185 m
Maximum connections per cable	2	2	Switching Hubs: 8 Hub-12TXM, 12TX: 5	30
Maximum connections per segment	2	2	Switching Hubs: 8 Hub-12TXM, 12TX: 5	30
10-Mbps operation	Yes*	Yes	Yes	Yes
100-Mbps operation	Yes*	Yes	Yes	No
Noise immunity	Good	Excellent	Good	Good
Security	Moderate	Excellent	Good	Moderate
Reliability	Good	Good	Good	Moderate**
Ease of installation	Excellent	Good	Excellent	Good
Ease of troubleshooting	Excellent	Excellent	Excellent	Good
Ease of administration	Excellent	Excellent	Excellent	Poor
Cost per connection	Very low	High	Included with hub: none	Lower
Best application	Workgroup cabling	Long backbone, between wiring closets, between buildings	Workgroup cabling	Backbone in wiring closet

* 10Base-T (10 Mbps) and 100VG-AnyLAN (100 Mbps) signals should not be transmitted within the same 25-pair bundled cable.

** Thin coax cable itself is reliable, but connectors allow easy cable disruption by untrained network users.

Cabling Recommendations

The best cable for your situation depends if you are installing cable for a new installation or adding cable to an existing installation. Always consider future expansion and building codes when installing cable.

New Installations

For most new installations, we recommend using 100 meter lengths of Category 5 twisted-pair cabling in the workgroup, with fiber-optic cabling for long backbone connections. The Stacking Cable is appropriate for short backbone connections within wiring closets. Both twisted-pair and fiber-optic cabling let you upgrade from a 10-Mbps network to a 100-Mbps network. (If you are upgrading to 100Base-TX, the twisted-pair cable *must* be Category 5 or better.)

Since twisted-pair networks use the same cabling as your telephone system, you will find that your telephone maintenance people can install and administer the network in the same way that they handle the telephone system. Administrative changes (adds, moves, and drops) are the same as with telephones, and troubleshooting the point-to-point cables of a twisted-pair network is far simpler than troubleshooting a bus-structured coaxial cable system. Noise immunity for twisted-pair cabling is of the same order as for coaxial cabling: both are suitable for general office environments. For environments with heavy electrical noise, we recommend fiber-optic cabling. Twisted-pair cabling offers better reliability in the workgroup than coaxial cabling, largely because of the human factor: an individual user who unplugs his twisted-pair cable while investigating a network problem can affect only his own connection; with coaxial cabling, he can bring down the whole segment.

For long backbones we recommend fiber-optic cabling because it allows long cable runs and offers excellent security and noise immunity. It is the only cable type we recommend for cable runs outdoors between buildings. For short backbones in a wiring closet, such as the connections between stackable network components in racks, use Stacking Cable (included with each Switching Hub) which is inexpensive, effective, and reliable.

Existing Installations

For existing installations, it generally makes sense to use whatever cable types are installed, as long as they provide the bandwidth and capacity that you need for your operations. As your needs expand, however, we recommend that you consider moving in the direction outlined in the preceding paragraphs. Available networking equipment allows you to mix cable types easily, so that it is quite feasible to operate, say, an older coaxial cable system in conjunction with a new section of twisted-pair cabling.

In 1997, most network administrators will be installing Category 5 cable to replace Category 3 cable. Make sure the Category 5 cable is marked as "Category 5 verified". Unverified Category 5 cable may not work to Category 5 specifications. In the future, Category 6 cable will probably replace Category 5. The Category 6 specification is not finished as of this printing, so look for Category 6 well into the next decade.

Expansion

Whenever cable is installed, plan for future expansion. Keep in mind that cable itself is inexpensive, relative to the cost of installing it. When you pull new cable into the walls, floors, and ceilings of your buildings, it is much less expensive to pull additional cables now than to come back a few months or a year later and pull new cable again.

Planning the future capacity of your cable system can be something of a guessing game, depending on how fast your organization grows, how it adopts new information technologies, and how networking technologies may change. The basic rule of thumb is a simple one: make your best estimate, double it, and round up to the next even cable. For example, if you were planning for the installation of 10Base-T twisted-pair wiring for your employees a couple of years ago, you might have allowed one telephone connection (1 twisted pair) and one computer connection (2 twisted pairs) for a typical employee. If you were installing standard 4-pair cabling and applying the rule of thumb, you would have doubled it (6 pairs), rounded up to the next even cable (8 pairs), and installed two 4-pair cables for each employee.

That would have given you plenty of capacity to change to a digital phone (1 more pair) and to handle vastly more data by changing to 100VG-AnyLAN or 100Base-T networking (2 more pairs), and still left you a couple of pairs for patching around the occasional faulty wire.

A Word about Building Codes

Building and electrical codes can affect the way you install your network cabling, particularly in the areas of grounding and cable jacket material. The codes generally require that cables with an insulation that does not give off toxic fumes when burning, such as FEP (fluoro-ethylene polymer), be used in air ducts, air plenums, and other environmental air spaces. In addition, some fiber-optic cables contain metallic strength members (that are not used as conductors); consult your codes for guidance on how to handle such cables, especially between buildings.

To avoid electrical interference, run networking cable and electrical cable away from each other and away from electrical motors if possible.

Note that specific codes may impose different requirements from the general ones that we have just mentioned. Be sure that you check the building and electrical codes that apply in your area.

At this point, you are ready to read Designing the Shared Workgroup to build your network. Or you can read about the physical description of cables next.

Physical Descriptions of Cable Types

There are many types of cables to choose from:

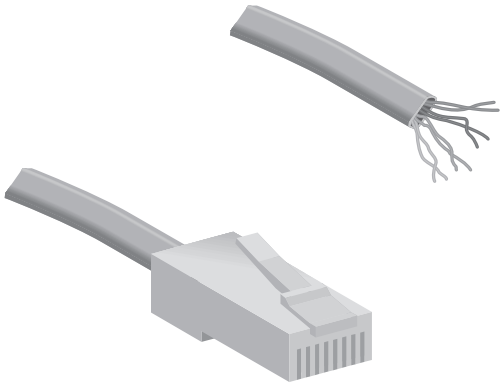
- twisted-pair cable
- fiber-optic cable
- stacking cable
- thin coaxial cable
- thick coaxial cable
- AUI cable

Twisted-Pair Cable

Twisted-pair cabling includes a variety of twisted-pair cable types with a nominal impedance of 100 ohms. It comes in cables of 4 pairs or bundles of 25 or more pairs, and can be either unshielded (UTP) or shielded (STP). It is suitable for use in both 10-Mbps networks (Type 10Base-T) and 100-Mbps networks (100Base-TX or 100VG-AnyLAN). 10Base-T, 100Base-TX, and 100VG-AnyLAN networking devices all use unshielded twisted-pair cable.

The standard for Ethernet-style twisted-pair cabling (IEEE 802.3 Type 10Base-T, 100Base-T, and 100VG-AnyLAN) specifies that cables be run in point-to-point cable segments. These segments connect to network devices at each end of the cable, with no device connections anywhere else along the cable. All cable sections must use twisted pairs; no untwisted wire is permitted anywhere.

Workgroup: twisted-pair



The following table describes the categories of unshielded twisted-pair cable types that you can use:

Unshielded Twisted-Pair Cable Types

Categories of unshielded twisted-pair cable…			Required for…			Cable Lengths for…		
Category	**Bandwidth**	**Designation**	**10Base-T**	**100Base-TX**	**100VG-AnyLAN**	**10Base-T**	**100Base-TX**	**100VG-AnyLAN**
Category 3	15 MHz	Voice Grade	2 pairs	not available: use 100Base-T4	4 pairs	100 m	not available: use 100Base-T4	100 m
Category 4	20 MHz	None	2 pairs	not available	4 pairs	100 m	not available	100 m
Category 5	100 MHz	Data grade	2 pairs	2 pair	4 pairs	100 m	100 m	200 m

Twisted-Pair Cable in 10 Mbps Networks

Category 5 is the popular choice for new networks but most companies still have Category 3 cable because it is standard telephone wire and works well with 10 Mbps networks. Standard connectors for twisted-pair network cable are the same RJ-45 (8-pin) and 50-pin telco connectors used in telephone systems. In addition, standard telephone cross-connect blocks can be used for cable administration; adds, changes, and drops can be made in the same way as for the telephone system. Many buildings of recent construction have been pre-wired with enough telephone cabling that the extra capacity can be used for networks. Sometimes, both telephone and network signals can be freely intermixed in the same cables and bundles. All these factors make it easy for your telephone system people to install, maintain, and administer your twisted-pair network cabling.

For 10Base-T networks, in addition to the maximum cable lengths specified by the 10Base-T standard, Hewlett-Packard provides for extended cable lengths as described under special situations.

Twisted-Pair Cable in 100 Mbps Networks

The cabling standard for 100Base-TX and 100VG-AnyLAN are slightly different.

For 100Base-TX networks, you need to use Category 5 cable or better. The segment length from hub to end node is 100 meters for twisted-pair.

The standard for 100-Mbps 100VG-AnyLAN cabling is the same as for 10Base-T cabling, except that all 4 wire pairs are required for communication over UTP (Categories 3, 4, and 5) cables: the cables most commonly used. The long cable options available for 10-Mbps operation are not available for 100-Mbps operation, although, because of the tighter cable specifications of category 4 and 5 cables, they can support longer distances: for example, category 5 supports lengths of up to 150 meters.

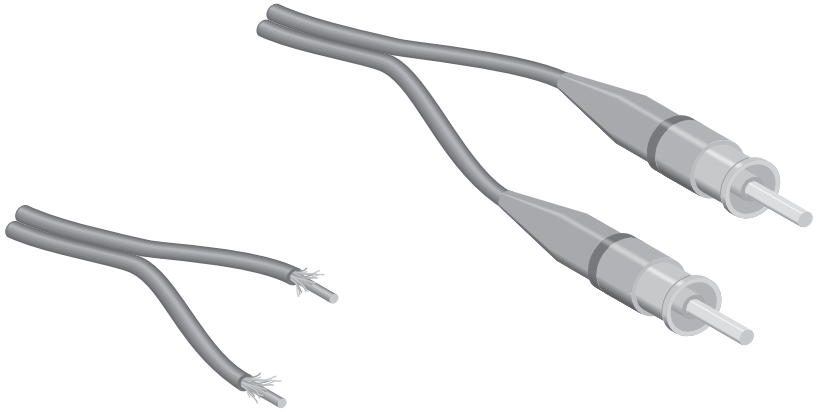
Because twisted-pair cabling is familiar and easy to administer, it makes an excellent choice for workgroup networking. Its ability to operate at either 10 Mbps or 100 Mbps allows it to adapt readily to changing organizational situations over long periods of time.

Fiber-Optic Cabling

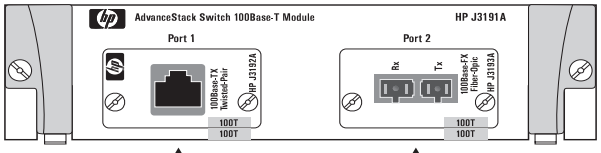
Fiber-optic network cabling is made up of two strands of optical fiber running parallel to each other in a plastic, "zip-cord" jacket or multiple fibers in a single jacket. The fibers are made of glass. Three types of connectors are attached to fiber-optic cable:

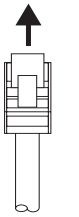
Connector Type	Technology
SC connector	100Base-FX
ST connector	10Base-FL, 100VG
FDDI connector	FDDI

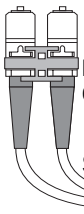
Long Backbone: fiber-optic cable with SC connectors



Fiber-Optic Cable With ST connectors







Category 5 cable.
Maximum: 100 meters
Hub to hub: crossover cable
Switch to switch: crossover
Switch to end node: straight-through

Fiber-optic cable. The maximum distance depends on the device connected to this port.

See the table below.

Fiber-optic cabling can be used under several network standards:

- IEEE 802.3 Type 10Base-FL
- FDDI (Fiber Distributed Data Interface)
- IEEE 802.12 (100VG-AnyLAN)
- IEEE 802.3u (100Base-T)

You can meet the specifications for all these standards by using 62.5/125-µm, dual-window cabling; dual-window cabling is designed for operation at both 850-nm and 1333-nm wavelengths. Check with your cable supplier for complete specifications and conformance information on the cables you use. The cable segment lengths vary.

Fiber-Optic Cable Lengths

Fiber-Optic Cable	Maximum Segment Length
Ethernet, Type 10Base-FL	1000 m from repeater to end node 2000 m switch to switch
100Base-FX	412 m, half-duplex multimode fiber: switch to switch 2000 m, full duplex multimode fiber switch to switch
100VG-AnyLAN	2000 m
FDDI	2000 m node to node
10Base-F	2 km

Though fiber-optic cabling can be relatively expensive, its other characteristics make it suitable for a number of applications. Because it is an optical rather than an electrical medium, it is immune to electrical noise and lightning strikes, and can not cause ground loops. It can be somewhat difficult to attach connectors to fiber-optic cable cleanly; this makes it generally unsuitable for office environments with their frequent changes. Because of this characteristic, however, it is very difficult to tap fiber-optic cable undetected, making this a very secure cable type.

With its capacity for long cable runs, one primary use of fiber-optic network cable is for long backbones. There are strong secondary uses in areas with high electrical noise-such as a factory floor in a heavy industrial setting-or where physical network security is important.

Stacking Cable

Stacking cable is a thick cable that connects one hub to another and is usually about 30 cm long. Stacking cable carries network management as well as data between segments. You will find stacking cable included with each Switching Hub.

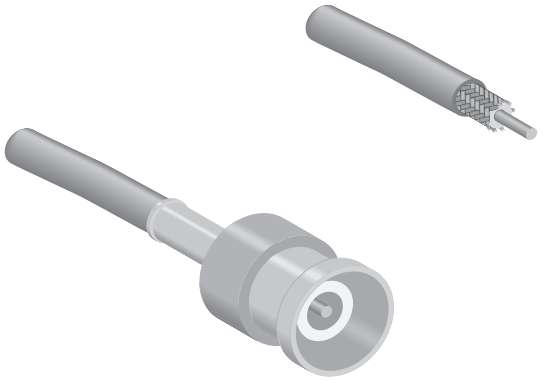
Note that each networking company makes their own stacking cable for a product line so stacking cables are not interchangable from stack to stack. However, the benefits of stacking cables outweigh this disadvantage. The benefits of stacking cable are:

- high speed: 1 gigabit speed between hubs
- high bandwidth: carries both network management traffic and data between hubs
- cable included: cable is included with the hub so you don't need to find or purchase this cable
- reliability: stacking cable is less apt to have termination problems like thin coaxial cable

Thin Coaxial Cable

Thin coaxial cabling ("thin coax") has a diameter of approximately 5 mm and an impedance of 50 ohms. It comes with a jacket material of either polyvinyl chloride (PVC) or fluoroethylene polymer (FEP), a Teflon-like substance. (The FEP cable is for use in air ducts, air plenums, and other environmental air spaces; check your building and electrical codes to see where you should use this cable.) Thin coaxial cabling requires a 50-ohm terminator (terminating resistor) at each end to maintain the correct cable impedance.

Thin Coaxial Cable



The governing standard for thin coaxial network cabling (IEEE 802.3, Type 10Base2) permits a maximum cable segment length of 185 meters. The cable segment can be built up from shorter sections, allowing connection of network devices along the length of the cable through BNC "T" connectors; the cable sections must be at least 0.5 meters (20 inches) long. The standard limits the number of connections to a thin coaxial cable segment to 30.

Thin coaxial cabling should not be grounded at any point, unless grounding is required by your local electrical code; in that case, ground the cable segment at one point only.

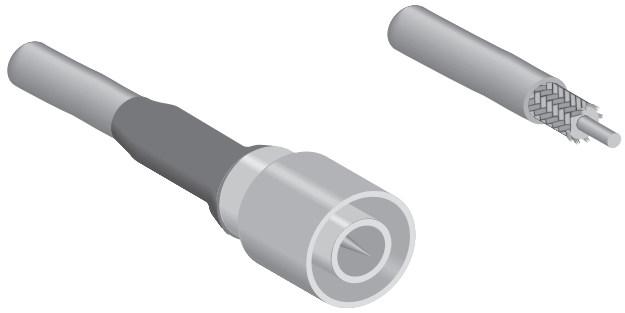
Generally, thin coaxial cable is not recommended for the workgroup. The cable itself works fine electrically; its problem is the ease with which it can be disconnected. When thin coax is in an unprotected area (as it must be where it connects to a node), network users can and do get to it. It is not uncommon for a user to disconnect the cable in the course of attempting to isolate a network problem at his node. In doing so, if the user separates the cable (rather than just disconnecting the "T" from the computer), the entire coaxial cable segment becomes "unterminated", which disables all network communications on the cable. This condition may also cause network software to crash. (A terminator left off the end of the cable, or a stray section of 75-ohm video cable mixed in with the 50-ohm network cable, will cause the same problem.) For this reason it is best to use thin coaxial cable only in secure areas like wiring closets.

In addition, the bus structure of thin coaxial cable is harder to troubleshoot than the star structure of twisted-pair cable. A twisted-pair cable segment has a very simple topology, as it involves only a single node, the hub, and the cable between them; it is not difficult to isolate a problem on such a simple cable segment. A thin coaxial cable segment, on the other hand, has a much more complex topology, since the cable is shared by many nodes. A network problem could be caused by any of the nodes, any of the cable sections that make up the cable, or either of the two terminators; such a problem typically takes much more time to troubleshoot.

Currently, the preferred cable is using Stacking Cable, or twisted-pair cable from hub to hub using the MDI port.

Thick Coaxial Cabling

Thick coaxial cabling ("thick coax") has a diameter of 10 mm and an impedance of 50 ohms. It comes with a jacket material of either polyvinyl chloride (PVC) or fluoroethylene polymer (FEP), a Teflon-like substance. (The FEP cable is for use in air ducts, air plenums, and other environmental air spaces; check your building and electrical codes to see where you should use this cable.) Thick coaxial cabling requires a 50-ohm terminator (terminating resistor) at each end to maintain the correct cable impedance.



The governing standard for thick coaxial network cabling (IEEE 802.3, Type 10Base5), permits a maximum cable segment length of 500 meters. To minimize impedance discontinuities and the resultant signal reflections, the

standard recommends that the entire thick coaxial segment be a single length of unbroken cable. If that is not possible, the alternatives are, in decreasing order of preference: cable sections from the same manufacturer and lot number, using sections of any length; or cable sections from different manufacturers and/or lot numbers, with lengths of 23.4 meters, 70.2 meters, or 117 meters (the odd half-wavelengths of the network signals, to minimize reflections). Connection to cable is made with a transceiver, using a "vampire" tap that pierces the cable without cutting it into sections, or by cutting the cable to install N-series connectors and a "T"; the transceiver connects to the AUI port of a network device via an AUI cable. Transceivers should be attached only at the black bands marked every 2.5 meters along the cable (to minimize the constructive interference of reflections caused by the impedance discontinuity at the points of attachment). The standard limits the number of connections to a thick coaxial segment to 100.

Each thick coaxial cable segment should be grounded at one (and only one) point. Check with your building and electrical codes for further details on grounding requirements.

Because of its thickness and consequent stiffness, thick coax is cumbersome to install and administer. In the situations where it is generally used it does not offer significant advantages over other cable types, so we do not recommend it for new cable installations. It is, however, already in place as backbone cabling at many sites, and we see no reason to replace it where it is working well. Since it interoperates readily with other cable types, it is easy to expand an existing thick coaxial cabling system using new cabling of other, more suitable, types.

AUI Cables

AUI cables contain individual, untwisted copper wires and come in both thick and thin varieties. Thick AUI cables can be up to 50 meters long, and thin AUI cables can be up to 15 meters long. We recommend that you use thin AUI cable wherever the AUI cable distance is short, as the thick AUI cable is inflexible and difficult to handle.

AUI cables do not constitute a separate cable type under the standards; they are simply a means of connecting a network device to its network cable (via transceiver) under certain circumstances. But the standards do take them into account in determining the limits of network topologies.

The table below summarizes the relative strengths and weaknesses of the different cable types in backbone applications.

Comparison of Cable Types for Backbone Applications

	Fiber-optic	Twisted-pair	Thin coaxial
Growth potential	S	A	A
Topological flexibility	S	S	A
Upgrade potential: FDDI	S*	n/a	n/a
Upgrade potential: 100Base-T	S*	S	n/a
Upgrade potential: 100VG-AnyLAN	S*	S	n/a
Cable lengths	S	A	A
Security	S	A	A
Noise Immunity	S	A	A
Ease of Troubleshooting	S	S	A
Cost	A	S	S

S = superior solution
A = acceptable solution
n/a = solution not available
* = when using multi-mode cable

Cable Connections Summary Table

The following table summarizes how to stack HP's networking products together. Note that this table includes three concepts: stacking, cascading, and using a backbone.

- **Stacking** is using a wide cable called "stacking cable" such as the cable used with the Switching Hubs and the HP AdvanceStack 100Base-T Hub-12TX, 12TXM Hubs. This cable carries both management and data and allows the stack of hubs to act as one repeater instead of several.
- **Cascading** is connecting twisted-pair cable from one hub to the other. The twisted-pair is straight through if you connect from the MDI/MDI-X port to a port on the next hub. The twisted-pair cable is crossed over if no MDI/MDI-X port is available. When you cascade hubs together, each hub is a repeater.
- For the ThinLAN Hub plus and other hubs with a BNC connector, thin coax cable can be used to create a thin coaxial **backbone**.

Hub or Switch	Type of Cable for Stacking/ Cascading for Network Data and/or In-Band Management	Number of Hubs or Switches Allowed in a Stack	Port for Stacking/ Cascading	Distance Limits from Hub to Hub or Switch to Switch
Hub-8E, Hub-8U, Hub-16U, Hub 12, Hub 24, Hub 12M, Hub 24M	unshielded, twisted-pair cable, Category 3 or better	4 hubs using twisted-pair cable	MDI/MDI-X Port	100 meters
Switching Hub-12R, 24R, 24T	Stacking Cable 12.5 in or Long Stacking Cable 28 in	8 hubs using provided stacking cable	In and Out ports	Same as Stacking Cable length. Up to two Long Stacking Cables per stack
Hub-12, 24, 48	Category 3 twisted-pair cable	16 hubs with twisted-pair cable through the Distributed Management Chain ports	In and Out ports	185 meters for twisted-pair cable
100VG Hub-7M, Hub-14, 7E	EITHER: unshielded, twisted-pair cable, Category 3 or better or fiber-optic cable	3 hubs using twisted-pair cable	Uplink	twisted-pair: 100 meters, fiber: 2 km
ThinLAN Hub Plus, and others with BNC ports	thin coax	30 hubs using thin coax cable	BNC port	Varies. Total distance cannot exceed 185 meters of thin coax cable
Fiber-Optic Hub Plus	thin coax or fiber-optic cable	thin coax connection: 30 hubs/ fiber connection: 4 levels of hubs	BNC port or fiber optic port	thin coax: 185 meters, fiber: 1000 meters
100Base-T Hub-8TXE	unshielded twisted-pair cable, Category 5 or better	2 hubs	MDI port	23 meters
100VG Switch 200	twisted-pair cable, Category 3 or better	3 switches (each switch has SNMP built-in)	Uplink	100 meters
100Base-T Hub-12TX, 12TXM	Stacking Cable 8.5 in	5 hubs using provided stacking cable	In and Out ports	Same as Stacking Cable length

The following products are not stackable: Switch 2000, Switch 208/224, and Switch 800T.

Special Situations with Cable

Special situations are:

- Extra cable length required
- Noise immunity required
- Outdoor cabling required

Extra Cable Length Required

The nominal maximum length of a twisted-pair cable is 100 meters. ("Nominal" indicates that the actual, maximum length may vary from manufacturer to manufacturer. Check with your cable supplier to find the actual maximum length for the cable you use.) If you need a longer run than 100 meters, there are two solutions, one using twisted-pair cable and one using fiber-optic cable. You can get cable lengths up to 225 meters with twisted-pair cable, and up to 1000 meters with fiber-optic cable.

Twisted-Pair Solution: Long Cable Option

The extent of an Ethernet/IEEE 802.3 LAN (collision domain) is limited by the Ethernet topology. There are a couple of ways you can get around these limitations.

The twisted-pair solution uses an HP twisted-pair transceiver at each end of the cable, installed in the hub's transceiver slot or connecting to an available AUI port on a hub or other network device. For the HP AdvanceStack hubs, the transceiver can be either:

- an HP J2607A Twisted-Pair Transceiver Module that slides into the AUI/Xcvr slot, or
- an HP 28685B EtherTwist Transceiver (an external transceiver) that you can attach to an HP J2609A AUI Port Module.

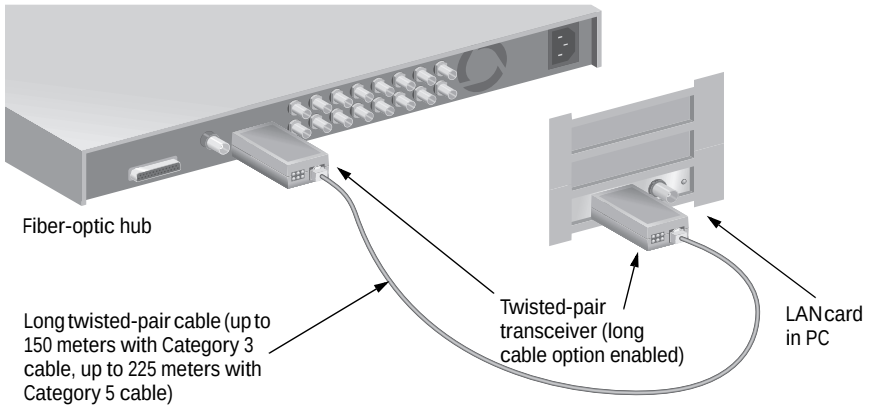
The AUI Port Module installs in the AUI/Xcvr slot on the HP AdvanceStack hub and provides a standard AUI connector, allowing you to attach any standard external transceiver or transceiver cable. You might encounter this situation if you are expanding an existing HP EtherTwist network with new AdvanceStack hubs; the external transceivers you are accustomed to using with your EtherTwist hubs will work with the AUI Port Module installed in an AdvanceStack hub.

These twisted-pair transceivers have a long cable option that increases the sensitivity of their receiver circuits, thus allowing the receivers to pick up fainter signals that have traveled through a greater length of cable. This option is set with a switch on the external transceiver, and with a jumper on the internal transceiver. Due to the transceiver's increased sensitivity when the long cable option is enabled, it is more susceptible to crosstalk. Therefore, you must use only 4-pair cable (not 25-pair cable) with only one set of

signals running in it, to eliminate any potentially disturbing adjacent pairs. The specific cable requirements are described in detail in the product documentation that is provided with each of these transceivers.

The long cable option must be enabled on the transceivers at both ends of the cable. In such a configuration, the maximum lengths are 150 meters using Category 3 cable and 225 meters using Category 5 cable. The extra cable length adds approximately 1.5 bit times of delay, and is unlikely to invalidate an otherwise valid topology.

The illustration below shows the cable connections.



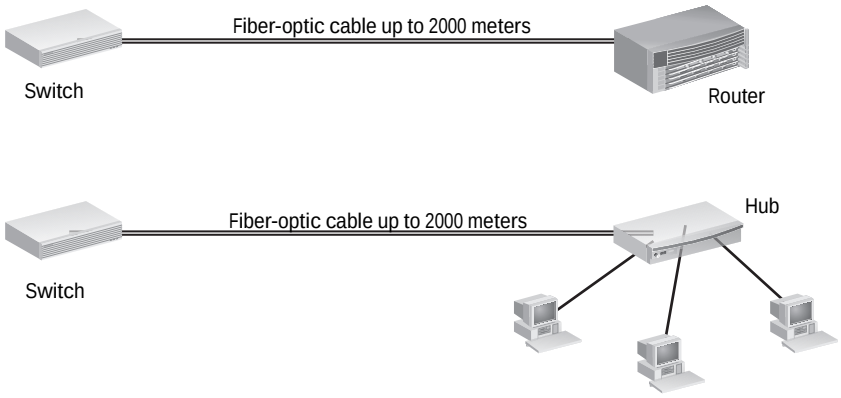
Fiber-Optic Solution

For longer cable runs between a hub and a computer or a printer, use fiber-optic cable. The fiber-optic solution uses a fiber-optic cable with a fiber-optic transceiver attached to the device at each end. Depending on the product, different transceivers are available:

- AUI Port that accepts an external transceiver: HP 28683A Fiber-Optic Transceiver
- HP AdvanceStack 10BT Switching Hub-12R, 24R, 24T and HP 10Base-T Hub-12, 24, 48, Hub-8U, Hub-16U accept an internal transceiver: HP J2606A Fiber-Optic Transceiver Module (Note that the Hub-12 and Hub-48 are no longer available from HP but are listed here in case you want to add a transceiver to these hubs.)
- HP AdvanceStack 100Base-T Hubs: HP J3248A AdvanceStack 100Base-T FX Switch Port Module
- HP AdvanceStack 100VG Hubs, Switches: HP J3028A 100VG UTP Transceiver
- HP AdvanceStack Switch 2000: HP 100Base-T Transceiver Module that accepts the HP 100Base-FX Transceiver
- HP AdvanceStack Switch 800T: HP 100Base-FX Transceiver Module

For connections between distant LANs, you can use up to 2000 meters of fiber-optic cable in a single segment. See the illustration below.

Extended cable segment lengths using fiber-optic cable

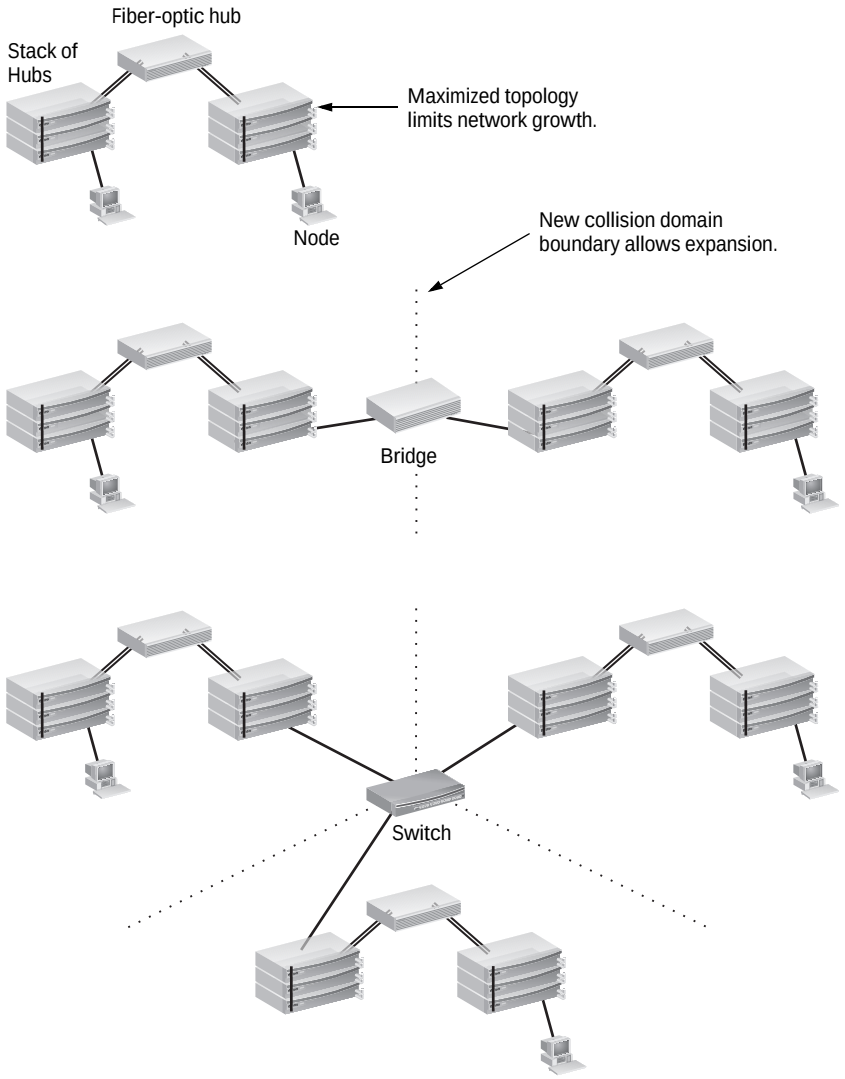


If the cable is connected between devices that form LAN boundaries (bridges, switches, and routers), the cable is a valid topology under the delay rules of the IEEE 802.3 standard. In fact, you could even attach a small workgroup to the fiber-optic cable, as long as the fiber-optic cable connects on the other end to a device that forms a LAN boundary (a router, bridge, or switch). Be sure to check the validity of your final topology, using the Ethernet topology rules.

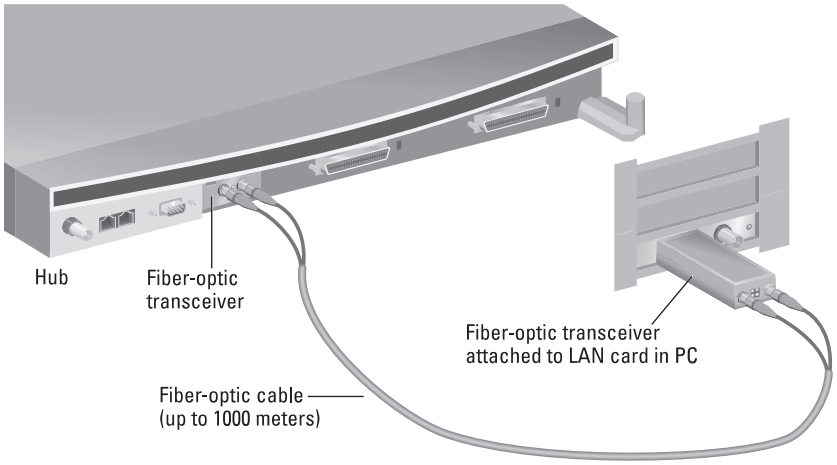
The second way to extend a maximum topology is to add a bridge, switch, or router. Any of these devices will provide a boundary for the LAN (collision domain); once you cross the boundary you are in a new LAN. You can build a completely new topology, up to the maximum IEEE 802.3 limits, in the new LAN.

Expanding into a new collision domain is a particularly good way to extend a network that has reached the maximum number of cable segments and repeaters. Be aware, however, that the IEEE 802.1 Spanning Tree Protocol recommends a limit of 7 bridges or switches between any 2 nodes in a bridged local area network; it is a good idea to follow this practice even if you don't currently have plans for using spanning tree bridging.

Expanding network by adding new collision domains



Hub Connected to a PC With Fiber-Optic Cable



If you want more than one fiber-optic port per hub, look at the HP Fiber-Optic Hub for 10Base-T networks.

Noise Immunity Required

Since fiber-optic cable uses optical, not electrical, signals, fiber-optic cable is immune to electrical noise. If you need to make network connections through an area of high electrical noise, fiber-optic cable will provide the noise immunity you need. Connections are as described above for fiber-optic cabling under Extra Cable Length Required and as shown in the above illustration.

Outdoor Cabling Required

For cabling that must run outdoors between buildings, the only cable we recommend is fiber-optic cable. Since fiber-optic cable is an optical rather than an electrical medium, it is immune to disturbance by lightning strikes. Outdoor fiber-optic cable should be buried to prevent physical abuse caused by foot traffic, vandalism, gnawing animals, and lawnmowers. Connections are as described above for fiber-optic cabling under Extra Cable Length Required and as shown in the above illustration.

Handling Adds, Moves, or Changes

One of the top tasks for you as a network administrator is adds, moves, changes, or disconnects. Adding new employees or moving employees from one building to the other usually involves a hardware change in the wiring closet or a software change.

Adding a New Employee

When a new employee starts work, you need to do the following steps:

1. If your network is using IP, assign an IP address to the new employee's PC.
2. Enter the LAN adapter's MAC address in a database for troubleshooting in the future. The MAC address needs to be kept because troubleshooting software identifies the PC by MAC address.
3. Connect the PC's LAN adapter cable to the "LAN drop" or "drop" in the employee's office or cube. This drop is numbered. Write down the number.
4. In the wiring closet, find the drop number on the patch panel or punch down block. Connect the desired cable from the patch panel or punch down block to the hub.

If you have not done so already, have each empty cube pre-wired for future employees.

Moving an Employee from one Office to Another

For all of HP's hubs (except the HP Switching Hubs), a move is handled by the following steps:

1. Identifying the number of the old drop and the new drop.
2. Find the numbers on the patch panel or punch down block and move the cable from one patch panel connection to another.
3. If the employee will be using a different printer and server, then you need to move the cable from one hub to another.

For the HP Switching Hubs, a move can be handled in software instead of the wiring closet. In the ASCII console or HP AdvanceStack Assistant, specify the new segment (1-4) that a user will be on. With the Switch 2000, you can also use VLANs.

Changing an Employee's Configuration

Usually a change of configuration such as a change in user rights or privileges involves a software change at the server level. If you already have the network segmented into groups-based on rights then you simply move the user to the desired segment using the terminal console or HP AdvanceStack Assistant.

Disconnecting an Employee from the Network

A list of IP addresses with the cubicle number along with the employee number will allow you to quickly identify which port each employee uses. Before or after an employee leaves your company, you need to disconnect that employee's workstation from the network in either software or hardware. In network management software, you can disable the port using the "port disable" command. The hardware method depends on your wiring:

- If the wiring closet uses cross-connect blocks, you can easily ensure the security of the network by removing the employee's twisted-pair cable out of the cross-connect block.
- If the cables are 50-pin telco, then use the "port disable" command by using the terminal console or HP AdvanceStack Assistant.