OPEN DECconnect System Overview

Digital Equipment Corporation's OPEN DECconnect System provides a comprehensive solution for supplying physical connections between individual network devices on a local area network (LAN). Standards-based, the OPEN DECconnect System accommodates networks — from the smallest LAN to a global multivendor network with products that have been stringently tested at the component and system level. The OPEN DECconnect System supports worldwide services to design, install, and manage networks that protect customers' network investments.

OPEN DECconnect System

Today's rapidly changing data communications market puts a premium on implementing data network cabling systems that can withstand the test of time. These cabling systems must be able to support all of the devices currently attached to the systems, and provide flexibility for future growth in the number of users and available bandwidth. The systems should serve users' needs for the facility's lifetime.

OPEN DECconnect is designed to run a wide array of application technologies and vendor platforms while providing true distributed computing by integrating terminals, personal computers, and workstations into the enterprisewide network. OPEN DECconnect offers a full range of media choices, while providing flexibility and modularity for network growth. The focus of OPEN DECconnect is on the use of:

- Fiber optics for the network backbone and horizontal LAN connections to allow capacity for high-traffic network usage
- OPEN DECconnect Super-5 (TIA/EIA Category 5), twisted-pair, fiber-optic backbone cabling, and, where necessary, fiber-optic cabling for horizontal wiring and work area/office connections

The OPEN DECconnect structured wiring supports fiber and copper information system solutions for applications such as:

- **Data** — FDDI, TP-PMD, IEEE 802.3/Ethernet, 100BaseTX, 100BaseT4, 10BaseT, 10Base2, 10Base5, 10BaseF, 802.5/Token Ring 4 Mb/s and 16 Mb/s, EIA-232, EIA-423, EIA-422, Apple, LocalTalk, IBM 3270, IBM AS/400E 3X Series, and ATM
- **Imaging** — Plotters, facsimile machines, and graphics stations
- **Sensing** — Building management
- **Video** — Interactive teleconferencing or security
- **Voice** — Telephone and intercom

OPEN DECconnect Architecture

The OPEN DECconnect Architecture is based on the TIA/EIA Building Standard Architecture consisting of the five basic subsystems: campus, building, horizontal, work area, and administration subsystem.

For the last several years, the Electronics Industries Association (EIA), at the request of the Computer Communications Industry Association (CCIA), has been developing a standard for telecommunications building wiring. The Telecommunications Industry Association (TIA), and each of the major U.S. computer manufacturers, including DIGITAL, have also been involved in developing this standard. This level of support facilitates widespread customer acceptance of the TIA/EIA standard for commercial building wiring.

This TIA/EIA-568A standard, which addresses voice and data using both copper and fiber, is now the structured wiring standard for commercial office buildings. The standard specifies topology, distances, media, and connectors to provide an application-independent cable plant with the goal of becoming a utility.

To support the building wiring standards, the OPEN DECconnect System has been upgraded to become a more scalable cabling system from the Main Cross-Connect (MC) to the office. Product enhancements to OPEN DECconnect have made it fully compliant with the TIA/EIA-568A standard and the international ISO/IEC 11801 standard.

TIA/EIA-568A Commercial Building Wiring Architecture Standard

The TIA/EIA-568A Commercial Building Wiring Standard defines telecommunications wiring for one building or multiple buildings in a campus environment. The standard specifies wiring system parameters, including:

- Topology
- Distances
- Media and connector-pin assignments

The *TIA/EIA-568A Commercial Building Wiring Standard* recognizes two types of wiring:

- Horizontal cabling
- Backbone cabling

Figure 2-1 illustrates the *TIA/EIA-568A Commercial Building Wiring Standard* distance limitations and distribution subsystems for TIA/EIA-568A and OPEN DECconnect. DIGITAL recommends the hierarchical physical star network topology as prescribed by this standard. Within this structure OPEN DECconnect also supports other topologies such as ring, bus, and point-to-point configuration.

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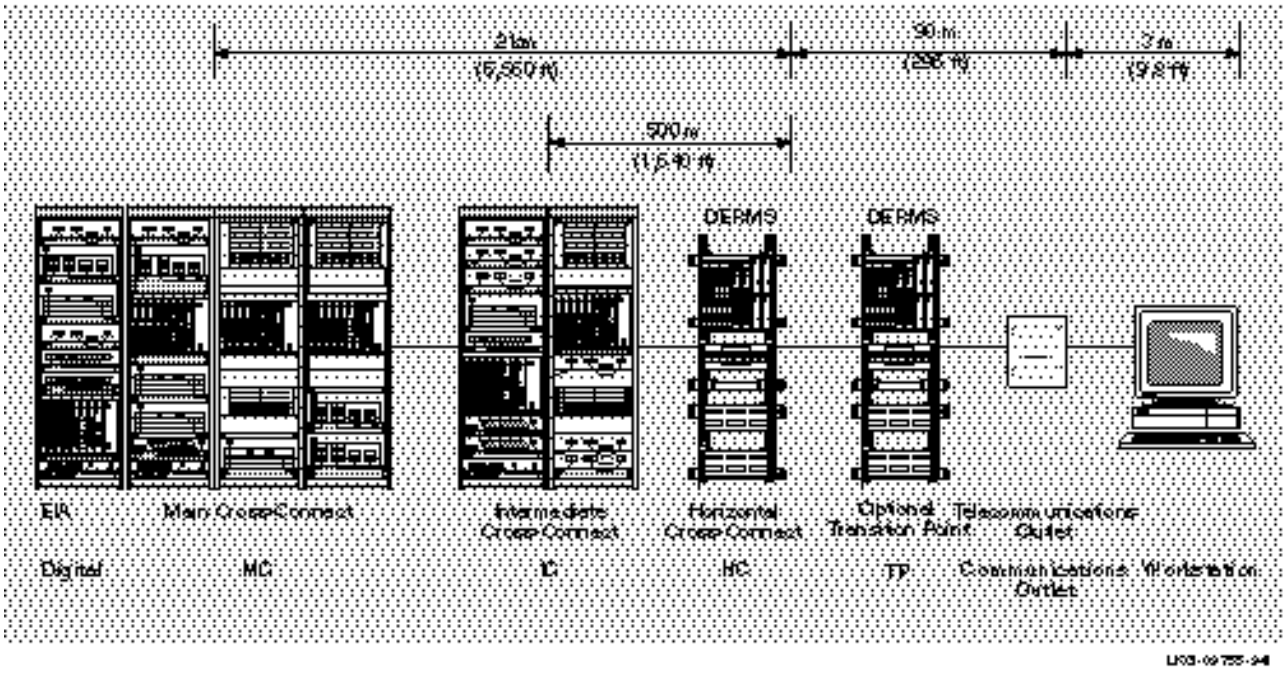


Figure 2-1: TIA/EIA-568A Distance Limitations and Distribution Subsystems

DIGITAL's Adherence to Standards

The development of standards to control the design and implementation of the physical network has benefited customers and manufacturers of network components. Standards expand the network's value, making it possible to support products from multiple vendors. DIGITAL is a charter member of the TIA/EIA standards body and continues to support the development of open networking solutions. The company's involvement with standards — both current and evolving — can clearly be seen in the OPEN DECconnect System, which allows the integration of networking products across all standard media types. Today, for example, the OPEN DECconnect System is flexible enough to accommodate FDDI network connectivity using 100-ohm UTP/ScTP/FTP cable, 150-ohm STP, or ThinWire coaxial cable. This demonstrates DIGITAL's commitment to existing investments by allowing expanded use of installed cable, while supporting new media currently being defined by standards.

Compliance with Current and Evolving Standards

The OPEN DECconnect System addresses physical management of the cable medium connecting the active products required to support the network. This system supports connectivity starting at the active port in the equipment room through the faceplate and office equipment cable. All components are specified to be compliant with national and international standards.

Commitment to current and evolving standards ensures that the breadth of products needed to support local Public Telephone & Telegraph (PTT) and Electromagnetic Compatibility (EMC) requirements are available from DIGITAL.

Increased Data Transmission Support

The industry anticipates significant advances in data transmission support.

Twisted Pair

The TIA/EIA TR-41.8.1 Subcommittee has released specifications for twisted-pair cables and connecting hardware that specifies media at signaling frequencies up to 100 MHz. The OPEN DECconnect Super-5 system also supports the ATM specification that specifies 155 Mb/s over Category 5 twisted-pair cabling.

FDDI (TP-PMD)

In addition, the ANSI X3T9 Technical Committee established specifications allowing FDDI data rates to be transmitted over (UTP) Category 5 interconnect cables and components. This application, identified as TP-PMD, is differentiated from the 100 Mb/s fiber-optic application defined as FDDI. Although the data rate is 100 Mb/s, the peak signal power is below 31.25 MHz because of the MLT3 encoding scheme. (MLT3 is specified in the TP-PMD portion of the ANSI X3T9.5 standard.)

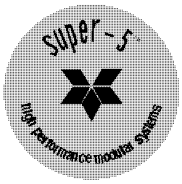
ATM

Emerging asynchronous transfer mode (ATM) implementations will specify encoding methods that can support 155 Mb/s data rates using Category 5 UTP/ScTP cabling.

OPEN DECconnect System Topology

To develop a structured data network, the OPEN DECconnect System provides products within the Main Cross-Connect (MC), Intermediate Cross-Connect (IC), Horizontal Cross-Connect (HC), and optional Transition Point (TP). OPEN DECconnect supports the TIA/EIA-568A Commercial Building Wiring Standard and the IEC/ISO 11801 Standard.

OPEN DECconnect Super-5 System (TIA/EIA Category 5)



DIGITAL has developed a complete Category 5 (Super-5) system consisting of cables, patch cords, and connectors to support TIA/EIA-568A, which defines the highest system performance in the industry. DIGITAL had taken the lead in specifying the highest performing UTP media for use in a network in advance of the release of the TIA/EIA Category 5 cable specification defined in TSB36 — the standard created by the working group responsible for defining cable category specifications.

This system of components is part of the Category 5 structured wiring system and includes Category 5 connectors, patch cords, and building cabling. These components support the transmission of high-speed data, which is defined today by ANSI X3T9 TP-PMD for FDDI including IEEE 802 100BaseT Ethernet standards along with the ATM standard.

DIGITAL's involvement does not end with the product. As with other OPEN DECconnect products, DIGITAL supplies the components — in this case, Category 5 — and workmanship practices and procedures to ensure that the installed network meets system performance specifications. Along with the installation procedure, DIGITAL is establishing verification processes to ensure that the network performs to specification. Customers using the OPEN DECconnect System's Super-5 (TIA/EIA Category 5) products will have a system composed of the highest quality components backed by the expertise needed to build the network.

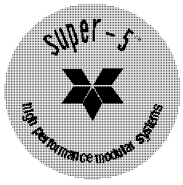
OPEN DECconnect Screened High-Performance Interconnect Components

Shielded Versus Screened

Two types of twisted-pair cables incorporate shielding: shielded cable (STP) and screened cable (ScTP/FTP). Shielded cable provides individual shields for each wire pair and an overall shield covering the individual shielded pairs. Screened cable incorporates only an overall shield covering the unshielded pairs included in the cable. Most 100-ohm twisted-pair cables that incorporate shielding are of the screened variety. DIGITAL supplies a complete line of screened connectors and cables. DIGITAL developed and specified the OPEN DECconnect screened cables and connectors to meet the same specifications defined in TIA/EIA-568A (Category 5 UTP).

The IEC/ISO 11801 standard covers generic cabling for the customer premises. This standard specifies 100-ohm shielded/screened twisted-pair cable as one cable type used in the customer premises and defines the performance of that cable using the same parameters defined by TIA/EIA-568A with the addition of a transfer impedance specification. DIGITAL tested its screened system to ensure compliance with the performance specifications. The company continually monitors standards activity to ensure that its screened system meets all specifications.

Categorizing Networking Components: Considerations for Implementing Category 5



The TIA/EIA-568A standard defines the performance of twisted-pair cables and associated connectors in three categories: Category 3 specifies the performance of copper cables and connectors from 1 MHz to 16 MHz; Category 4 defines performance from 1 MHz to 20 MHz; Category 5 specifies performance from 1 MHz up to 100 MHz; and Category 5 specifies the highest level of performance available for 24 AWG unshielded twisted-pair cable. Cables meeting this performance level are specified by the ATM standard to support data rates of up to 155 Mb/s.

FDDI (TP-PMD) 100 Mb/s over UTP

The performance requirements of 100 Mb/s data transmission are not directly correlated to the 100 MHz specification stated for Category 5 connectors. Two factors are involved. First, the current implementation of the 100 Mb/s data transmission uses a method of encoding (MLT3) that reduces the maximum required channel bandwidth to 31.25 MHz. Second, the pairs selected to carry 100 Mb/s transmission are generally those that are farthest apart.

TP-PMD specifies pins 1-2 and 7-8 on the 8-pin MJ for cable pair termination. Therefore, the near-end crosstalk (NEXT) in the connector is significantly reduced for those pairs, and consequently many of the existing connectors meet the performance limits on those two pairs.

This example does not diminish the importance of the Category 5 limits or imply that these connectors qualify as Category 5, but rather shows that in some cases existing connectors may not need to be replaced to support 100 Mb/s data rates. Category 5 system components are recommended to provide the required margin for supporting future high-speed communications.

Category 5 Implementation Without Significant Changes

Many of today's data systems that have evolved from the structured voice wiring systems use Cross-Connect termination fields. Category 5 components used to build high-speed networks are affected by including traditional termination fields. The use of 110-style Cross-Connect fields may not support Category 5 applications unless special Category 5 patch cords are used. In contrast, the OPEN DECconnect System was designed to avoid this cable management method, and easily accommodate Category 5 implementations without significant changes beyond installing the new components.

High-Performance Voice Networking Components

DIGITAL offers a complete set of components that support the distribution of the voice network. These products are based on 110-style insulation displacement connector (IDC) technology. Most of the connector assemblies have been verified to Category 5 limits and can support voice or data within the building's structure. This allows the development of an integrated network composed of both OPEN DECconnect Super-5 voice and data interconnect products.

The data and voice products are completely compatible and work together or separately. This allows the design to evolve to meet customers' needs in the multimedia environment. This system is ideally suited for the voice network structure but is not limited to that role. The system is built with the highest performing cables and connectors, and can support the integration of high-speed Ethernet, FDDI (TP-PMD), and ATM.

OPEN DECconnect: Vendor- and Product-Independent Wiring

OPEN DECconnect, introduced in February 1986, had two components: a primarily copper-based structured cabling system and active network hardware products. It has since evolved beyond its copper-based structured cabling system to one that is open and truly multivendor in nature, and focuses on the use of fiber optics for the network backbone. The OPEN DECconnect System includes all the passive networking products that provide for standards-based networks. The OPEN DECconnect System's structured cabling system is a vendor- and product-independent wiring system that is:

- Based upon TIA/EIA, IEEE 802, and ANSI standards, and stresses the use of fiber-optic cabling for network backbones and copper cabling for work area connectivity, with fiber-optic support to the desktop when required
- An application-independent structured cabling system

The key features of OPEN DECconnect are:

- Open, nonproprietary system
- Full multivendor support
- Increased modularity and flexibility
- Multimedia support
- Backwards compatibility with existing products
- Extended Performance Category 5 cable, tested up to 360 MHz

OPEN DECconnect Summary

OPEN DECconnect, the result of years of development, focuses on the network as a system. Many of the design decisions in the early development phases considered the network's future needs.

Today, requirements to support twisted-pair networks at 100 MHz, with data rates of 100 Mb/s and beyond, are possible through:.

- extensive planning in advance of standards implementation
- networking solutions tested at the component, system, and application levels
- products designed to meet the highest available system performance specifications and standards
- a worldwide support organization

The OPEN DECconnect System protects customers' investments in existing wiring, while accommodating the industry's highest performance specifications.

OPEN DECconnect Warranty

Digital Equipment Corporation warrants that, for a period of fifteen (15) years following customer acceptance, DIGITAL's OPEN DECconnect passive wiring components will transport data in accordance with the cable channel specification in effect at the time of acceptance. DIGITAL, at its option, will repair or replace any defective cable channel component that causes the channel to fail to meet the original design specification within the warranty period.

This warranty is effective only if the cable channel is designed and installed by DIGITAL's authorized reseller, in accordance with DIGITAL's approved design specifications, and is operating at the customer's original location. This warranty only covers the passive network components approved and specified by DIGITAL, and is intended for use with active network interface products certified by the manufacturer to comply with the cable channel specification released by the major standards organizations in effect at the time of installation. Future network upgrades, changes, applications, and/or requirements are covered by the warranty only if the installation is performed by DIGITAL's authorized resellers, and are tested and verified in accordance with the latest version of DIGITAL's cable channel specification.

Media and Network Planning

Media and network planning provides a framework for the management of heterogeneous, multivendor systems. An effective network management and planning system allows network personnel to meet specific organizational goals and technical needs.

Structured Cabling Systems: Planning for the Future

A well-planned structured cable plant allows network planners and managers to accommodate virtually any number of moves easily, inexpensively, and without disruption to the organization.

Advantages of Structured Cabling

Because the cabling infrastructure is such a crucial part of a local area network, proper planning and execution of building topology mapping is critical to its success. Structured wiring ensures properly designed pathways; its importance cannot be overemphasized. See Table 2-1 for a comparison of structured and unstructured wiring.

A structured cabling system consists of various families of components including: transmission media (cables); circuit administration; and other hardware such as communication connectors, jacks, plugs, adapters, baluns, and transmission electronics.

A well-designed structured cabling system such as OPEN DECconnect is independent of the equipment it connects. The structured cabling system should also be capable of interconnecting many different communication devices such as data terminals, analog and DIGITAL telephones, personal computers, and host computers.

Table 2-1: Comparison of Structured and Unstructured Cabling

Structured Cabling	Unstructured Cabling
Standards based	Non-standards based
Application independent	Prone to application dependency
Allows movement of people and equipment without rewiring	Often requires rewiring when moving people or equipment
Allows for growth and change	Does not allow for easy growth and change
Easy to reconfigure wiring and communication equipment	Difficult to reconfigure wiring and communications equipment
Modular design allows flexibility	Non-modular, inflexible system
Allows for administration and maintenance of the cable plant; facilitates the isolation of equipment and cable problems	Generally not labeled and documented; limited management and problem isolation capabilities
Defines distance and topology	Free form
Reduces cost of ownership	High cost of ownership

LAN Cable Media Applications and Selection Considerations

Data communications technological advances have been outpacing changes in most other areas including cable design. These advances have brought qualitative and exponential increases in data speed (for example, 9.6 Kb/s to 155 Mb/s) in just over a decade. Cable technology needs to meet this technological growth. Recent trends show:

- A growing number of users requiring connections to LANs
- A proliferation of multivendor-based LANs requiring support for a variety of equipment from different vendors
- An increasing demand by users for more LAN bandwidth

Cable Media Selection Criteria

Selecting the proper cable medium requires a thorough understanding of three key factors:

- Intended applications of the LAN
- Size and structure of the building
- Anticipated growth of the network and its application speed

Three major cost factors influence the selection of the cable media:

- Initial cost for the cable, connectors, patching hardware, and labor for installation
- Investment protection provided by the cable over its useful life, and by adherence of equipment and installations to industry standards
- Versatility of the cable to handle voice, video, and other forms of high- and low-speed data communications, resulting in maximizing returns on investments

Network technical requirements for cable media usually include the expected data rate needed, distance coverage, immunity to noise, troubleshooting, security, and the move, add, and change capabilities. The decision for appropriate media selection should be based on:

- Requirements for current applications
- Minimal risks such as financial and safety, while evaluating the opportunity costs
- Flexibility for changes
- Capability of expansion/growth for additional and future applications and users
- Investment protection provided by the cable over its useful life and through adherence to industry standards

Cabling Choices

DIGITAL's LANs support all of the following media choices for: unshielded (UTP) and screened (ScTP/FTP) twisted-pair cable, fiber-optic cable, ThinWire (coaxial), and baseband cable.

Twisted-Pair Cable

Twisted-pair cable was first developed to support voice networks. Expanding the use of twisted-pair, DIGITAL and other computer vendors use twisted-pair for data communication between high-speed workstations and terminal connections.

Due to its low cost, twisted-pair is ideally suited for connecting the work area equipment to the network. Unshielded (UTP) and screened (ScTP/FTP) are two types of 100-ohm, twisted-pair cabling which support Category 3 and Category 5 variations. The OPEN DECconnect system also offers and **Extended Performance** Category 5 UTP cable that is tested up to a frequency of 360 MHz. DIGITAL recommends using Category 5 cabling for structured wiring.

Twisted-Pair Cable Applications

Twisted-pair cable manufacturers have grouped these cables according to performance levels. NEMA, UL, ISO, and TIA/EIA have released specifications that group 100-ohm UTP and ScTP cables into five performance-grade categories. These categories define certain standards requirements, data-transmission rates, and specific transmission parameters for each group of cables.

OPEN DECconnect recommends high-performance data grade (Category 5) twisted-pair cables to cover the majority of Physical layer LAN applications. Table 2-2 indicates the choices of horizontal cable media along with information on what types of applications are presently supported.

Table 2-2: Application Versus Media Type

			Horizontal Media Type		
Physical Layer Application	**Fiber**	**ThinWire**	**UTP[1]/ Category 3**	**UTP/ Category 5**	**ScTP[2]/ Category 5**
EIA-232			X	X	X
EIA-422			X	X	X
EIA-423			X	X	X
ISDN			X	X	X
IEEE 802.3 10Base2		X			
IEEE 802.3 10BaseT			X	X	X
IEEE 100BaseT				X	X
Ethernet Synchronous (10BaseF)	X				
IEEE 802.3 FOIRL	X				
IEEE 802.5 4 Mb/s			X	X	X
IEEE 802.5 16 Mb/s[3]			(limited distance)	X	X
ANSI/ISO FDDI	X				
TP-PMD				X	X
LocalTalk			X	X	X
IBM 3270			X	X	X
IBM AS/400 3X			X	X	X
ATM				X	X

[1]UTP is unshielded 4-pair, 22- and 24-gauge, 100-ohm twisted-pair.

[2]ScTP/FTP is screened 4-pair, 22- and 24-gauge, 100-ohm twisted-pair.

[3]16-Mb/s Token Ring can be supported over Category 3 UTP provided that the cabling has been tested and verified to meet the Category 3 specifications and distance limitation requirements.

Twisted-Pair Connector Pin Assignments TIA/EIA-T568A

The OPEN DECconnect snap-in 8-pin modular data jacks (H3112-E/F/G/H series) conform to the TIA/EIA-T568A preferred pin-pair assignments. This pin/pairing meets ISO 8877 requirements. The H3112-IV/JV data jacks conform to the TIA/EIA-T568B pin-pair assignments. See Figure 2-2.

Figure 2-2: 8-Pin Modular Jack Assignments (TIA/EIA-T568A/T568B)

Table 2-3: Applications in Conjunction with Pin Assignments (TIA/EIA-T568A Pin-Pair Assignments)

Application	Pair 3 Pins 1, 2	Pair 2 Pins 3, 6	Pair 1 Pins 4, 5	Pair 4 Pins 7, 8
ISDN	Power	Transmit	Receive	Power
Analog Voice	—	—	Transmit/Receive	—
IEEE 10BaseT	Receive	Transmit	—	—
IEEE 100BaseTX	Receive	Transmit	—	—
IEEE 100BaseT4	Receive	Transmit	Bidirectional (BI)	Bidirectional (BI)
EIA-423 DL (only)	Receive	Transmit	—	—
EIA-423	Receive	Transmit	—	Ready In/Out
EIA-423 DL and Modem Control	Receive	Transmit	CTS/RTS Modem	Ready In/Out
IEEE 802.5/Token Ring	—	Transmit	Receive	—
TP-PMD for UTP	Transmit			Receive
ATM	Transmit			Receive

ThinWire 802.3/Ethernet Coaxial Cable

ThinWire coaxial cable, a variant of RG 58 cable, meets 802.3 base specifications for thin coaxial cable. It is flexible and cost effective, particularly when small groups of PCs, workstations, and servers are connected in a work group on one segment. ThinWire is ideally suited when a daisy-chain PC network is the low-cost preferred topology. However, note that daisy-chained segments can be difficult to manage.

Baseband Coaxial Cable

Standard baseband coaxial cable is the traditional backbone cable for 802.3/Ethernet networks. It is supported by the IEEE 802.3 10Base5 standard, and is relatively easy and inexpensive to install and add stations. Baseband coaxial cable can replace hundreds of twisted-pairs in a backbone. Although coaxial cable is supported, DIGITAL recommends a fiber-optic solution for the backbone.

Fiber-Optic LAN Backbones

Today's networks need to support high-speed data, imaging, voice, and video applications. Fiber optics, with its ability to support higher speeds, multiple data protocols, better security, and an extended network span, plays a crucial role at the backbone level. Copper cabling, such as thin coaxial and twisted pair, continues to be the predominant cable connecting the office to the fiber network. This will be true until the cost of fiber optics decreases to the same level as copper, unless specific applications warrant the bandwidth offered by fiber optics to the desk.

The following factors contribute to the copper-to-fiber migration in campus and building wiring, and give fiber-optic media advantages over copper:

- High bandwidth and a much higher data transfer rate
- Increased distance support with lower bit error rates (BER)
- Protection from ground potential differences and electromagnetic interference
- Small diameter and lighter weight cables
- Low attenuation carrying data longer distances than other media
- Decreasing fiber-optic cable and component costs
- High level of security
- Vendor and application independence

Based on current use and future capabilities, fiber is cost competitive as a backbone, particularly with the growth in the number of networked users combined with high bandwidth, networked applications (such as distributed databases, client/servers, virtual LAN (VLAN) records management, and CAD/CAM). Multimode fiber can be used for current LANs at the 850-nm window and for LANs at the 1300-nm window supporting FDDI at 100 Mb/s. If FDDI LANs become saturated, the traffic load can be handled by adding more multimode fiber or by moving up to a new generation LAN using single-mode fiber.

Structured Networking

Basic Considerations

The network's structure determines how effectively and efficiently an enterprise communicates within its own organization and with the rest of the business community. The network's configuration helps to maximize the productivity of individuals, departments, and the enterprise.

The increased productivity resulting from a specific networking solution must be weighed against the cost of that solution, and the performance and reliability of each technology must be considered not only for the present but also for the future.

Since the network architecture reflects the business architecture and, ultimately, the enterprise's success, the following elements must be weighed carefully to determine which type of networking structure best suits the organization's requirements:

- What networking or communications standards fit the needs of the enterprise?
- How much bandwidth does each department require for data communications?
- Which communications wiring scheme provides functional growth, flexibility, and cost efficiency?

DIGITAL's DEChub Products

Since DIGITAL's hubs perform within a consistent architecture, they scale well; that is, they adjust to communications requirements as the network grows and changes. This feature allows the implementation of networks as little or as large as an enterprise requires — even starting with one or two single-slot hubs. The network can then scale up — adding the incremental cost of just one piece of equipment at a time with the assurance that everything works together properly.

With the DEChub family, a network can be designed that will:

- Physically co-locate network hardware to reduce problem isolation and error recovery time
- Reduce plant cabling at a site
- Maintain the functionality of a centralized, common management tool
- Provide access to resources for distributed work groups
- Provide interconnection of heterogeneous media types
- Provide heterogeneous LAN interconnection
- Provide appropriate bandwidth to users under Network Management Control
- Allow for reconfiguration on error detection and for bandwidth allocation
- Allow maximum flexibility for moves, adds, and changes

Zone Distribution Model

In a zone distribution environment, work groups are small and may be geographically distant from each other. A zone distribution model may contain multiple LAN technologies or one LAN technology. The basis of zone distribution is wiring one cable to a remote group and attaching a single- or multiple-slot hub (MultiStack or ONEhub) near the work site as opposed to running multiple wires from the hub to the work site. This topology is flexible, inexpensive, easy to implement, and is usually a part of a larger network.

The zone distribution model is used when a small work group:

- requires LAN connections
- is added to an existing LAN

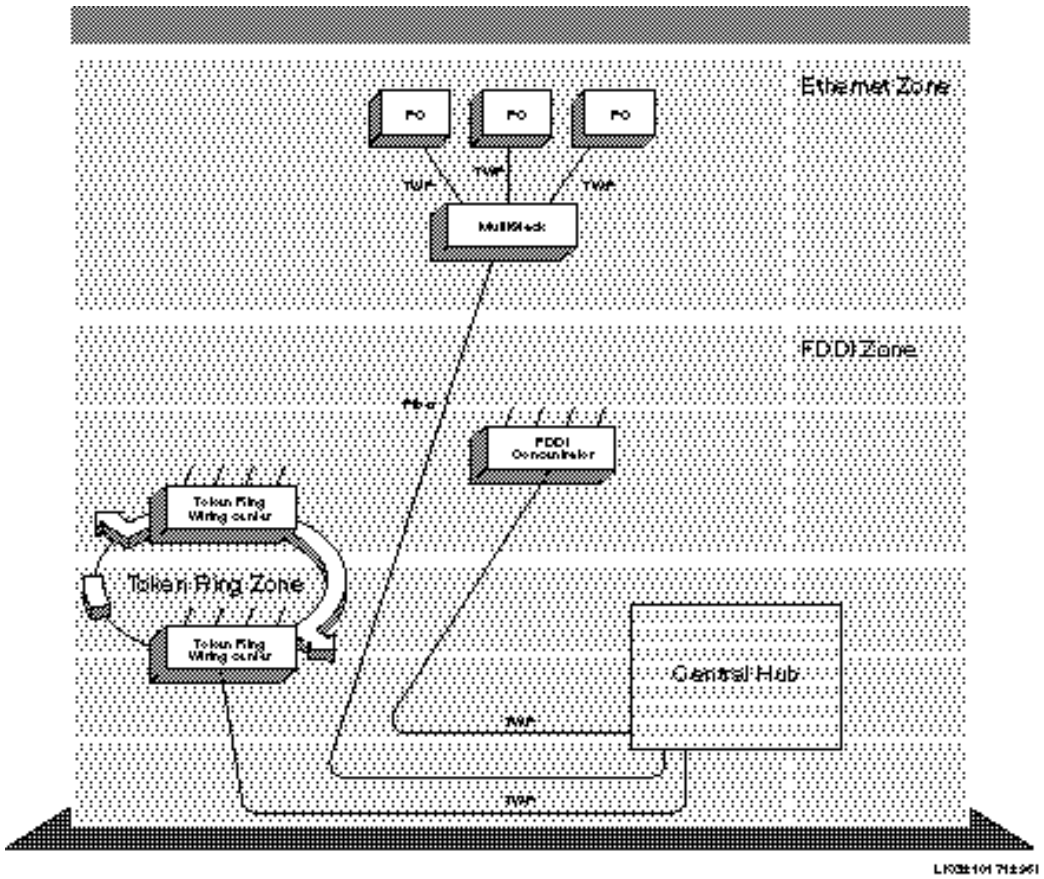


Figure 2-3: Zone Distribution Model

Zone Distribution MultiStack Rack Pack

The plug-and-play OPEN DECconnect packaged work group system is a solution that allows a small business or company to deliver a simple, and easy-to-use work group system. This solution integrates DIGITAL's MultiStack system and a selection of the OPEN DECconnect network components into a single package that complies with the TIA/EIA-568A Building Wiring Standard and the ISO11801 cabling standards.

DIGITAL's OPEN DECconnect packages let you simply and cost-effectively interconnect from one to 48 users. When expanding the basic kit, multiple options are available including UTP, ScTP, fiber optic, coaxial, patch panel inserts, and the Modular Mounting System wallmount options.

The packaged systems approach using DIGITAL's OPEN DECconnect modular mounting products provides the easiest method for structuring the wiring in a work group or stackable environment. There is minimum use of tools and the system snaps together with little effort. The entry-level system supports, and can expand to support, the maximum allowable MultiStack configuration. The basic 16-user package can be expanded to support up to 48 ports on a single patch panel. Up to three, 16-port, DECrepeater 90T-16 options can be mounted in this package. Any combination of media including fiber optics can be supported. As the system grows, none of the original investment is lost. All the existing products can be added to a larger configuration, either wall or rackmounted to expand into the enterprise.

This packaged system provides everything to manage the connection of a 16-user, structured wiring environment. The options only need to be snapped together and mounted on the wall, in a rack, or on a desktop, and then the building wiring connected using insulation displacement connection (IDC) connectors in the patch panel.

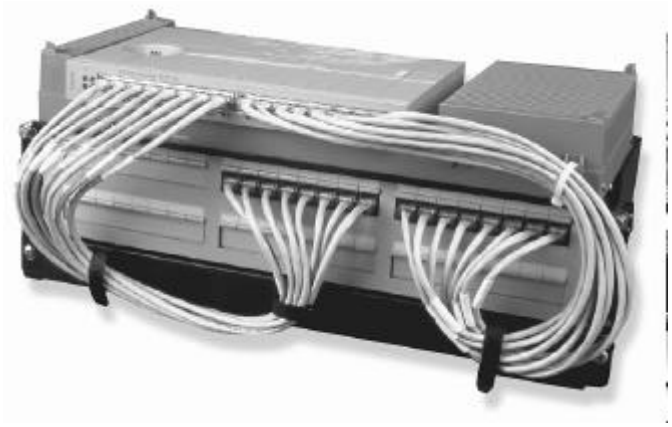


Figure 2-4: MultiStack Rack Pack

Table 2-4: MultiStack RackPack (DETML-P*) Materials List (Basic package with active product)

DIGITAL Part Number	Quantity	Description
DETML-S*	1	DECrepeater 90T-16 stackable unit
H3117-LA	2	Snap-in 8-position 110 (IDC) punchdown to 8-pin modular jack patch panel connector insert supporting TIA/EIA-568A (T568A) wiring
BN25G-0E	16	UTP 8-pin to 8-pin MP Category 5 interconnect cable non-crossover for use in the office and equipment room
H3108-PA	1	Modular snap-in hinged plastic panel frame and mounting assembly
H3108-HA	1	Blank patch panel insert, 5 pack
H3108-TG	1	MultiStack mounting support tray and cover
H3108-TB	1	Work surface tray, rackmount
H3109-AF	1	Cable management kit (3) Reusable cable management ties (2) KEP nuts (3) One square inch dual lock (2) L-brackets (2) Standard screws to mount 1u blank filler (8) #6 screws (1) Velcro roll, 36” length by 3/4” width (2) Shoulder screws
H3108-BE	1	Blank filler panel, 1U

Table 2-5: Dimensions of MultiStack Components

Dimension	Structured Wiring Kit (H3109-EA)	DIGITAL MultiStack Rack Pack DETML-Px (Figure 2-4)
Height	5.25 inches	8 inches
Width	19 inches	19 inches
Depth	9 inches	9 inches
Weight	5.15 lbs	12.15 lbs

Distributed Backbone Model

In a distributed backbone topology, all users have access to a single, shared building backbone. Often this backbone is implemented in either star radial wiring or a multidrop cable. Each floor of a building is connected to the backbone by a bridge or router. The bridge or router filters all local traffic from the backbone and forwards it to the appropriate location. The backbone may be redundant for high availability.

The distributed backbone model is used when:

- Each floor supports a high volume of local traffic
- Each floor's traffic is isolated from the backbone
- Different floors may support different LAN technologies to suit user needs
- Servers are local to work groups

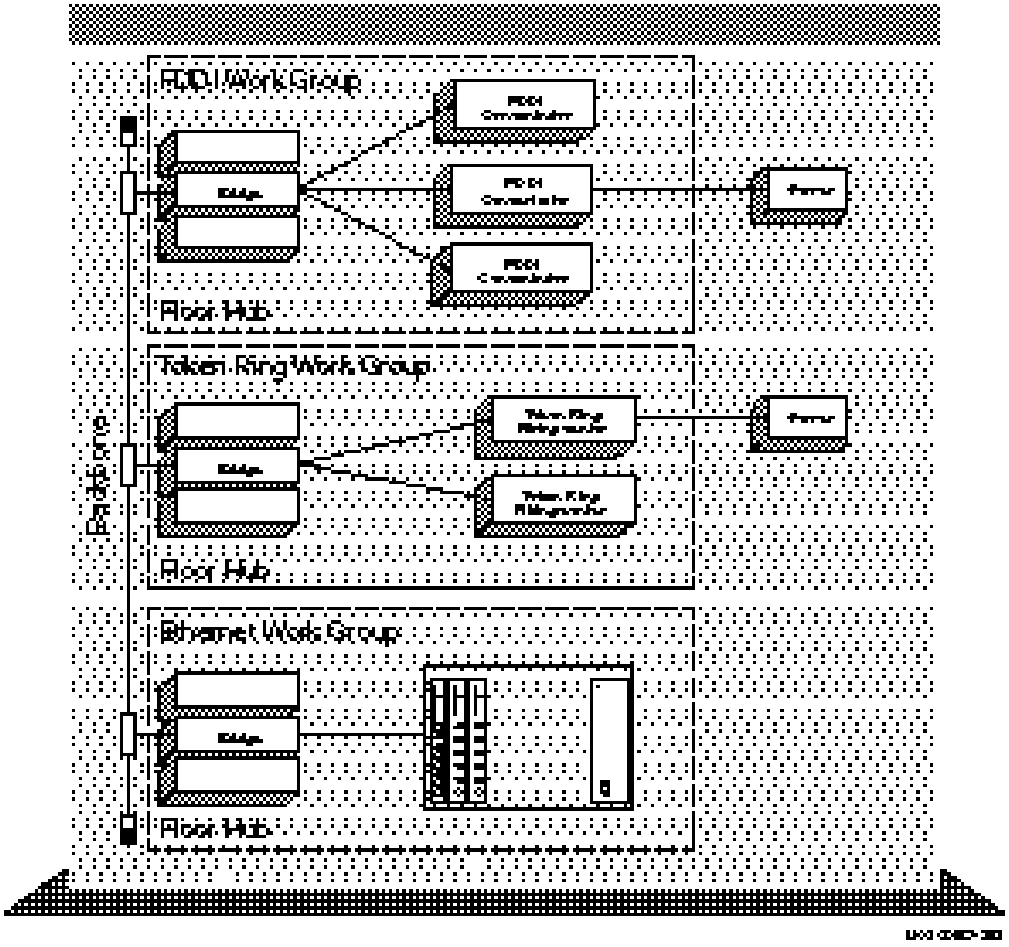


Figure 2-5: Work Group Distributed Backbone Model

Work Group Model

A work group is defined by its physical location and network requirements, and meets the following criteria:

- Typically supported by common servers
- May include representatives of different work functions
- Has multiple media type requirements
- Requires access to common resources

The DIGITAL MultiSwitch 900 (formerly called DEChub 900 MultiSwitch) supports this topology by providing multiple LAN channels through the backplane. The MultiSwitch 900 provides flexible channels that can be configured as Ethernet, Token Ring, FDDI, or ATM. The work groups can be homogeneous or heterogeneous.

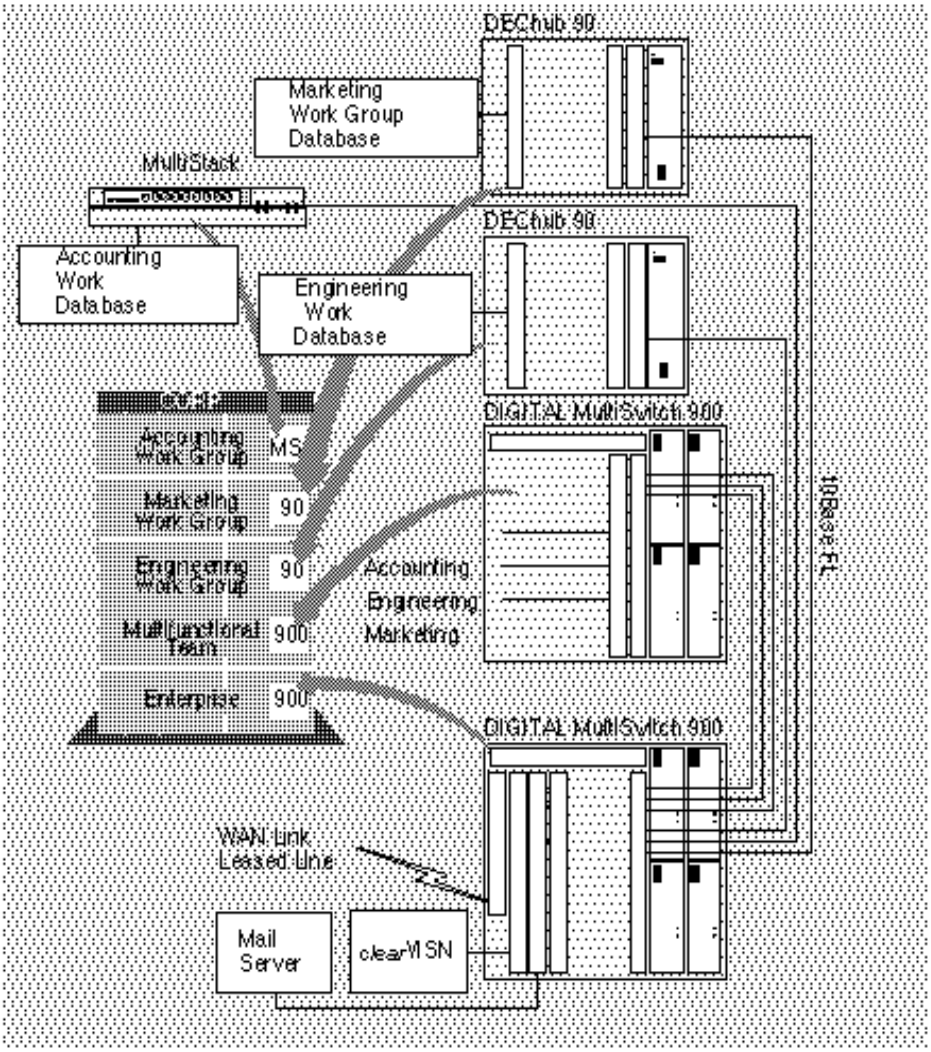


Figure 2-6: Work Group Model

Collapsed Backbone Model

In a collapsed backbone, each floor hub or floor network device directly connects to a central router/bridge, which serves as the building's backbone. In other words, the backplane of the router/bridge becomes the building backbone. The router/bridge services all of the building traffic.

The collapsed backbone model is used to:

- Minimize the number of router/bridge hops between users and between users and servers
- Minimize the number of bridges used in the network to minimize equipment cost
- Provide higher bandwidth connections to centralized servers
- Provide a higher bandwidth backbone

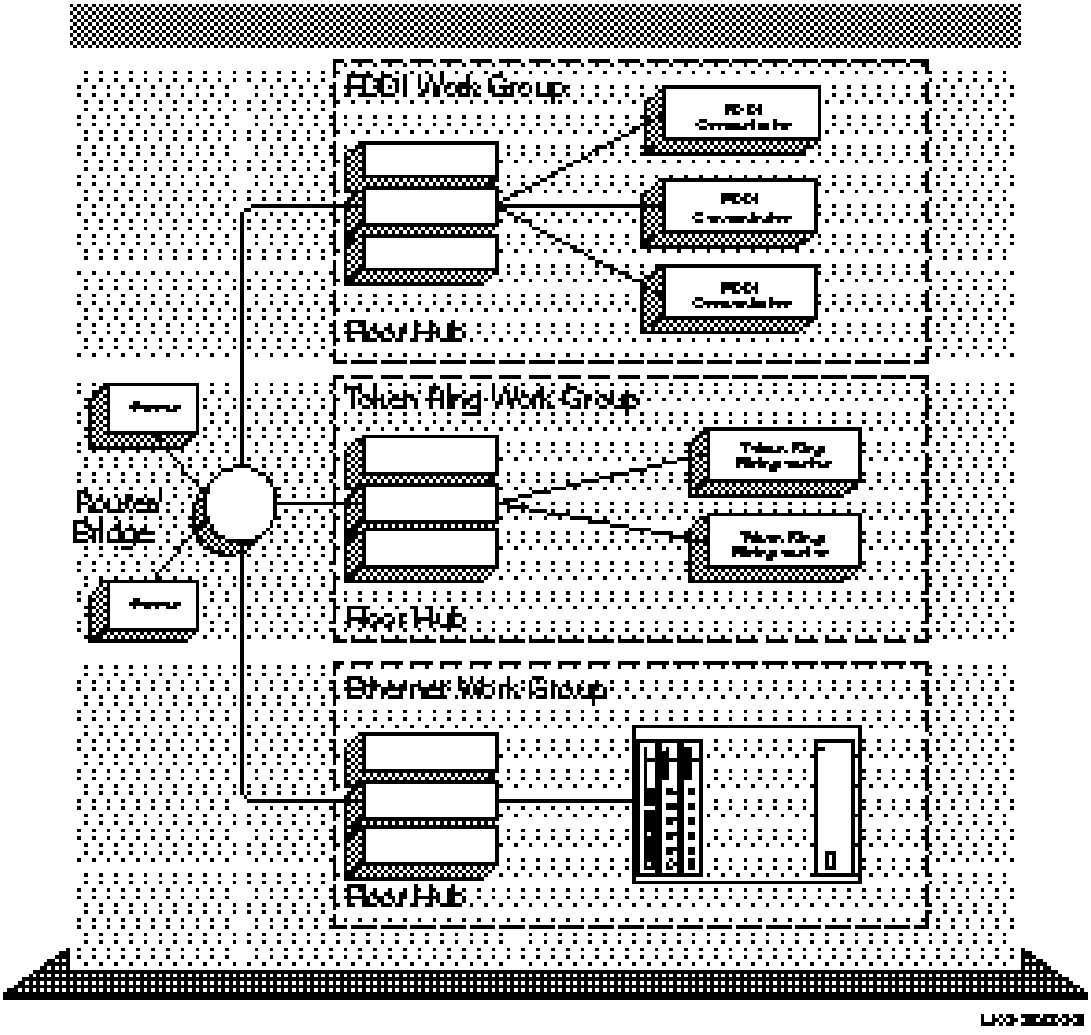


Figure 2-7: Collapsed Backbone Model

Interconnect Implementation

Interconnect and Full Cross-Connect are two methods used to attach the Equipment Room active device to the passive network. The direct Interconnect method shown in Figure 2-8 is the most widely used and least expensive. This method uses only one patch panel for the office termination point, and only one patch cable to connect it to the active port of the active device. When a move is needed, the patch cable on the active device is moved to another port.

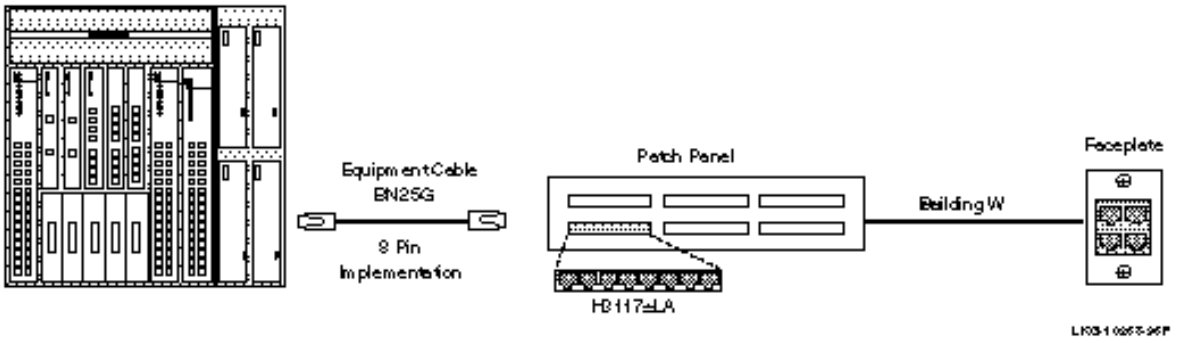


Figure 2-8: Interconnect Implementation

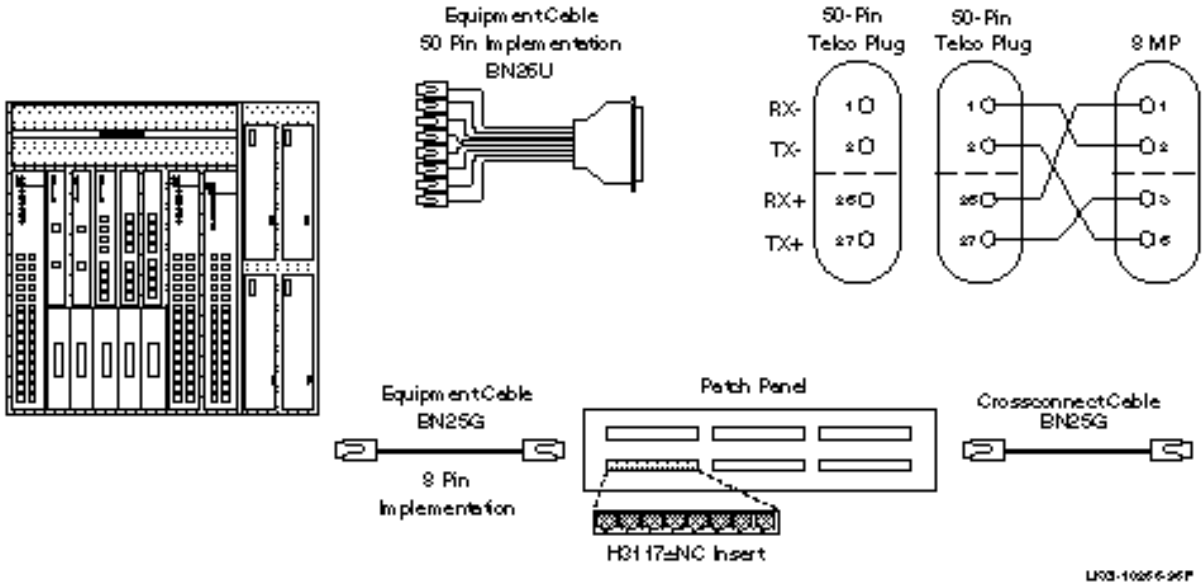
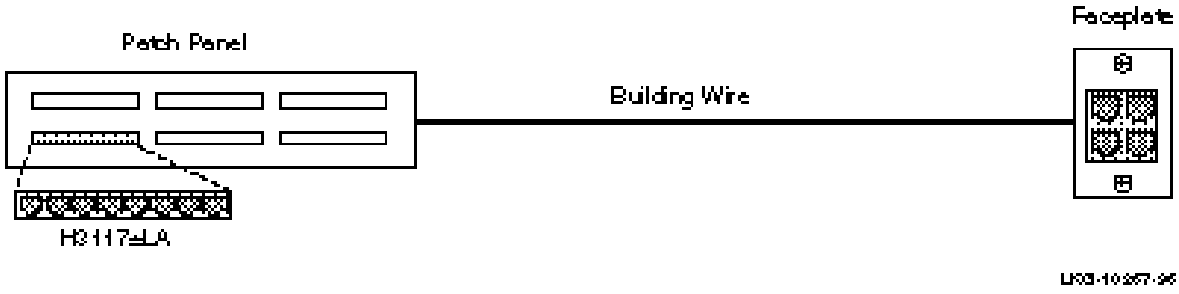


Figure 2-9: Full Cross-Connect Implementation

Full Cross-Connect Implementation

When the Full Cross-Connect method is used, two patch panels and two cables must be used. The first patch panel assembly is used to terminate the office connection and the second patch panel is used to attach the active equipment. Patching is accomplished by using the patch cable between the patch panel assemblies. See Figure 2-9. When a move is made, the patch cable is moved, not the connection to the active device. The Cross-Connect can be implemented using either a mass terminated cable connection or a single cable. Both methods and the components necessary are shown in Figure 2-9.



OPEN DECconnect Components Support EIA/TIA Standards

The OPEN DECconnect Structured Wiring System supplies a full series of passive components that fit into the TIA/EIA 568 standard architecture. This architecture defines the five individual wiring subsystems, campus backbone, building backbone, horizontal, work area, and administration. DIGITAL has designed and tested a system of components that physically complement these subsystems and meets the standard's technical requirements. The following three figures show some of the key OPEN DECconnect passive components and how they have been implemented within the Structured Wiring System.

Figure 2-10 shows the campus backbone subsystem and some of the key interconnecting components.

Figure 2-11 illustrates the horizontal and work area and building backbone subsystems and some of the passive components used within those areas.

Figure 2-12 illustrates the horizontal and work area subsystems and some of the passive components used within those wiring subsystems.

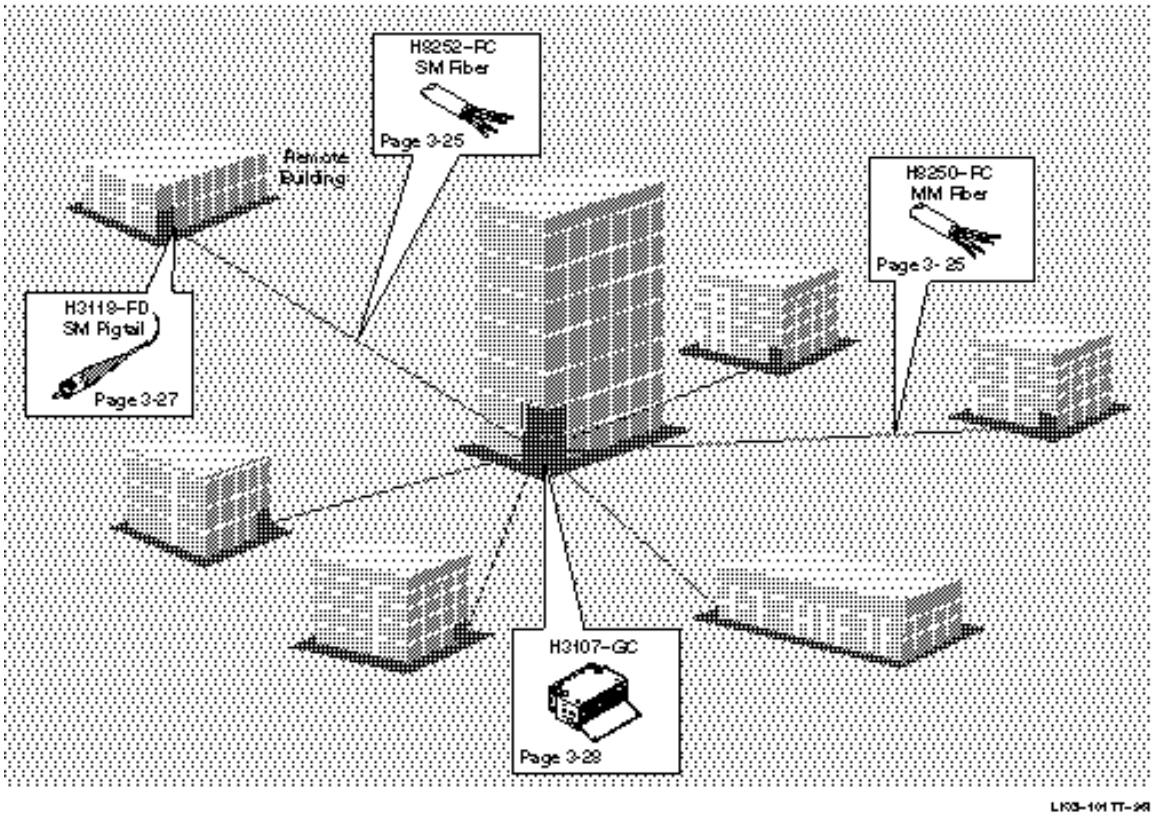


Figure 2-10: Campus Subsystem

Figure 2-11: Building Backbone Subsystem

Figure 2-12: Horizontal and Work Area Subsystem

OPEN DECconnect System Overview

Digital Equipment Corporation's OPEN DECconnect System provides a comprehensive solution for supplying physical connections between individual network devices on a local area network (LAN). Standards-based, the OPEN DECconnect System accommodates networks — from the smallest LAN to a global multivendor network with products that have been stringently tested at the component and system level. The OPEN DECconnect System supports worldwide services to design, install, and manage networks that protect customers' network investments.

OPEN DECconnect System

Today's rapidly changing data communications market puts a premium on implementing data network cabling systems that can withstand the test of time. These cabling systems must be able to support all of the devices currently attached to the systems, and provide flexibility for future growth in the number of users and available bandwidth. The systems should serve users' needs for the facility's lifetime.

OPEN DECconnect is designed to run a wide array of application technologies and vendor platforms while providing true distributed computing by integrating terminals, personal computers, and workstations into the enterprisewide network. OPEN DECconnect offers a full range of media choices, while providing flexibility and modularity for network growth. The focus of OPEN DECconnect is on the use of:

- Fiber optics for the network backbone and horizontal LAN connections to allow capacity for high-traffic network usage
- OPEN DECconnect Super-5 (TIA/EIA Category 5), twisted-pair, fiber-optic backbone cabling, and, where necessary, fiber-optic cabling for horizontal wiring and work area/office connections

The OPEN DECconnect structured wiring supports fiber and copper information system solutions for applications such as:

- **Data** — FDDI, TP-PMD, IEEE 802.3/Ethernet, 100BaseTX, 100BaseT4, 10BaseT, 10Base2, 10Base5, 10BaseF, 802.5/Token Ring 4 Mb/s and 16 Mb/s, EIA-232, EIA-423, EIA-422, Apple, LocalTalk, IBM 3270, IBM AS/400E 3X Series, and ATM
- **Imaging** — Plotters, facsimile machines, and graphics stations
- **Sensing** — Building management
- **Video** — Interactive teleconferencing or security
- **Voice** — Telephone and intercom

OPEN DECconnect Architecture

The OPEN DECconnect Architecture is based on the TIA/EIA Building Standard Architecture consisting of the five basic subsystems: campus, building, horizontal, work area, and administration subsystem.

For the last several years, the Electronics Industries Association (EIA), at the request of the Computer Communications Industry Association (CCIA), has been developing a standard for telecommunications building wiring. The Telecommunications Industry Association (TIA), and each of the major U.S. computer manufacturers, including DIGITAL, have also been involved in developing this standard. This level of support facilitates widespread customer acceptance of the TIA/EIA standard for commercial building wiring.

This TIA/EIA-568A standard, which addresses voice and data using both copper and fiber, is now the structured wiring standard for commercial office buildings. The standard specifies topology, distances, media, and connectors to provide an application-independent cable plant with the goal of becoming a utility.

To support the building wiring standards, the OPEN DECconnect System has been upgraded to become a more scalable cabling system from the Main Cross-Connect (MC) to the office. Product enhancements to OPEN DECconnect have made it fully compliant with the TIA/EIA-568A standard and the international ISO/IEC 11801 standard.

TIA/EIA-568A Commercial Building Wiring Architecture Standard

The TIA/EIA-568A Commercial Building Wiring Standard defines telecommunications wiring for one building or multiple buildings in a campus environment. The standard specifies wiring system parameters, including:

- Topology
- Distances
- Media and connector-pin assignments

The *TIA/EIA-568A Commercial Building Wiring Standard* recognizes two types of wiring:

- Horizontal cabling
- Backbone cabling

Figure 2-1 illustrates the *TIA/EIA-568A Commercial Building Wiring Standard* distance limitations and distribution subsystems for TIA/EIA-568A and OPEN DECconnect. DIGITAL recommends the hierarchical physical star network topology as prescribed by this standard. Within this structure OPEN DECconnect also supports other topologies such as ring, bus, and point-to-point configuration.

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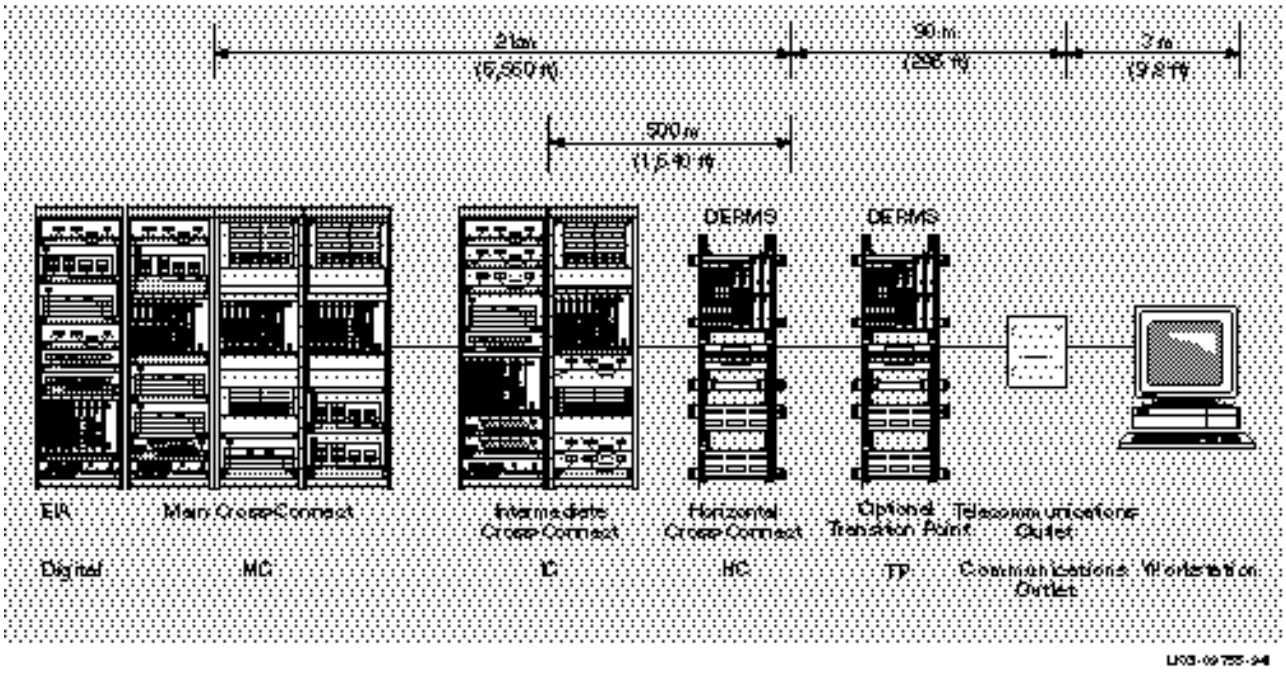


Figure 2-1: TIA/EIA-568A Distance Limitations and Distribution Subsystems

DIGITAL's Adherence to Standards

The development of standards to control the design and implementation of the physical network has benefited customers and manufacturers of network components. Standards expand the network's value, making it possible to support products from multiple vendors. DIGITAL is a charter member of the TIA/EIA standards body and continues to support the development of open networking solutions. The company's involvement with standards — both current and evolving — can clearly be seen in the OPEN DECconnect System, which allows the integration of networking products across all standard media types. Today, for example, the OPEN DECconnect System is flexible enough to accommodate FDDI network connectivity using 100-ohm UTP/ScTP/FTP cable, 150-ohm STP, or ThinWire coaxial cable. This demonstrates DIGITAL's commitment to existing investments by allowing expanded use of installed cable, while supporting new media currently being defined by standards.

Compliance with Current and Evolving Standards

The OPEN DECconnect System addresses physical management of the cable medium connecting the active products required to support the network. This system supports connectivity starting at the active port in the equipment room through the faceplate and office equipment cable. All components are specified to be compliant with national and international standards.

Commitment to current and evolving standards ensures that the breadth of products needed to support local Public Telephone & Telegraph (PTT) and Electromagnetic Compatibility (EMC) requirements are available from DIGITAL.

Increased Data Transmission Support

The industry anticipates significant advances in data transmission support.

Twisted Pair

The TIA/EIA TR-41.8.1 Subcommittee has released specifications for twisted-pair cables and connecting hardware that specifies media at signaling frequencies up to 100 MHz. The OPEN DECconnect Super-5 system also supports the ATM specification that specifies 155 Mb/s over Category 5 twisted-pair cabling.

FDDI (TP-PMD)

In addition, the ANSI X3T9 Technical Committee established specifications allowing FDDI data rates to be transmitted over (UTP) Category 5 interconnect cables and components. This application, identified as TP-PMD, is differentiated from the 100 Mb/s fiber-optic application defined as FDDI. Although the data rate is 100 Mb/s, the peak signal power is below 31.25 MHz because of the MLT3 encoding scheme. (MLT3 is specified in the TP-PMD portion of the ANSI X3T9.5 standard.)

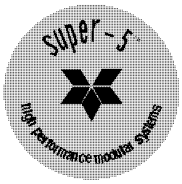
ATM

Emerging asynchronous transfer mode (ATM) implementations will specify encoding methods that can support 155 Mb/s data rates using Category 5 UTP/ScTP cabling.

OPEN DECconnect System Topology

To develop a structured data network, the OPEN DECconnect System provides products within the Main Cross-Connect (MC), Intermediate Cross-Connect (IC), Horizontal Cross-Connect (HC), and optional Transition Point (TP). OPEN DECconnect supports the TIA/EIA-568A Commercial Building Wiring Standard and the IEC/ISO 11801 Standard.

OPEN DECconnect Super-5 System (TIA/EIA Category 5)



DIGITAL has developed a complete Category 5 (Super-5) system consisting of cables, patch cords, and connectors to support TIA/EIA-568A, which defines the highest system performance in the industry. DIGITAL had taken the lead in specifying the highest performing UTP media for use in a network in advance of the release of the TIA/EIA Category 5 cable specification defined in TSB36 — the standard created by the working group responsible for defining cable category specifications.

This system of components is part of the Category 5 structured wiring system and includes Category 5 connectors, patch cords, and building cabling. These components support the transmission of high-speed data, which is defined today by ANSI X3T9 TP-PMD for FDDI including IEEE 802 100BaseT Ethernet standards along with the ATM standard.

DIGITAL's involvement does not end with the product. As with other OPEN DECconnect products, DIGITAL supplies the components — in this case, Category 5 — and workmanship practices and procedures to ensure that the installed network meets system performance specifications. Along with the installation procedure, DIGITAL is establishing verification processes to ensure that the network performs to specification. Customers using the OPEN DECconnect System's Super-5 (TIA/EIA Category 5) products will have a system composed of the highest quality components backed by the expertise needed to build the network.

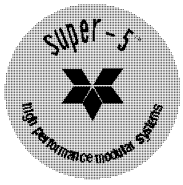
OPEN DECconnect Screened High-Performance Interconnect Components

Shielded Versus Screened

Two types of twisted-pair cables incorporate shielding: shielded cable (STP) and screened cable (ScTP/FTP). Shielded cable provides individual shields for each wire pair and an overall shield covering the individual shielded pairs. Screened cable incorporates only an overall shield covering the unshielded pairs included in the cable. Most 100-ohm twisted-pair cables that incorporate shielding are of the screened variety. DIGITAL supplies a complete line of screened connectors and cables. DIGITAL developed and specified the OPEN DECconnect screened cables and connectors to meet the same specifications defined in TIA/EIA-568A (Category 5 UTP).

The IEC/ISO 11801 standard covers generic cabling for the customer premises. This standard specifies 100-ohm shielded/screened twisted-pair cable as one cable type used in the customer premises and defines the performance of that cable using the same parameters defined by TIA/EIA-568A with the addition of a transfer impedance specification. DIGITAL tested its screened system to ensure compliance with the performance specifications. The company continually monitors standards activity to ensure that its screened system meets all specifications.

Categorizing Networking Components: Considerations for Implementing Category 5



The TIA/EIA-568A standard defines the performance of twisted-pair cables and associated connectors in three categories: Category 3 specifies the performance of copper cables and connectors from 1 MHz to 16 MHz; Category 4 defines performance from 1 MHz to 20 MHz; Category 5 specifies performance from 1 MHz up to 100 MHz; and Category 5 specifies the highest level of performance available for 24 AWG unshielded twisted-pair cable. Cables meeting this performance level are specified by the ATM standard to support data rates of up to 155 Mb/s.

FDDI (TP-PMD) 100 Mb/s over UTP

The performance requirements of 100 Mb/s data transmission are not directly correlated to the 100 MHz specification stated for Category 5 connectors. Two factors are involved. First, the current implementation of the 100 Mb/s data transmission uses a method of encoding (MLT3) that reduces the maximum required channel bandwidth to 31.25 MHz. Second, the pairs selected to carry 100 Mb/s transmission are generally those that are farthest apart.

TP-PMD specifies pins 1-2 and 7-8 on the 8-pin MJ for cable pair termination. Therefore, the near-end crosstalk (NEXT) in the connector is significantly reduced for those pairs, and consequently many of the existing connectors meet the performance limits on those two pairs.

This example does not diminish the importance of the Category 5 limits or imply that these connectors qualify as Category 5, but rather shows that in some cases existing connectors may not need to be replaced to support 100 Mb/s data rates. Category 5 system components are recommended to provide the required margin for supporting future high-speed communications.

Category 5 Implementation Without Significant Changes

Many of today's data systems that have evolved from the structured voice wiring systems use Cross-Connect termination fields. Category 5 components used to build high-speed networks are affected by including traditional termination fields. The use of 110-style Cross-Connect fields may not support Category 5 applications unless special Category 5 patch cords are used. In contrast, the OPEN DECconnect System was designed to avoid this cable management method, and easily accommodate Category 5 implementations without significant changes beyond installing the new components.

High-Performance Voice Networking Components

DIGITAL offers a complete set of components that support the distribution of the voice network. These products are based on 110-style insulation displacement connector (IDC) technology. Most of the connector assemblies have been verified to Category 5 limits and can support voice or data within the building's structure. This allows the development of an integrated network composed of both OPEN DECconnect Super-5 voice and data interconnect products.

The data and voice products are completely compatible and work together or separately. This allows the design to evolve to meet customers' needs in the multimedia environment. This system is ideally suited for the voice network structure but is not limited to that role. The system is built with the highest performing cables and connectors, and can support the integration of high-speed Ethernet, FDDI (TP-PMD), and ATM.

OPEN DECconnect: Vendor- and Product-Independent Wiring

OPEN DECconnect, introduced in February 1986, had two components: a primarily copper-based structured cabling system and active network hardware products. It has since evolved beyond its copper-based structured cabling system to one that is open and truly multivendor in nature, and focuses on the use of fiber optics for the network backbone. The OPEN DECconnect System includes all the passive networking products that provide for standards-based networks. The OPEN DECconnect System's structured cabling system is a vendor- and product-independent wiring system that is:

- Based upon TIA/EIA, IEEE 802, and ANSI standards, and stresses the use of fiber-optic cabling for network backbones and copper cabling for work area connectivity, with fiber-optic support to the desktop when required
- An application-independent structured cabling system

The key features of OPEN DECconnect are:

- Open, nonproprietary system
- Full multivendor support
- Increased modularity and flexibility
- Multimedia support
- Backwards compatibility with existing products
- Extended Performance Category 5 cable, tested up to 360 MHz

OPEN DECconnect Summary

OPEN DECconnect, the result of years of development, focuses on the network as a system. Many of the design decisions in the early development phases considered the network's future needs.

Today, requirements to support twisted-pair networks at 100 MHz, with data rates of 100 Mb/s and beyond, are possible through:.

- extensive planning in advance of standards implementation
- networking solutions tested at the component, system, and application levels
- products designed to meet the highest available system performance specifications and standards
- a worldwide support organization

The OPEN DECconnect System protects customers' investments in existing wiring, while accommodating the industry's highest performance specifications.

OPEN DECconnect Warranty

Digital Equipment Corporation warrants that, for a period of fifteen (15) years following customer acceptance, DIGITAL's OPEN DECconnect passive wiring components will transport data in accordance with the cable channel specification in effect at the time of acceptance. DIGITAL, at its option, will repair or replace any defective cable channel component that causes the channel to fail to meet the original design specification within the warranty period.

This warranty is effective only if the cable channel is designed and installed by DIGITAL's authorized reseller, in accordance with DIGITAL's approved design specifications, and is operating at the customer's original location. This warranty only covers the passive network components approved and specified by DIGITAL, and is intended for use with active network interface products certified by the manufacturer to comply with the cable channel specification released by the major standards organizations in effect at the time of installation. Future network upgrades, changes, applications, and/or requirements are covered by the warranty only if the installation is performed by DIGITAL's authorized resellers, and are tested and verified in accordance with the latest version of DIGITAL's cable channel specification.

Media and Network Planning

Media and network planning provides a framework for the management of heterogeneous, multivendor systems. An effective network management and planning system allows network personnel to meet specific organizational goals and technical needs.

Structured Cabling Systems: Planning for the Future

A well-planned structured cable plant allows network planners and managers to accommodate virtually any number of moves easily, inexpensively, and without disruption to the organization.

Advantages of Structured Cabling

Because the cabling infrastructure is such a crucial part of a local area network, proper planning and execution of building topology mapping is critical to its success. Structured wiring ensures properly designed pathways; its importance cannot be overemphasized. See Table 2-1 for a comparison of structured and unstructured wiring.

A structured cabling system consists of various families of components including: transmission media (cables); circuit administration; and other hardware such as communication connectors, jacks, plugs, adapters, baluns, and transmission electronics.

A well-designed structured cabling system such as OPEN DECconnect is independent of the equipment it connects. The structured cabling system should also be capable of interconnecting many different communication devices such as data terminals, analog and DIGITAL telephones, personal computers, and host computers.

Table 2-1: Comparison of Structured and Unstructured Cabling

Structured Cabling	Unstructured Cabling
Standards based	Non-standards based
Application independent	Prone to application dependency
Allows movement of people and equipment without rewiring	Often requires rewiring when moving people or equipment
Allows for growth and change	Does not allow for easy growth and change
Easy to reconfigure wiring and communication equipment	Difficult to reconfigure wiring and communications equipment
Modular design allows flexibility	Non-modular, inflexible system
Allows for administration and maintenance of the cable plant; facilitates the isolation of equipment and cable problems	Generally not labeled and documented; limited management and problem isolation capabilities
Defines distance and topology	Free form
Reduces cost of ownership	High cost of ownership

LAN Cable Media Applications and Selection Considerations

Data communications technological advances have been outpacing changes in most other areas including cable design. These advances have brought qualitative and exponential increases in data speed (for example, 9.6 Kb/s to 155 Mb/s) in just over a decade. Cable technology needs to meet this technological growth. Recent trends show:

- A growing number of users requiring connections to LANs
- A proliferation of multivendor-based LANs requiring support for a variety of equipment from different vendors
- An increasing demand by users for more LAN bandwidth

Cable Media Selection Criteria

Selecting the proper cable medium requires a thorough understanding of three key factors:

- Intended applications of the LAN
- Size and structure of the building
- Anticipated growth of the network and its application speed

Three major cost factors influence the selection of the cable media:

- Initial cost for the cable, connectors, patching hardware, and labor for installation
- Investment protection provided by the cable over its useful life, and by adherence of equipment and installations to industry standards
- Versatility of the cable to handle voice, video, and other forms of high- and low-speed data communications, resulting in maximizing returns on investments

Network technical requirements for cable media usually include the expected data rate needed, distance coverage, immunity to noise, troubleshooting, security, and the move, add, and change capabilities. The decision for appropriate media selection should be based on:

- Requirements for current applications
- Minimal risks such as financial and safety, while evaluating the opportunity costs
- Flexibility for changes
- Capability of expansion/growth for additional and future applications and users
- Investment protection provided by the cable over its useful life and through adherence to industry standards

Cabling Choices

DIGITAL's LANs support all of the following media choices for: unshielded (UTP) and screened (ScTP/FTP) twisted-pair cable, fiber-optic cable, ThinWire (coaxial), and baseband cable.

Twisted-Pair Cable

Twisted-pair cable was first developed to support voice networks. Expanding the use of twisted-pair, DIGITAL and other computer vendors use twisted-pair for data communication between high-speed workstations and terminal connections.

Due to its low cost, twisted-pair is ideally suited for connecting the work area equipment to the network. Unshielded (UTP) and screened (ScTP/FTP) are two types of 100-ohm, twisted-pair cabling which support Category 3 and Category 5 variations. The OPEN DECconnect system also offers and **Extended Performance** Category 5 UTP cable that is tested up to a frequency of 360 MHz. DIGITAL recommends using Category 5 cabling for structured wiring.

Twisted-Pair Cable Applications

Twisted-pair cable manufacturers have grouped these cables according to performance levels. NEMA, UL, ISO, and TIA/EIA have released specifications that group 100-ohm UTP and ScTP cables into five performance-grade categories. These categories define certain standards requirements, data-transmission rates, and specific transmission parameters for each group of cables.

OPEN DECconnect recommends high-performance data grade (Category 5) twisted-pair cables to cover the majority of Physical layer LAN applications. Table 2-2 indicates the choices of horizontal cable media along with information on what types of applications are presently supported.

Table 2-2: Application Versus Media Type

			Horizontal Media Type		
Physical Layer Application	**Fiber**	**ThinWire**	**UTP[1]/ Category 3**	**UTP/ Category 5**	**ScTP[2]/ Category 5**
EIA-232			X	X	X
EIA-422			X	X	X
EIA-423			X	X	X
ISDN			X	X	X
IEEE 802.3 10Base2		X			
IEEE 802.3 10BaseT			X	X	X
IEEE 100BaseT				X	X
Ethernet Synchronous (10BaseF)	X				
IEEE 802.3 FOIRL	X				
IEEE 802.5 4 Mb/s			X	X	X
IEEE 802.5 16 Mb/s[3]			(limited distance)	X	X
ANSI/ISO FDDI	X				
TP-PMD				X	X
LocalTalk			X	X	X
IBM 3270			X	X	X
IBM AS/400 3X			X	X	X
ATM				X	X

[1]UTP is unshielded 4-pair, 22- and 24-gauge, 100-ohm twisted-pair.

[2]ScTP/FTP is screened 4-pair, 22- and 24-gauge, 100-ohm twisted-pair.

[3]16-Mb/s Token Ring can be supported over Category 3 UTP provided that the cabling has been tested and verified to meet the Category 3 specifications and distance limitation requirements.

Twisted-Pair Connector Pin Assignments TIA/EIA-T568A

The OPEN DECconnect snap-in 8-pin modular data jacks (H3112-E/F/G/H series) conform to the TIA/EIA-T568A preferred pin-pair assignments. This pin/pairing meets ISO 8877 requirements. The H3112-IV/JV data jacks conform to the TIA/EIA-T568B pin-pair assignments. See Figure 2-2.

Figure 2-2: 8-Pin Modular Jack Assignments (TIA/EIA-T568A/T568B)

Table 2-3: Applications in Conjunction with Pin Assignments (TIA/EIA-T568A Pin-Pair Assignments)

Application	Pair 3 Pins 1, 2	Pair 2 Pins 3, 6	Pair 1 Pins 4, 5	Pair 4 Pins 7, 8
ISDN	Power	Transmit	Receive	Power
Analog Voice	—	—	Transmit/Receive	—
IEEE 10BaseT	Receive	Transmit	—	—
IEEE 100BaseTX	Receive	Transmit	—	—
IEEE 100BaseT4	Receive	Transmit	Bidirectional (BI)	Bidirectional (BI)
EIA-423 DL (only)	Receive	Transmit	—	—
EIA-423	Receive	Transmit	—	Ready In/Out
EIA-423 DL and Modem Control	Receive	Transmit	CTS/RTS Modem	Ready In/Out
IEEE 802.5/Token Ring	—	Transmit	Receive	—
TP-PMD for UTP	Transmit			Receive
ATM	Transmit			Receive

ThinWire 802.3/Ethernet Coaxial Cable

ThinWire coaxial cable, a variant of RG 58 cable, meets 802.3 base specifications for thin coaxial cable. It is flexible and cost effective, particularly when small groups of PCs, workstations, and servers are connected in a work group on one segment. ThinWire is ideally suited when a daisy-chain PC network is the low-cost preferred topology. However, note that daisy-chained segments can be difficult to manage.

Baseband Coaxial Cable

Standard baseband coaxial cable is the traditional backbone cable for 802.3/Ethernet networks. It is supported by the IEEE 802.3 10Base5 standard, and is relatively easy and inexpensive to install and add stations. Baseband coaxial cable can replace hundreds of twisted-pairs in a backbone. Although coaxial cable is supported, DIGITAL recommends a fiber-optic solution for the backbone.

Fiber-Optic LAN Backbones

Today's networks need to support high-speed data, imaging, voice, and video applications. Fiber optics, with its ability to support higher speeds, multiple data protocols, better security, and an extended network span, plays a crucial role at the backbone level. Copper cabling, such as thin coaxial and twisted pair, continues to be the predominant cable connecting the office to the fiber network. This will be true until the cost of fiber optics decreases to the same level as copper, unless specific applications warrant the bandwidth offered by fiber optics to the desk.

The following factors contribute to the copper-to-fiber migration in campus and building wiring, and give fiber-optic media advantages over copper:

- High bandwidth and a much higher data transfer rate
- Increased distance support with lower bit error rates (BER)
- Protection from ground potential differences and electromagnetic interference
- Small diameter and lighter weight cables
- Low attenuation carrying data longer distances than other media
- Decreasing fiber-optic cable and component costs
- High level of security
- Vendor and application independence

Based on current use and future capabilities, fiber is cost competitive as a backbone, particularly with the growth in the number of networked users combined with high bandwidth, networked applications (such as distributed databases, client/servers, virtual LAN (VLAN) records management, and CAD/CAM). Multimode fiber can be used for current LANs at the 850-nm window and for LANs at the 1300-nm window supporting FDDI at 100 Mb/s. If FDDI LANs become saturated, the traffic load can be handled by adding more multimode fiber or by moving up to a new generation LAN using single-mode fiber.

Structured Networking

Basic Considerations

The network's structure determines how effectively and efficiently an enterprise communicates within its own organization and with the rest of the business community. The network's configuration helps to maximize the productivity of individuals, departments, and the enterprise.

The increased productivity resulting from a specific networking solution must be weighed against the cost of that solution, and the performance and reliability of each technology must be considered not only for the present but also for the future.

Since the network architecture reflects the business architecture and, ultimately, the enterprise's success, the following elements must be weighed carefully to determine which type of networking structure best suits the organization's requirements:

- What networking or communications standards fit the needs of the enterprise?
- How much bandwidth does each department require for data communications?
- Which communications wiring scheme provides functional growth, flexibility, and cost efficiency?

DIGITAL's DEChub Products

Since DIGITAL's hubs perform within a consistent architecture, they scale well; that is, they adjust to communications requirements as the network grows and changes. This feature allows the implementation of networks as little or as large as an enterprise requires — even starting with one or two single-slot hubs. The network can then scale up — adding the incremental cost of just one piece of equipment at a time with the assurance that everything works together properly.

With the DEChub family, a network can be designed that will:

- Physically co-locate network hardware to reduce problem isolation and error recovery time
- Reduce plant cabling at a site
- Maintain the functionality of a centralized, common management tool
- Provide access to resources for distributed work groups
- Provide interconnection of heterogeneous media types
- Provide heterogeneous LAN interconnection
- Provide appropriate bandwidth to users under Network Management Control
- Allow for reconfiguration on error detection and for bandwidth allocation
- Allow maximum flexibility for moves, adds, and changes

Zone Distribution Model

In a zone distribution environment, work groups are small and may be geographically distant from each other. A zone distribution model may contain multiple LAN technologies or one LAN technology. The basis of zone distribution is wiring one cable to a remote group and attaching a single- or multiple-slot hub (MultiStack or ONEhub) near the work site as opposed to running multiple wires from the hub to the work site. This topology is flexible, inexpensive, easy to implement, and is usually a part of a larger network.

The zone distribution model is used when a small work group:

- requires LAN connections
- is added to an existing LAN

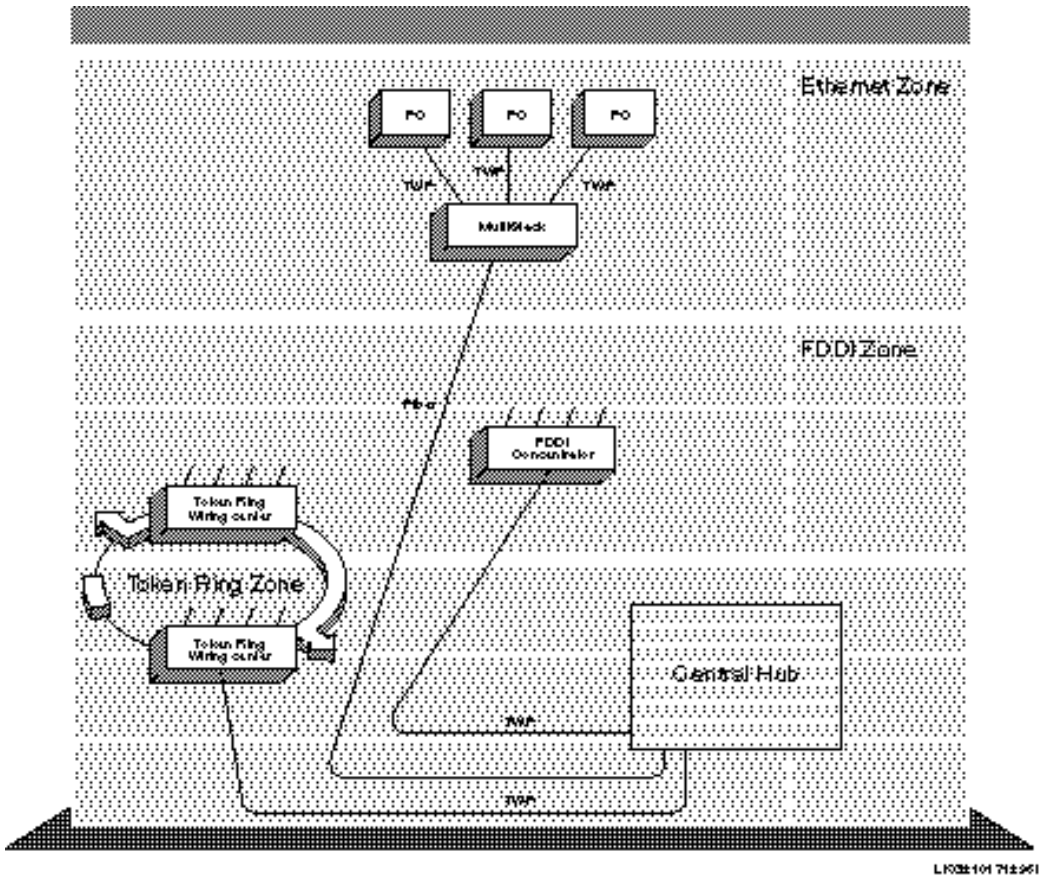


Figure 2-3: Zone Distribution Model

Zone Distribution MultiStack Rack Pack

The plug-and-play OPEN DECconnect packaged work group system is a solution that allows a small business or company to deliver a simple, and easy-to-use work group system. This solution integrates DIGITAL's MultiStack system and a selection of the OPEN DECconnect network components into a single package that complies with the TIA/EIA-568A Building Wiring Standard and the ISO11801 cabling standards.

DIGITAL's OPEN DECconnect packages let you simply and cost-effectively interconnect from one to 48 users. When expanding the basic kit, multiple options are available including UTP, ScTP, fiber optic, coaxial, patch panel inserts, and the Modular Mounting System wallmount options.

The packaged systems approach using DIGITAL's OPEN DECconnect modular mounting products provides the easiest method for structuring the wiring in a work group or stackable environment. There is minimum use of tools and the system snaps together with little effort. The entry-level system supports, and can expand to support, the maximum allowable MultiStack configuration. The basic 16-user package can be expanded to support up to 48 ports on a single patch panel. Up to three, 16-port, DECrepeater 90T-16 options can be mounted in this package. Any combination of media including fiber optics can be supported. As the system grows, none of the original investment is lost. All the existing products can be added to a larger configuration, either wall or rackmounted to expand into the enterprise.

This packaged system provides everything to manage the connection of a 16-user, structured wiring environment. The options only need to be snapped together and mounted on the wall, in a rack, or on a desktop, and then the building wiring connected using insulation displacement connection (IDC) connectors in the patch panel.

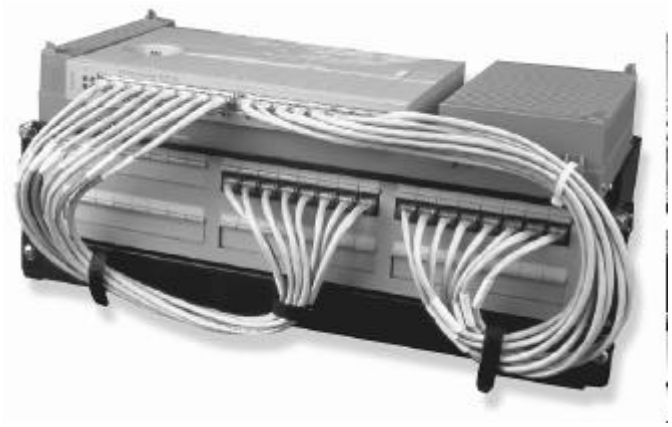


Figure 2-4: MultiStack Rack Pack

Table 2-4: MultiStack RackPack (DETML-P*) Materials List (Basic package with active product)

DIGITAL Part Number	Quantity	Description
DETML-S*	1	DECrepeater 90T-16 stackable unit
H3117-LA	2	Snap-in 8-position 110 (IDC) punchdown to 8-pin modular jack patch panel connector insert supporting TIA/EIA-568A (T568A) wiring
BN25G-0E	16	UTP 8-pin to 8-pin MP Category 5 interconnect cable non-crossover for use in the office and equipment room
H3108-PA	1	Modular snap-in hinged plastic panel frame and mounting assembly
H3108-HA	1	Blank patch panel insert, 5 pack
H3108-TG	1	MultiStack mounting support tray and cover
H3108-TB	1	Work surface tray, rackmount
H3109-AF	1	Cable management kit (3) Reusable cable management ties (2) KEP nuts (3) One square inch dual lock (2) L-brackets (2) Standard screws to mount 1u blank filler (8) #6 screws (1) Velcro roll, 36” length by 3/4” width (2) Shoulder screws
H3108-BE	1	Blank filler panel, 1U

Table 2-5: Dimensions of MultiStack Components

Dimension	Structured Wiring Kit (H3109-EA)	DIGITAL MultiStack Rack Pack DETML-Px (Figure 2-4)
Height	5.25 inches	8 inches
Width	19 inches	19 inches
Depth	9 inches	9 inches
Weight	5.15 lbs	12.15 lbs

Distributed Backbone Model

In a distributed backbone topology, all users have access to a single, shared building backbone. Often this backbone is implemented in either star radial wiring or a multidrop cable. Each floor of a building is connected to the backbone by a bridge or router. The bridge or router filters all local traffic from the backbone and forwards it to the appropriate location. The backbone may be redundant for high availability.

The distributed backbone model is used when:

- Each floor supports a high volume of local traffic
- Each floor's traffic is isolated from the backbone
- Different floors may support different LAN technologies to suit user needs
- Servers are local to work groups

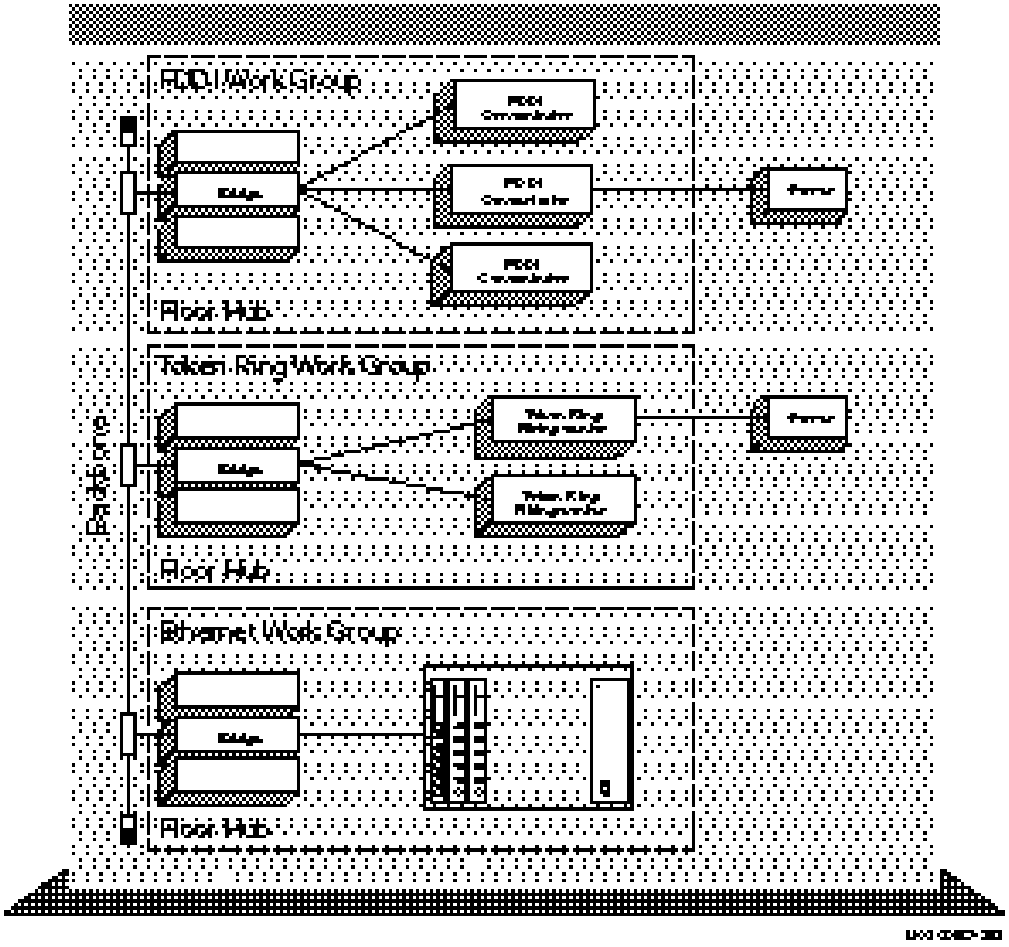


Figure 2-5: Work Group Distributed Backbone Model

Work Group Model

A work group is defined by its physical location and network requirements, and meets the following criteria:

- Typically supported by common servers
- May include representatives of different work functions
- Has multiple media type requirements
- Requires access to common resources

The DIGITAL MultiSwitch 900 (formerly called DEChub 900 MultiSwitch) supports this topology by providing multiple LAN channels through the backplane. The MultiSwitch 900 provides flexible channels that can be configured as Ethernet, Token Ring, FDDI, or ATM. The work groups can be homogeneous or heterogeneous.

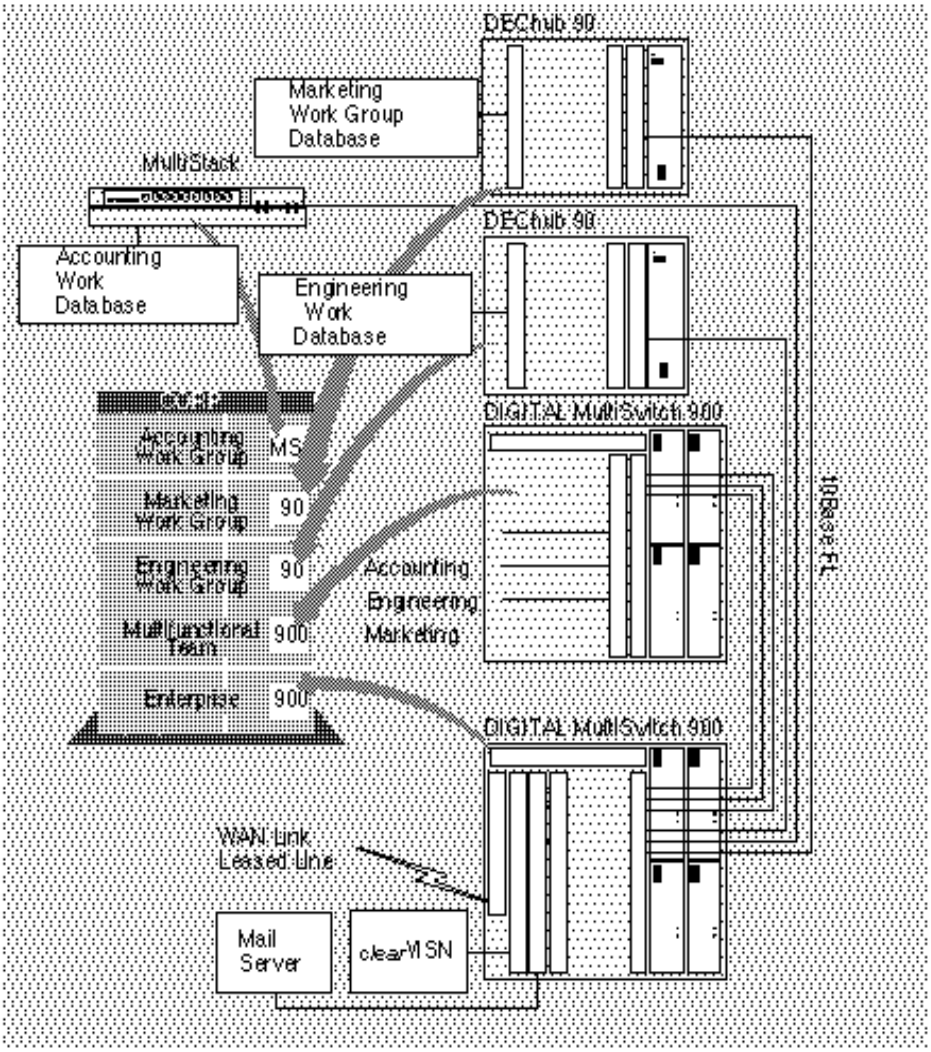


Figure 2-6: Work Group Model

Collapsed Backbone Model

In a collapsed backbone, each floor hub or floor network device directly connects to a central router/bridge, which serves as the building's backbone. In other words, the backplane of the router/bridge becomes the building backbone. The router/bridge services all of the building traffic.

The collapsed backbone model is used to:

- Minimize the number of router/bridge hops between users and between users and servers
- Minimize the number of bridges used in the network to minimize equipment cost
- Provide higher bandwidth connections to centralized servers
- Provide a higher bandwidth backbone

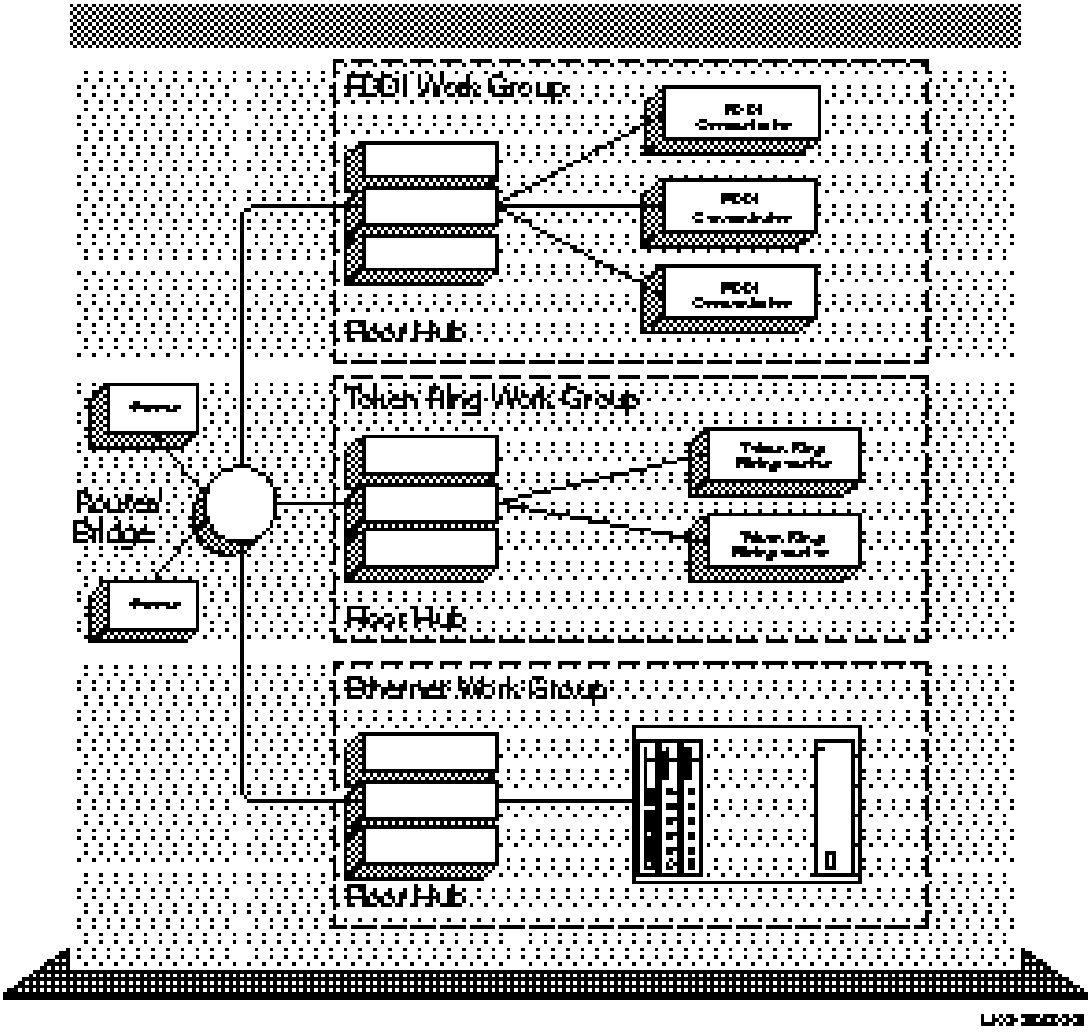


Figure 2-7: Collapsed Backbone Model

Interconnect Implementation

Interconnect and Full Cross-Connect are two methods used to attach the Equipment Room active device to the passive network. The direct Interconnect method shown in Figure 2-8 is the most widely used and least expensive. This method uses only one patch panel for the office termination point, and only one patch cable to connect it to the active port of the active device. When a move is needed, the patch cable on the active device is moved to another port.

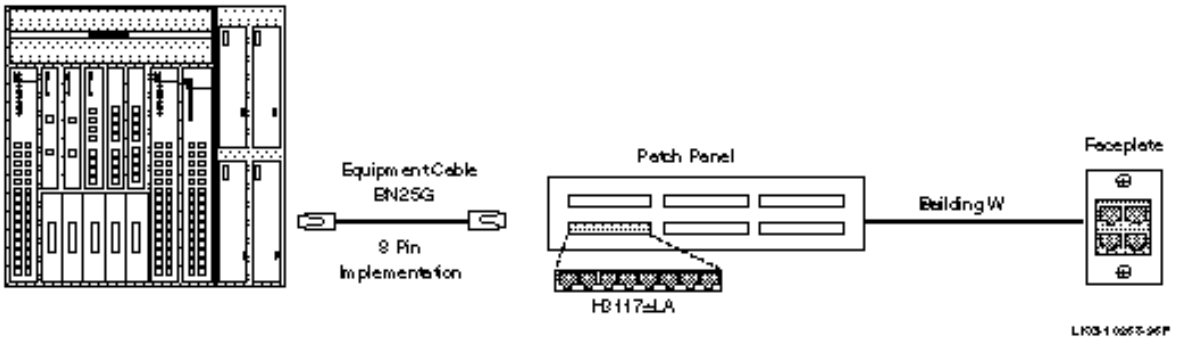


Figure 2-8: Interconnect Implementation

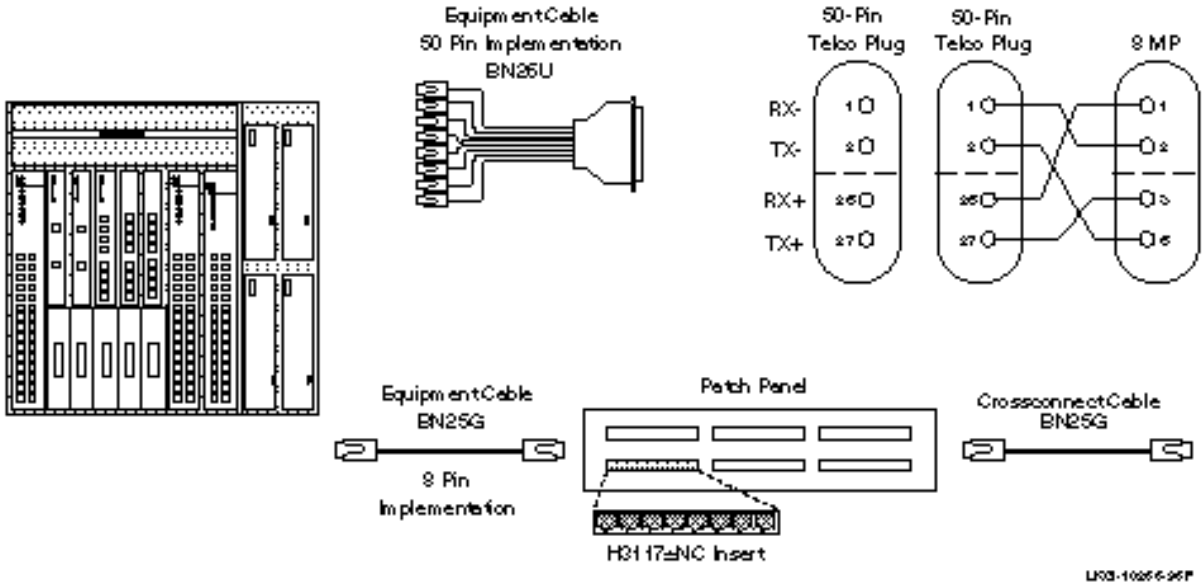
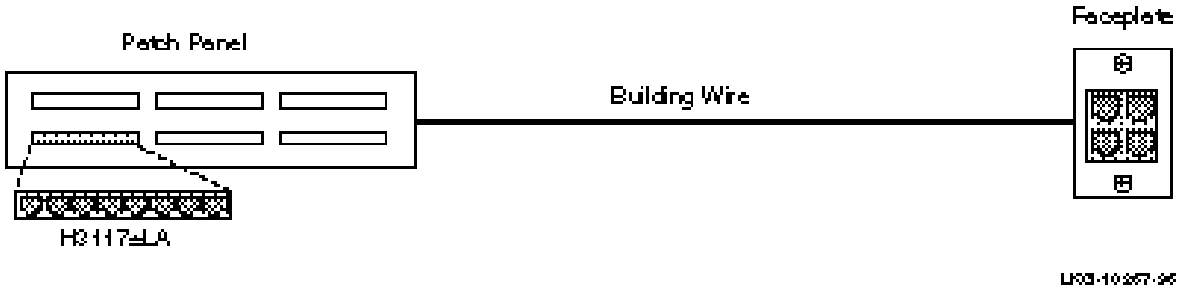


Figure 2-9: Full Cross-Connect Implementation

Full Cross-Connect Implementation

When the Full Cross-Connect method is used, two patch panels and two cables must be used. The first patch panel assembly is used to terminate the office connection and the second patch panel is used to attach the active equipment. Patching is accomplished by using the patch cable between the patch panel assemblies. See Figure 2-9. When a move is made, the patch cable is moved, not the connection to the active device. The Cross-Connect can be implemented using either a mass terminated cable connection or a single cable. Both methods and the components necessary are shown in Figure 2-9.



OPEN DECconnect Components Support EIA/TIA Standards

The OPEN DECconnect Structured Wiring System supplies a full series of passive components that fit into the TIA/EIA 568 standard architecture. This architecture defines the five individual wiring subsystems, campus backbone, building backbone, horizontal, work area, and administration. DIGITAL has designed and tested a system of components that physically complement these subsystems and meets the standard's technical requirements. The following three figures show some of the key OPEN DECconnect passive components and how they have been implemented within the Structured Wiring System.

Figure 2-10 shows the campus backbone subsystem and some of the key interconnecting components.

Figure 2-11 illustrates the horizontal and work area and building backbone subsystems and some of the passive components used within those areas.

Figure 2-12 illustrates the horizontal and work area subsystems and some of the passive components used within those wiring subsystems.

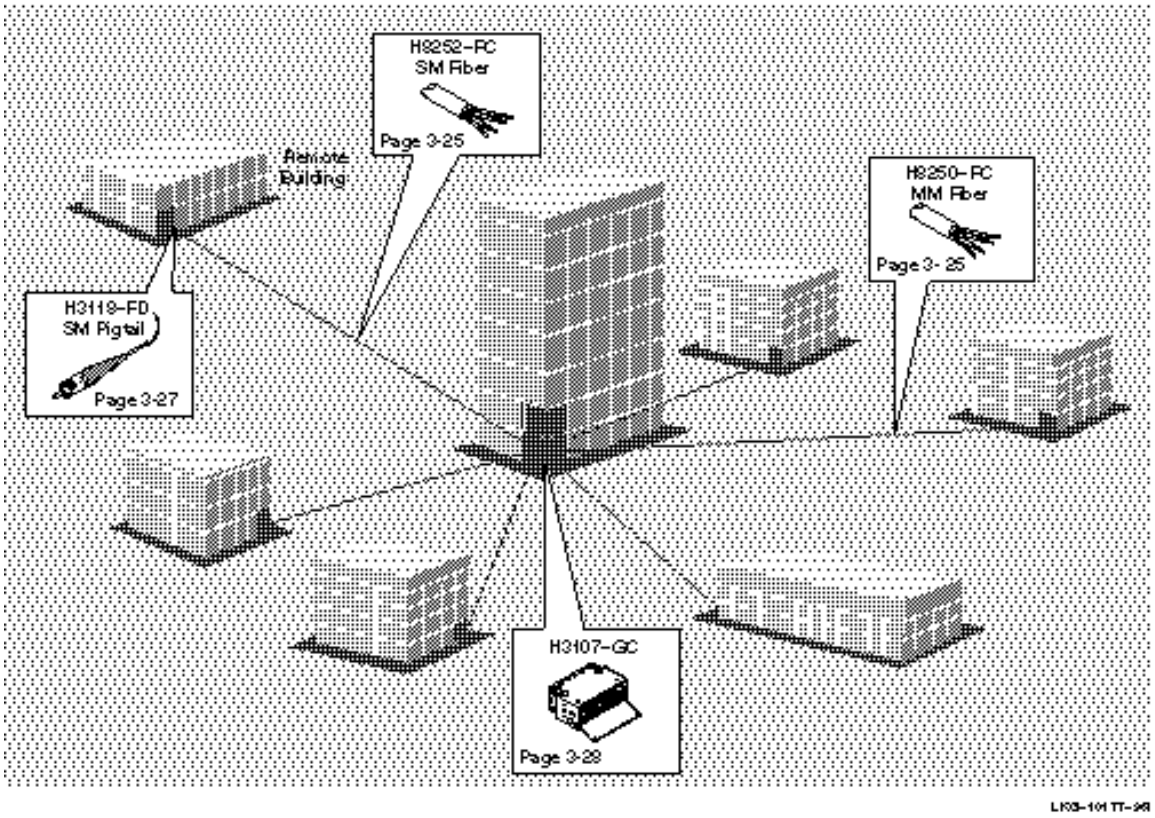


Figure 2-10: Campus Subsystem

Figure 2-11: Building Backbone Subsystem

Figure 2-12: Horizontal and Work Area Subsystem