Networks • Communication

Ethernet Installation Guide

Site Survey and Configuration Planning
Volume 1

Installation and Testing
Volume 2

digital™

EK-ETHV1-IN-003

Networks • Communication

Ethernet Installation Guide

Site Survey and Configuration Planning
Volume 1

Digital Equipment Corporation

1st Edition, August 1983
2nd Edition (Rev), November 1984
3rd Edition (Rev), October 1985

Printed in U.S.A.

This document was set on a DIGITAL DECset Integrated Publishing System.

- Class A Computing Devices:

Notice: This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such radio frequency interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference in which case the user at his own expense may be required to take measures to correct the interference.

CONTENTS

CONTENTS (Cont)

FIGURES

FIGURES (Cont)

TABLES

PREFACE

MANUAL OVERVIEW

The *Ethernet Installation Guide* provides DIGITAL Field Service personnel, DIGITAL customers, and/or designated subcontractors with the necessary technical information and surveying and planning procedures to successfully install and test an Ethernet Local Area Network (LAN).

This guide consists of two volumes:

Volume I Site Survey and Configuration Planning

- Chapter 1 – Overview of the system including a discussion of the physical channel components.
- Chapter 2 – Survey criteria including measurement conventions, types of installations, survey tools, and procedures.
- Chapter 3 – Planning component and cable routing.
- Appendices A through E – Additional information about the physical channel components and various forms that must be completed during the survey and planning process.

Volume II Installation and Testing

- Chapter 1 – Overview of the installation and test procedures.
- Chapter 2 – Installation of the Ethernet physical channel components (procedures and guidelines).
- Chapter 3 – Testing procedures to ensure that installed components function as specified.
- Chapter 4 – Repair of cables after damage, correction of transceiver taps, and repair/replacement of transceiver drop cables.
- Chapter 5 – Discussion of cable installations in high-rise buildings, and conduit and nonconduit installation of fiber-optic cables.

ORDERING INFORMATION

The *Ethernet Installation Guide* is packaged as a two volume set. When ordering, use order number EK-ETHER-IN.

RELATED DOCUMENTS

The following is a list of Ethernet documents that should be referred to during installation, acceptance testing, and repair of the Ethernet cabling system.

EK-DELNI-IN	*DELNI Installation/Owner's Manual*
EK-DELNI-TD	*DELNI Technical Description*
EK-DEREP-TM	*DEREP Ethernet Repeater Technical Manual*
EK-DEREP-IN	*DEREP-AA Local Ethernet Repeater Installation/Owner's Manual*
EK-DERRP-IN	*DEREP-RA Remote Ethernet Repeater Installation/Owner's Manual*
EK-ETHER-RM	*Ethernet Reference Manual*
EK-H4000-TM	*H4000 Digital Ethernet Transceiver Technical Manual*
EK-H4000-IN	*H4000 Digital Ethernet Transceiver Installation Manual*
MP-01369	*H4000 Field Maintenance Print Set*
EB-22714-18	*Introduction to Local Area Networks*
EK-DEUNA-UG	*DEUNA User's Guide*
EK-DECNA-IN	*DECNA Installation Guide*
EK-DEQNA-UG	*DEQNA User's Guide*
EK-DECSA-SP	*The Ethernet Communications Server Site Preparation and Planning Guide*
EK-DECSA-IN	*The Ethernet Communications Server Installation Guide*
AA-X019A-TK	*The DECnet Router Server Installation and Operations Guide*
AA-X020A-TK	*Terminal Server Installation and Operations Guide*
AA-X021A-TK	*The User's Reference Card*

CHAPTER 1
INTRODUCTION

1.1 SYSTEM OVERVIEW

The Ethernet Local Area Network is a data communications system offering optimized, high-speed communications channels for connecting various information processing equipment. Typically, the area served by the Ethernet network is limited to a section of a building, an entire building, or a cluster of buildings.

The Ethernet Local Area Network enables users to share expensive peripheral devices and data bases that are connected to a single, logical network cable. This eliminates the need for several inter-connecting cables as found in the more traditional point-to-point networks. In addition, this network may be easily upgraded as new systems and additional capabilities are added without disturbing the operation of the network.

The following list summarizes the Ethernet specifications.

Item	**Description**
Topology	Branching bus
Medium	Shielded coaxial cable, Manchester encoded digital base-band signaling
Data Rate	10 million bits per second (bits/s)
Maximum Separation of Nodes	2.8 km (1.74 mi)
Maximum Number of Nodes	1024
Network Access	Multiaccess – Fairly distributed to all nodes
Access Control	Carrier Sense, Multiple Access with Collision Detect (CSMA/CD)
Data Packet	Packet lengths from 64 to 1518 bytes (includes a variable length data field of 46 to 1500 bytes)
Preamble	8 bytes (64 bits)

Rules for configuring the Ethernet network are derived from limits imposed on cable distances between connections and the number of components connected. To ensure optimum network performance, the following conditions should be followed.

- Coaxial cable segment
  - Maximum of 500 m (1640.5 ft) in length
  - 49.9 ohm (Ω) terminators
  - Maximum of 100 transceiver connections accepted
- Transceivers
  - Transceivers are attached to the coaxial cable at black bands that occur every 2.5 m (8.2 ft)
  - Transceiver drop cables to station length equals 50 m (164.0 ft) maximum (see Note 1)
- Repeaters
  - Maximum of two repeaters (DEREP) (see Note 2) allowed between any two nodes
  - Distance between any two nodes is a maximum of 2800 m (9186.8 ft)
  - Network cannot exceed 1024 nodes

NOTES

1. **Station controller assemblies such as the DEUNA controller, provided by Digital Equipment Corporation, use an internal cabinet cable that produces a loss equivalent to 10 m (32.8 ft) of transceiver drop cable. In this case, the maximum transceiver drop cable length is limited to 40 m (131.2 ft).**
2. **The DEREP repeater has no internal cable and, therefore, falls within the 50 m (164.0 ft) maximum distance limitation for interconnections of multiple segments.**

1.2 PHYSICAL CHANNEL COMPONENTS

During the planning and design phases of the layout, familiarization with Ethernet physical channel components and configuration specifications is necessary. A description of these components, along with procedures for assembling them into an integrated network, is covered in the following sections. Ethernet physical channel components are illustrated in Figure 1-1.

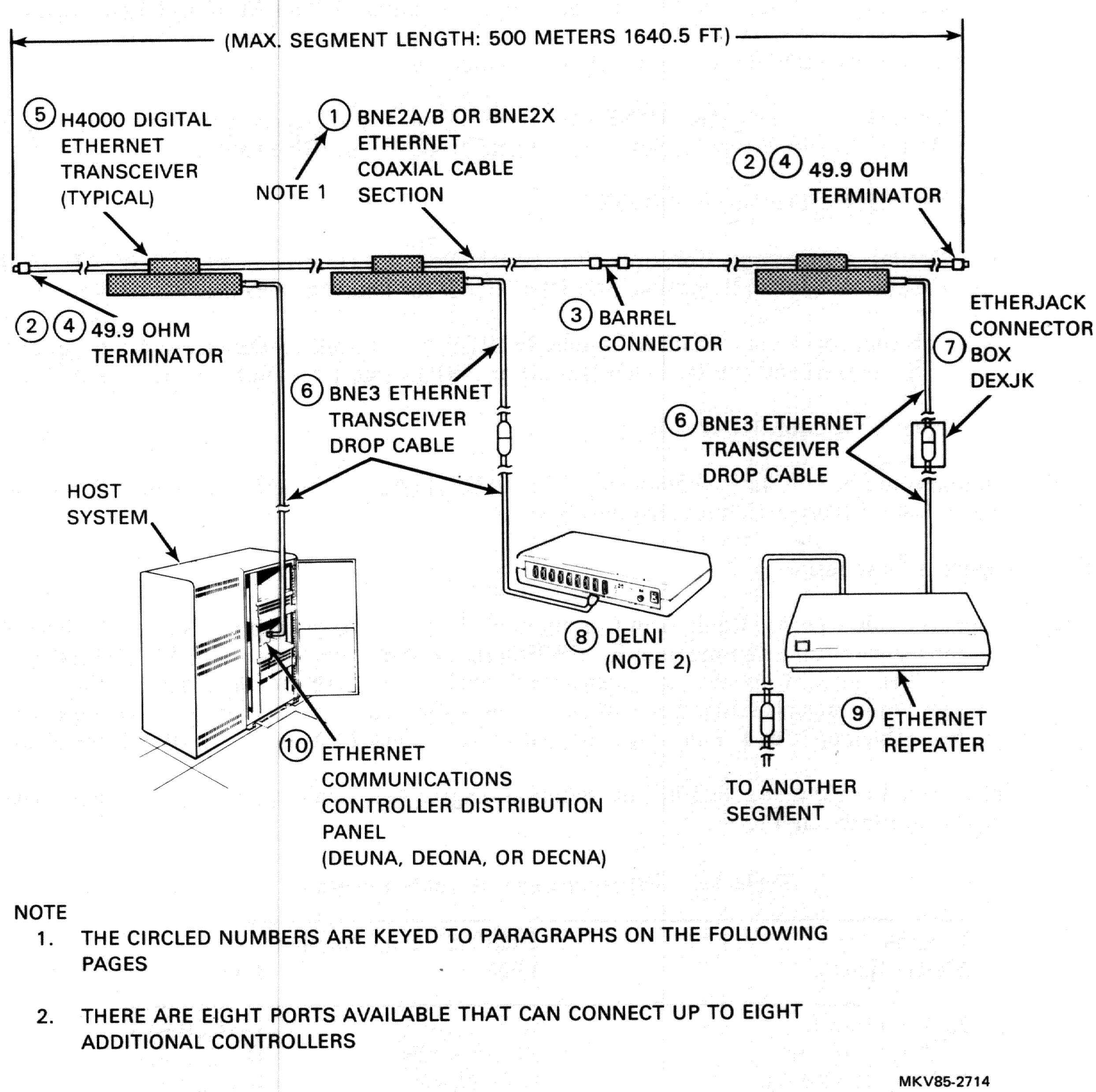


Figure 1-1 Ethernet Physical Channel Components

1.2.1 Components and Station Equipment

Ethernet communications systems consist of:

- Physical channel components – Physical channel components refer to the coaxial cable and the hardware that directly attaches to it. These components consist of:
  - Ethernet coaxial cables with preinstalled male type N connectors (DIGITAL model BNE2A for FEP type cables, and BNE2B for PVC type cables).
  - Double-female type N coaxial barrel connectors (DIGITAL model 12-19817-01).

- Female type N coaxial 49.9 Ω connector terminators, (DIGITAL model 12-19816-01).
- Transceiver (DIGITAL model H4000 transceiver).
- Transceiver drop cables (BNE3A or BNE3B for PVC type cables, and BNE3C or BNE3D for FEP type cables. BNE4A and BNE4B for office cables).
- Etherjack connection box (DEXJK).
- Digital Equipment Corporation's Local Network Interconnect (DIGITAL model DELNI-AA for U.S. version, and DELNI-AB for non-U.S. versions).
- Ethernet repeaters (DIGITAL model DEREP-AA (Local) or DEREP-RA (Remote) for U.S. version) and (DEREP-AB (Local) or DEREP-RB (Remote) for non-U.S versions).
- Fiber-optic cable (BN25B).

• Station equipment – Station equipment refers to DIGITAL computer systems and other devices that use the Ethernet Communications System.

1.2.2 Component Descriptions

① **Coaxial Cable** – Digital Equipment Corporation's Ethernet coaxial cable, BNE2A and BNE2B, are the main transmission medium for the Ethernet Local Area Network (LAN). These cables are shielded to provide very low signal loss. One or more shorter lengths of cable, called *sections*, can be joined together with a coaxial cable barrel connector to make up a cable *segment*. Each open end of the coaxial cable segment must be fitted with a 49.9 Ω terminator.

The coaxial cable is supplied in four standard lengths that minimize signal reflections. These lengths are listed in Table 1-1.

Table 1-1 Ethernet Coaxial Cable Lengths

Lengths Meters/Feet	DIGITAL Part Number FEP	PVC
23.4 m (76.8 ft)	BNE2A-MA	BNE2B-MA
70.2 m (230.3 ft)	BNE2A-MB	BNE2B-MB
117.0 m (383.9 ft)	BNE2A-MC	BNE2B-MC
500.0 m (1640.5 ft)	BNE2A-ME	BNE2B-ME

The model BNE2A coaxial cable contains a Teflon® FEP (fluoridated ethylene propylene copolymer) fluorocarbon insulation and jacket covering. This material is "classified as fire and smoke only" in accordance with the National Electrical Code (NEC) Article 725-2(b).

The model BNE2B coaxial cable is made with polyvinyl chloride (PVC) insulation and jacket covering. PVC cables are not approved for installation in environmental airspaces per the requirements of NEC article 725-2(b).

Teflon is a registered trademark of Dupont de Nemours & Co., Inc.

Annular rings referred to as black bands, are imprinted on the coaxial cable every 2.5 m (8.2 ft). These black bands indicate where the Ethernet transceivers may be mounted.

Additional information on the Ethernet coaxial cables may be found in Appendix A.

② **Coaxial Cable Connectors (Figure 1-2)** – All coaxial cable sections are prefitted with male type N connectors crimped onto the cable at each end. Replacement part number for the connectors is H4056. Dimensions are listed in Table 1-2.

③ **Barrel Connectors (12-19817-01) (Figure 1-2)** – Used to join various lengths of coaxial cable. Barrel connectors are double-female type N connectors. Dimensions are listed in Table 1-2.

④ **Terminators (12-19816-01) (Figure 1-2)** – Incorporates a 49.9 Ω resistive element. This 49.9 Ω element has been designed to match the average characteristic impedance of the Ethernet coaxial cable segments to prevent signal reflections from the ends of the cable. A terminator is required at each end of the cable. Dimensions are listed in Table 1-2.

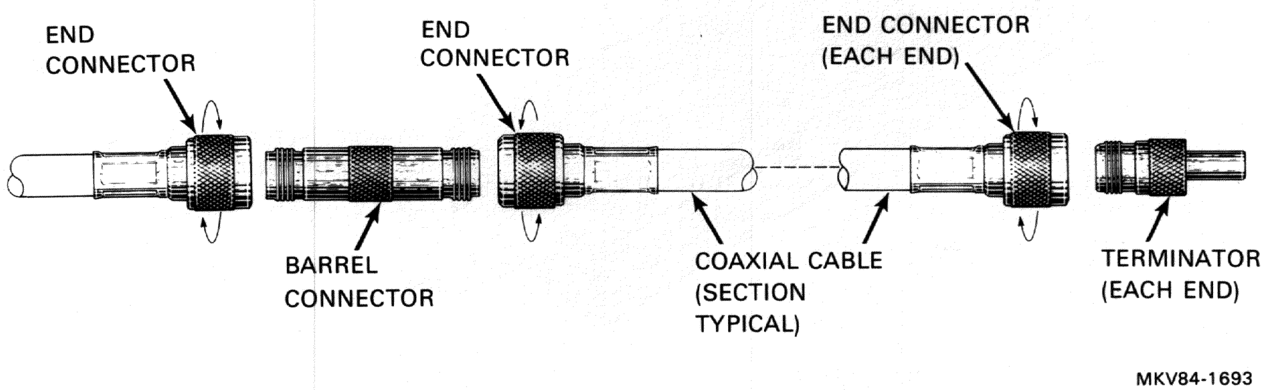


Figure 1-2 Coaxial Cable Connectors, Barrel Connectors, and Terminators

Table 1-2 Coaxial Cable Connector Sizes

Type Connector	Outside Diameter	Maximum Length
End Connector	2.1 cm (0.83 in)	4.1 cm (1.61 in)
Barrel Connector	1.9 cm (0.75 in)	4.6 cm (1.81 in)
Terminator	1.9 cm (0.75 in)	3.6 cm (1.41 in)

⑤ **Transceiver** – The DIGITAL H4000 Ethernet transceiver provides the physical and electrical interface between the Ethernet coaxial cable and the Ethernet station (host systems, servers, repeaters), and Digital Equipment Corporation's Local Network Interconnect (DELNI). The transceiver connects directly to the coaxial cable (refer to Figure 1-3). It consists of a small, rugged, plastic housing that contains the electronics to send and receive encoded signals. In addition, the transceiver provides electrical isolation between the coaxial cable and transceiver cables.

Length	27.7 cm	(10.9 in)
Width	9.5 cm	(3.7 in)
Height	9.0 cm	(3.5 in)
Weight	1.4 kg	(3.0 lbs)

A maximum of 100 transceivers may be attached to an Ethernet coaxial cable segment. These transceivers are installed on the black attachment bands located every 2.5 m (8.2 ft) on the cable. Installation requires the use of a special DIGITAL transceiver installation kit.

The transceiver is UL approved for installation in environmental airspaces per requirements of NEC Article 725-2(b).

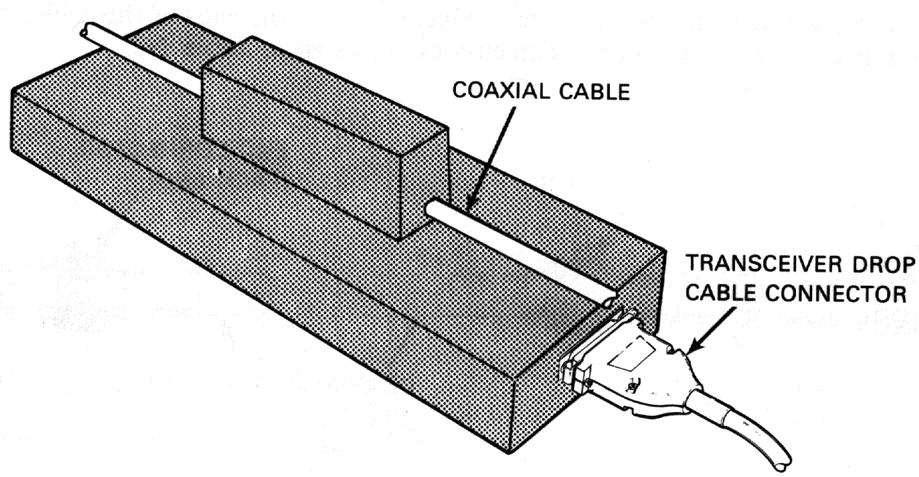


Figure 1-3 H4000 Transceiver

⑥ **Transceiver Drop Cable** – Each transceiver requires its own transceiver drop cable. This cable connects the transceiver to the host, system server, repeater, or DELNI interconnect. Station transceiver drop cable lengths generally do not exceed 40 m (131.2 ft). This cable is also used to connect hosts and servers to a DELNI interconnect, or to connect DELNI interconnects when they are cascaded.

There are three types of transceiver drop cables provided by Digital Equipment Corporation. These cables may be ordered in various lengths and with either straight or right-angle connectors (refer to Figure 1-4). BNE3A, BNE3C, and BNE4A cables have straight connectors; BNE3B, BNE3D, and BNE4B cables have right-angle connectors. Refer to Appendix A, Table A-3 for lengths of transceiver drop cables.

A description of the transceiver drop cables is as follows.

- BNE3A or BNE3B – This type of cable is made with polyvinyl chloride (PVC) insulation. These cables *are not* approved for installation in environmental airspaces as defined by NEC Article 300-22(c).

- BNE3C or BNE3D – This type of cable is made with fluoridated ethylene propylene copolymer (FEP) insulation. These cables *are* approved by UL for installation in environmental airspaces and meet the requirements of NEC Article 725-2(b), "classified as fire and smoke only".

- BNE4A or BNE4B – This type of cable is made with polyvinyl chloride (PVC) insulation. These cables *are not* approved for installation in environmental airspaces as defined by NEC Article 300-22(c). This type of cable is smaller and more flexible and better suited for the office environment.

NOTE

For planning purposes, 1 m (3.3 ft) of office cable (BNE4A/B produces the same attenuation as 4 m (13.1 ft) of BNE3 cable.

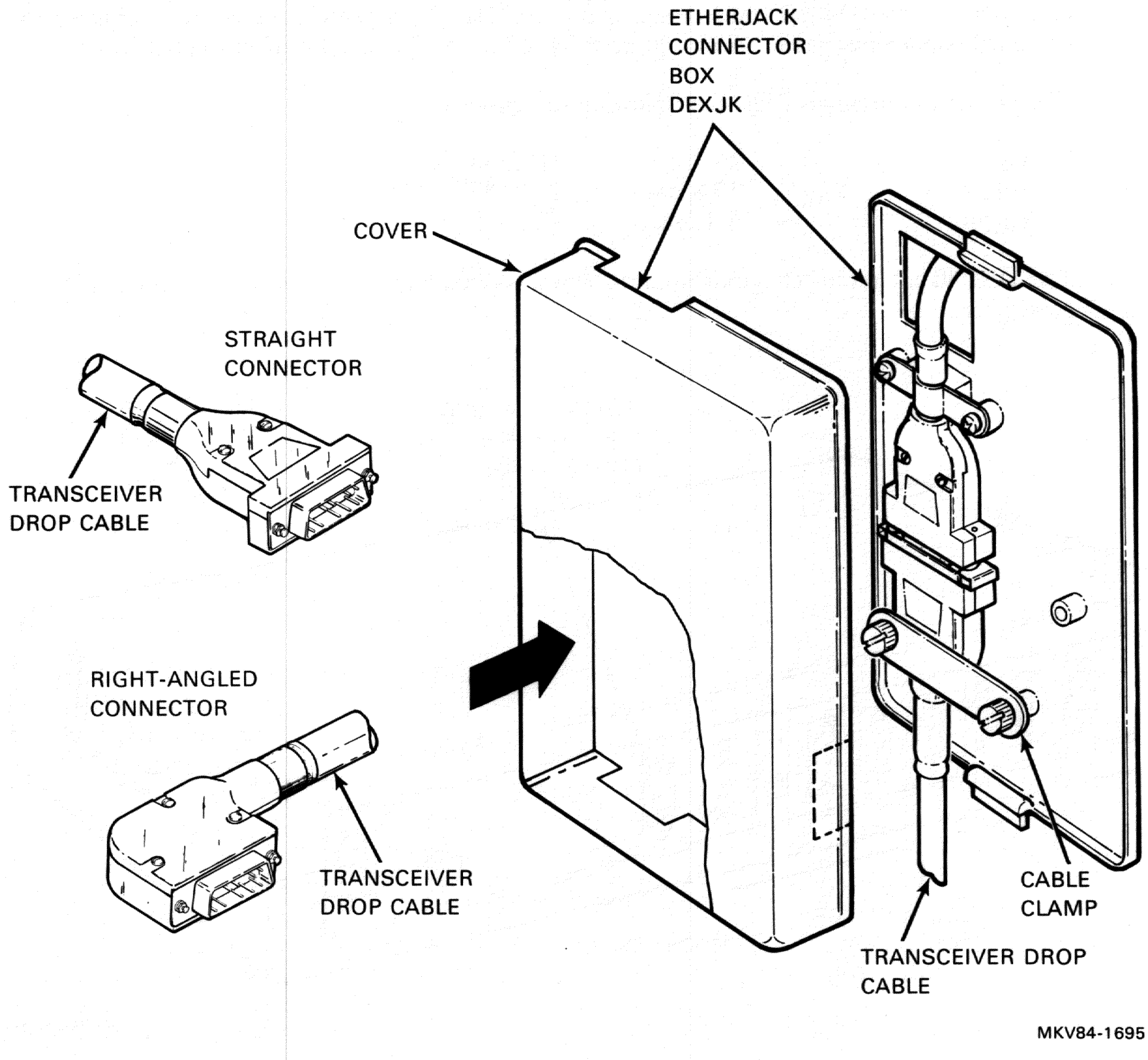


Figure 1-4 Transceiver Drop Cable Connectors and Etherjack Connection Box (DEXJK)

⑦ **DIGITAL Etherjack Connection Box (DEXJK)** – A device for mounting cable connectors. It can be used to:

- Secure cables along the base of a wall, keeping the cable from the office floor area.
- Cover connectors at cable connection points within the office area.

⑧ **DIGITAL Local Network Interconnect (DELNI)** – An eight-station clustering device that is logically a short piece of coaxial cable and eight H4000 transceivers in a single box. The DELNI interconnect can connect any device having an Ethernet communications controller (DEUNA, DEQNA, or DECNA controllers), including the Ethernet communications servers. Network performance is the same, whether the devices (controllers or servers) connect to a DELNI interconnect or directly to an H4000 transceiver.

The DELNI interconnect is housed in a small system box (refer to Figure 1-5) and has a self-contained power supply. The connector panel has eight device ports and a ninth port for connection to the H4000 transceiver, or another DELNI interconnect when configured in a cascaded, standalone mode. A switch permits selection of either Local or Global Mode.

The DELNI interconnect has the following dimensions:

Length	43.2 cm	(17.0 in)
Width	17.8 cm	(7.0 in)
Height	6.4 cm	(2.5 in)

The DELNI interconnect requires an ac power source and comes with a 190.5 cm (75.0 in) power cord.

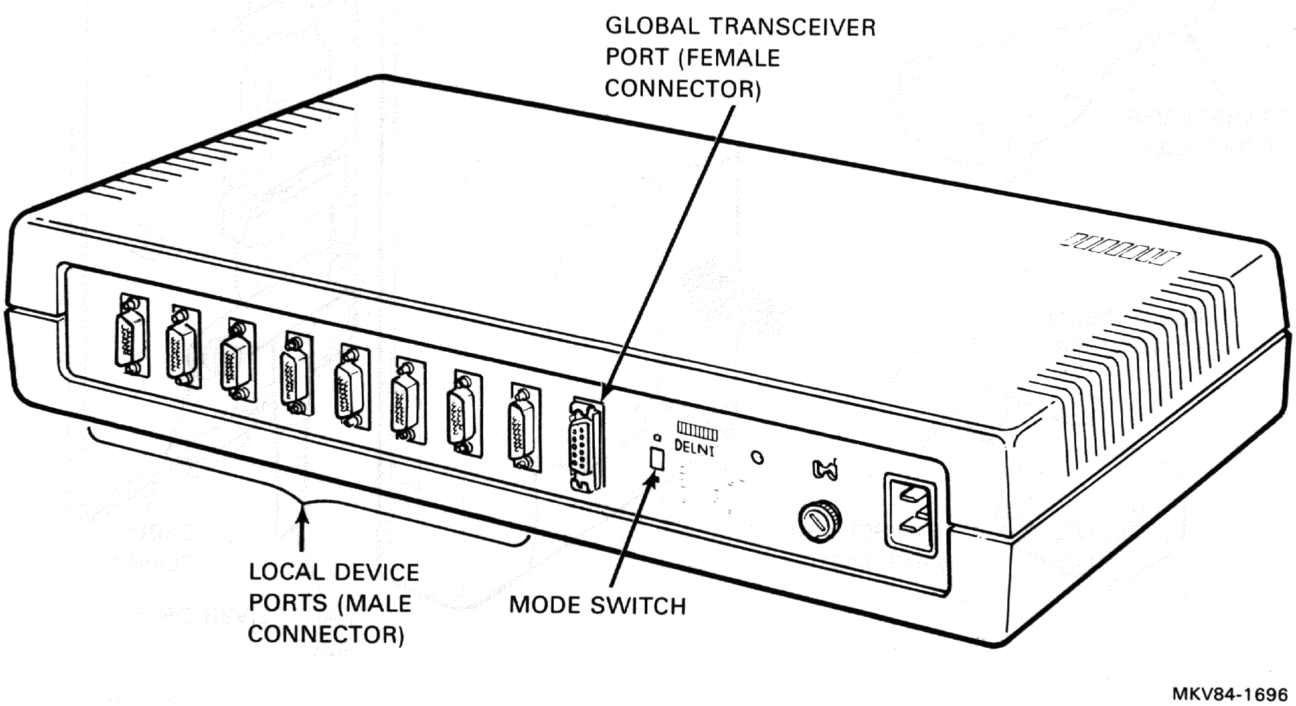


Figure 1-5 DIGITAL Local Network Interconnect (DELNI)

⑨ **Repeater (DEREP-AA/RA)** – A standalone, tabletop device used to expand the Ethernet network to multiple coaxial cable segments. Each repeater can add a branch segment of coaxial cable up to 500 m (1640.5 ft) long on which an additional 99 transceivers may be installed (one transceiver is used to make the DEREP connection).

Digital Equipment Corporation has two types of repeaters.

- Local Repeater (DEREP-AA) – Used within buildings to connect two coaxial cable segments that are no more than 100 m (328 ft) apart (refer to Figure 1-6).

- Remote Repeater (DEREP-RA) – Consists of two repeater halves connected by a fiber-optic cable that cannot exceed a length of 1000 m (3281 ft), and connects two coaxial cable segments. The remote repeater contains a powered systems box at each end of the fiber-optic cable.

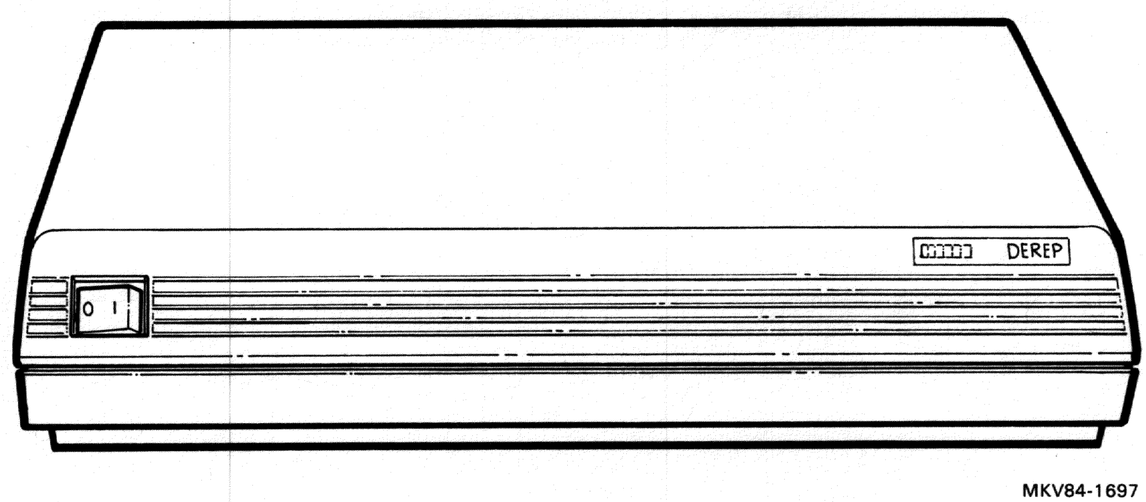


Figure 1-6 Ethernet Repeater (DEREP-AA)

Repeaters maintain data integrity by repeating and retiming all signals transmitted between the two coaxial cables. A repeater requires two H4000 transceivers and two separate transceiver drop cables for connection to the coaxial cable segments.

Fiber-optic cable is required for the interconnection of two units of a DEREP-RA remote repeater. Up to 1000 m (3281 ft) of cable may be used. Digital Equipment Corporation presently supplies preterminated duplex fiber-optic cable (both transmit and receive fibers in a single jacket) in a number of lengths, BNE25B-x. Fiber-optic cables are suited for use inside buildings where the cables will not be routed through air plenums. It may also be used in conduits between buildings where the environmental conditions of temperature and humidity do no exceed the cable specifications. When polling long lengths of fiber-optic cables, or when installing fiber-optic cables in conduits, a pulling device is required. Refer to Appendix D for lengths and part numbers.

The DEREP-AA and DEREP-RA repeaters require an ac power source and each comes with a 190.5 cm (75 in) power cord.

⑩ **DEUNA, DEQNA, and DECNA Controllers** – Digital Equipment Corporation has Ethernet communication controllers for UNIBUS, Q-BUS, and Professional 350 systems. These controllers implement the Ethernet data link layer function and CSMA/CD protocol to provide connections between nodes. These controllers are:

- DEUNA – Allows VAX and UNIBUS-based PDP-11 computers to be connected to the Ethernet network.
- DEQNA – Allows Q-BUS systems to be connected to the Ethernet network.
- DECNA – Allows the Professional 350 computers to be connected to the Ethernet network.

These controllers are combinations of hardware module boards, distribution panels, and cabling that is installed in the host system (refer to Figure 1-7). They connect the host system physically and electrically through either an H4000 transceiver or a DIGITAL Ethernet Local Network Interconnect (DELNI) using a transceiver drop cable.

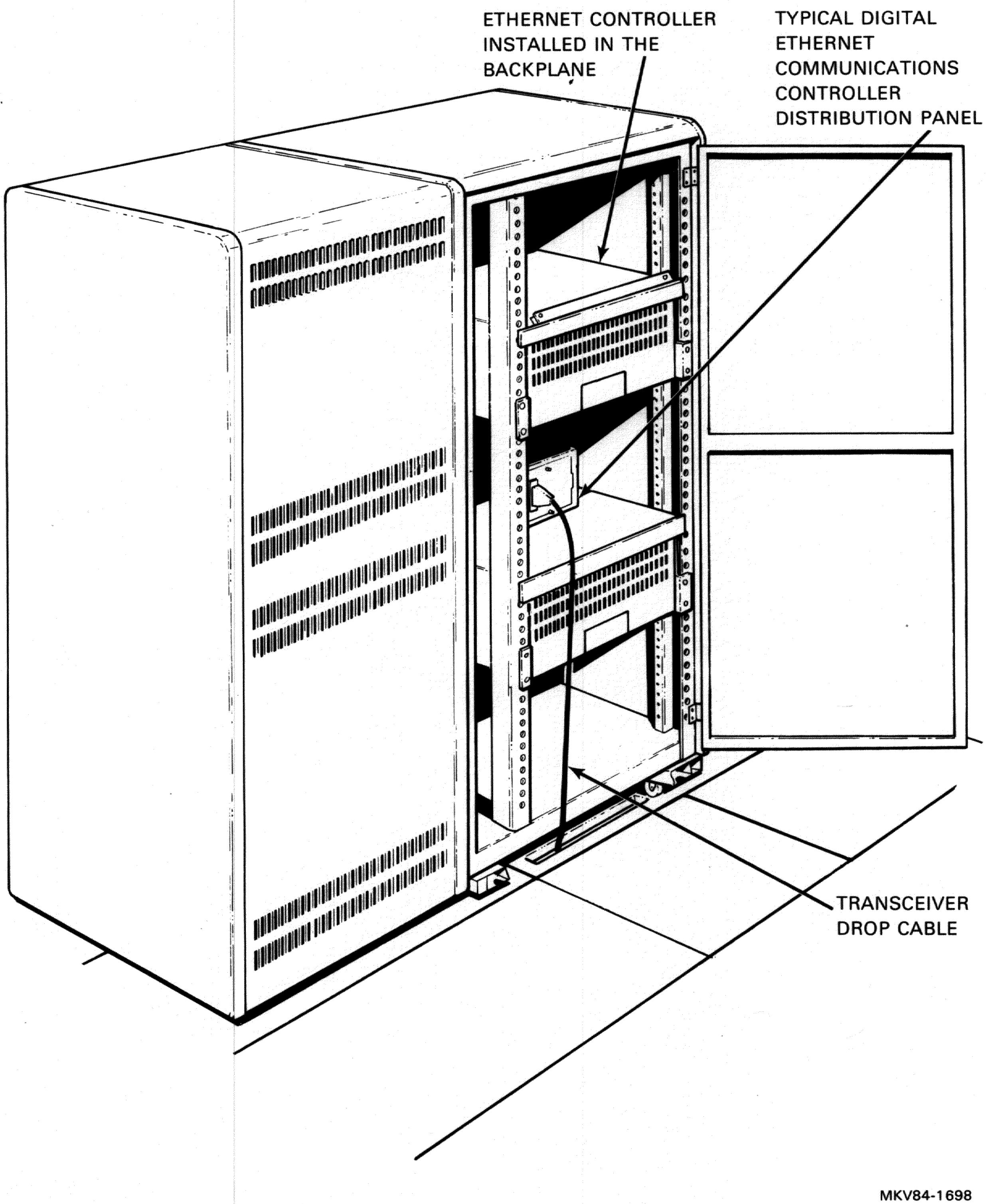


Figure 1-7 Typical DEUNA Host Installation

CHAPTER 2
SITE SURVEY

2.1 INTRODUCTION

Careful planning and design of the physical layout of the Ethernet components is required when the Ethernet Communications System is installed in an existing building, or a building in the design phase or under construction. To do this, the surveyor must consider such issues as the type of structure, the type of occupancy, local building codes, fire codes and restrictions, and the Ethernet configuration specifications. This chapter addresses these areas.

The objectives of this chapter are to help the site surveyor to:

- Gather information on building types, structures, and occupancy,
- Investigate and report any particulars of building construction that might affect the installation of the Ethernet physical channel components,
- Use the proper method for determining distances involved,
- Provide the system planner with detailed site measurements,
- Locate the stations to be connected on the floor plan,
- Suggest appropriate placement for physical channel hardware, and
- Ensure that ac power is available for any DELNI interconnects or repeaters used.

2.2 MEASUREMENT CONVENTIONS

All measurements given in this guide are in metric dimensions: meters (m), centimeters (cm), millimeters (mm). English equivalents are given after all metric dimensions, such as, 2.5 m (8.2 ft). Metric measurements should be used when surveying or planning an Ethernet installation to eliminate the need to convert measurements later.

2.3 TYPES OF INSTALLATIONS

Information gathered during the site survey is dependent upon the type of facility being addressed.

2.3.1 Site Occupancy and Structure

A Network Site Requirement Survey is prepared (refer to Appendix D) to obtain information on the:

- Network owner
- Type buildings
- Network size requirements
- Target completion date

Information to be recorded about the facility should include the following.

- **Network Owner** – Record the name of the network owner, address, name of the facility manager, and so on.

- **Type Occupancy** – Is the building owned or leased by the customer? If leased, are there any lease restrictions that prohibit installation of coaxial cable, or restric- tions as to how it is installed?

- **Type Structure** – Investigate and list the various building characteristics, such as: is the facility a single-floor or multifloor structure? If station equipment will be located on two or more floors, special attention must be given to how the floors will be penetrated for cable installation.

- **Component Location** – Locate Ethernet components to comply with local codes, network owner needs, and aesthetic values. The surveyor must evaluate each site to determine the best location for these components, including:

  - Suspended-ceiling installation of Ethernet coaxial cables and transceivers where the transceiver drop cable is routed to stations on the floor below.

  - Suspended-ceiling installation of Ethernet coaxial cables and transceivers where the transceiver drop cable is routed to stations on the floor above.

  - Raised-floor installation of Ethernet coaxial cables and transceivers where the transceiver drop cable is routed to stations on the floor above.

A detailed example of a site survey (using sample floor plan layouts) for both suspended-ceiling and raised-floor installation of Ethernet coaxial cable and H4000 transceivers is presented in Appendix B.

2.4 SURVEY PREPARATION

The following sections discuss the personnel required to conduct the survey and location of physical channel components, and the type of tools needed for the survey.

2.4.1 Survey Personnel

The system planner is the overall coordinator for the Ethernet installation project. The system planner's duties are to define the coaxial cable pathway and to specify the required parts and equipment. The planner also arranges for the actual installation, verifies that the installation adheres to local building codes, and verifies network configuration.

The facility manager may be able to provide valuable assistance to the surveyor/planner in the form of floor plans and consulting services, as well as, knowledge of the locations of power sources, risers, conduits, environmental airspaces, firewalls, and so on.

The surveyor should ask the facility manager or plant engineer for assistance in obtaining the services of the following professionals.

- HVAC (heating, ventilating, and air conditioning) engineer – An HVAC Engineer can properly examine the facility's ventilating system to determine if the proposed Ethernet coaxial cable installation will be routed through an environmental airspace. Also, it may be necessary to distinguish between various types of airspaces.

- Licensed (or appropriately qualified) electrician – A licensed electrician can survey and locate a suitable ground (network earth reference) point for the Ethernet Communications System.

Before beginning a site survey, the surveyor should become familiar with the physical sizes and space requirements of the various Ethernet physical channel components. These components have already been discussed in Chapter 1 and are shown in Figures 1-1 through 1-7. Additional information on the Ethernet physical channel components may be obtained from Appendix A.

2.4.2 Locating Physical Channel Components

The surveyor should review the various locations that are available for the placement of the Ethernet physical channel components, with particular emphasis placed on locating and servicing the coaxial cable, transceivers, and their drop cables.

Installations, in order of preference, are as follows.

- In exposed cable racks, where many computers are installed in a laboratory-type environment (refer to Figure 2-1). Exposed cable racks offer the greatest ease of installation, while at the same time, providing the greatest support for the coaxial cables and transceivers.

- Underneath raised floors, as found in many computer rooms. In many cases, other cabling already exists in the space beneath the floor. In this type of installation, the transceiver drop cables are installed through openings in the floor (refer to Figure 2-2).

- In suspended ceilings, the coaxial cable and transceivers are located above the ceiling (refer to Figure 2-3).

If it is necessary to penetrate a firewall, it should be noted on the floor plans.

When Ethernet coaxial cables and transceivers are installed above suspended ceilings, the transceiver drop cable can be routed either down to the floor below, or up to the floor above.

When the transceiver drop cable is routed down, the cable may be encased in a drop pole to the work floor.

When the transceiver drop cable is routed up, the cable is routed through a hole drilled in the floor above, and then through a floor service fitting (refer to Figure 2-4).

The coaxial cable and transceiver should be supported every 3 m (9.8 ft) in a suspended ceiling installation. There are two methods that can be used to suspend the cable and transceivers.

- The cable and transceiver can be secured to the ceiling rail support hangers.

- The cable and transceivers may be supported by "J" hooks.

Figure 2-4 shows the latter method of securing the equipment.

Floor conduits are wireways located within a poured concrete floor. Due to the limited size of these conduits [typically 10 cm (4 in)], there may not be sufficient clearance for either the coaxial cable or the transceivers. In addition, the minimum bend radius requirement [20 cm (8 in)] may often be violated. If this type of installation is undertaken, place the H4000 transceivers external to the conduit for easy access, and use a DELNI interconnect to connect up to eight stations.

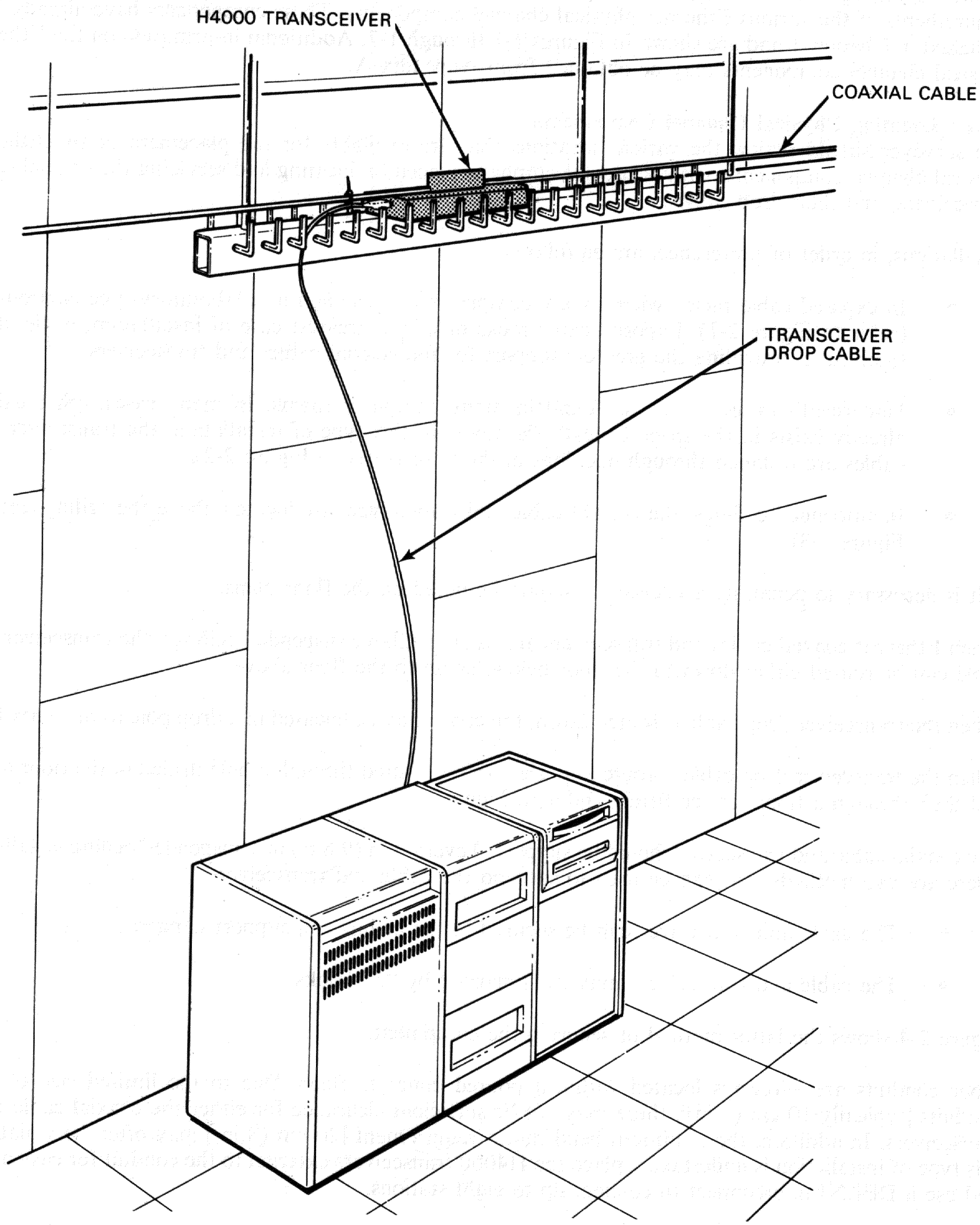


Figure 2-1 Typical Installation of an Ethernet Physical Channel Component in an Exposed Cable Rack

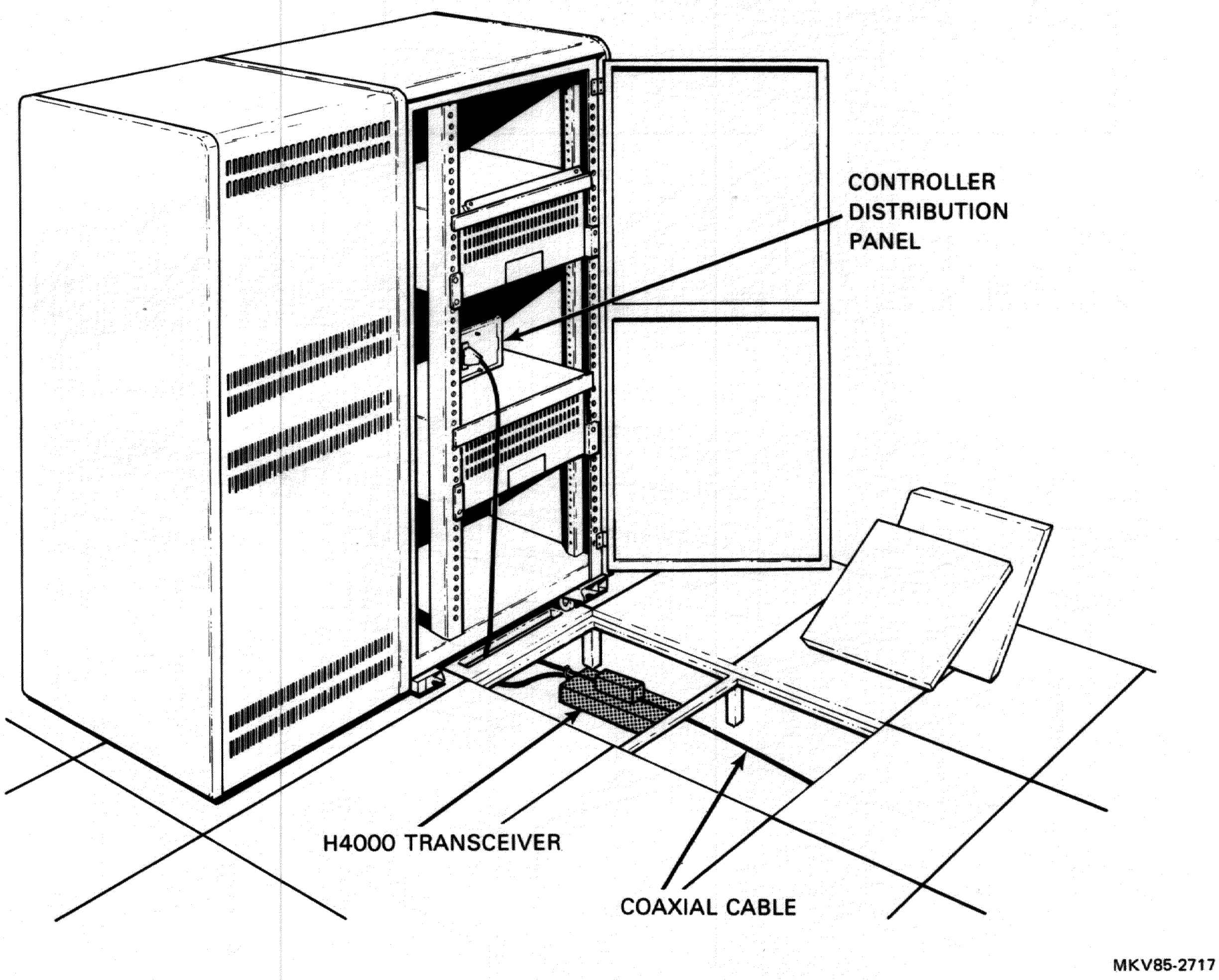
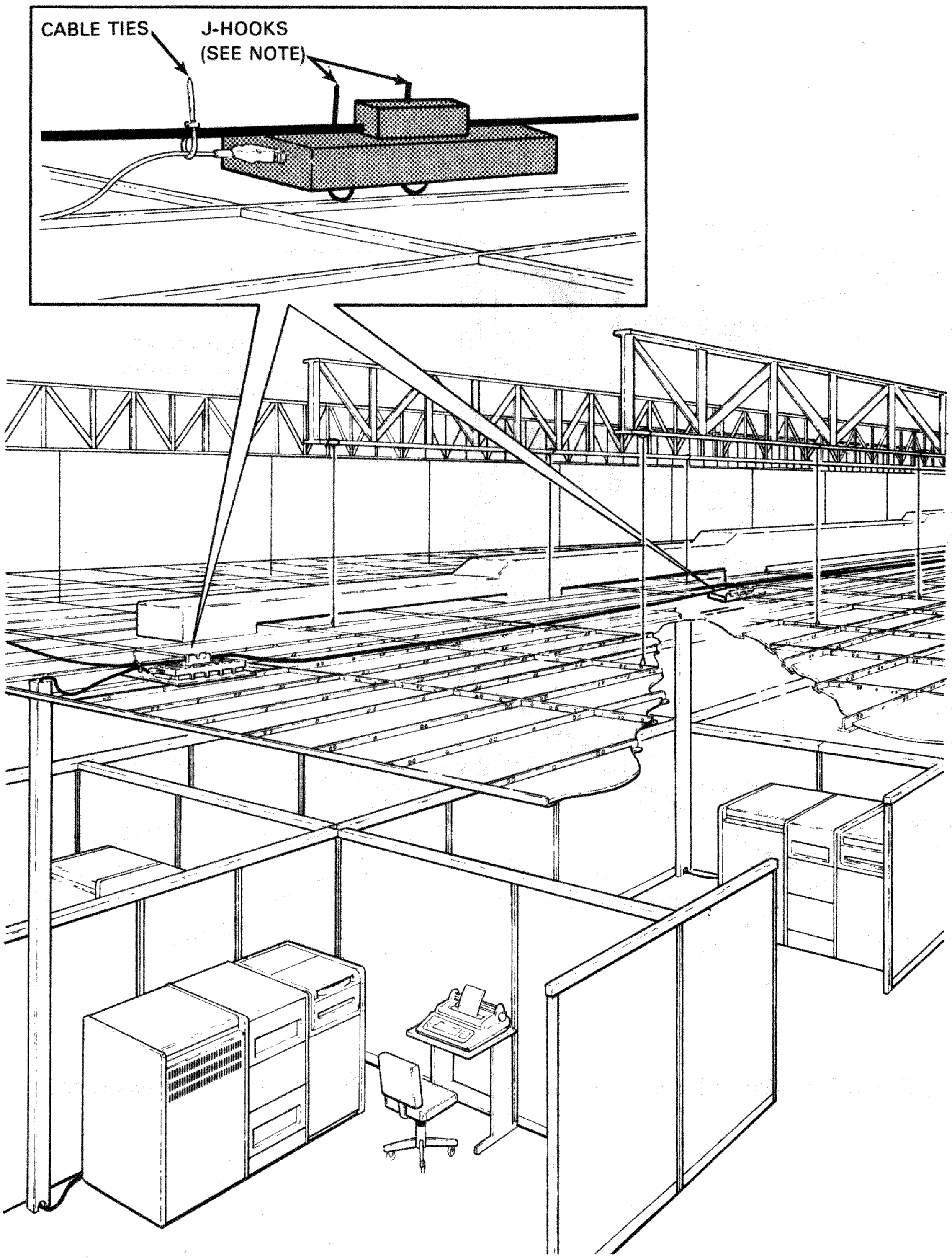


Figure 2-2 Raised-Floor Installation of an Ethernet Physical Channel Component



NOTE:
TRANSCEIVERS AND COAXIAL CABLE ARE SUSPENDED 0.3 M (1 FT) ABOVE CEILING BY J-HOOKS.

MKV85-2718

Figure 2-3 Ethernet Suspended Ceiling Installation

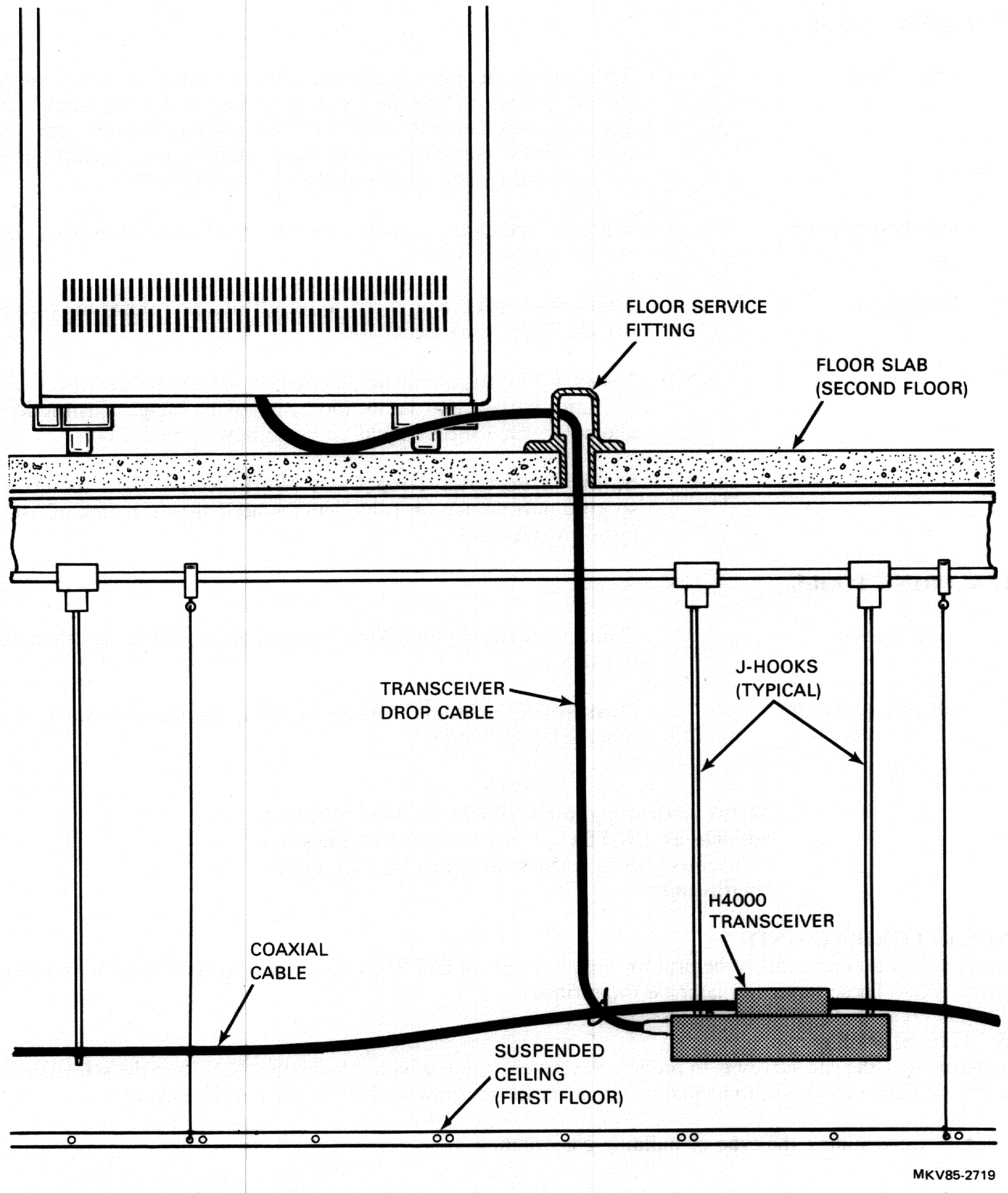


Figure 2-4 Transceiver Drop Cable Routed to an Above-Served Station in a Suspended-Ceiling Installation

2.4.3 Survey Tools

The surveyor should consider using the following tools when conducting a site survey.

RECORDING TOOLS

- Floor Plans — The facility manager, architect, plant engineer or other source should be able to provide the floor plans of the site being surveyed. These floor plans should be reproducible (vellum, sepia, or mylar). These plans are used to locate all Ethernet physical channel components and to record the various cable runs.

- Standard Symbols — Ethernet standard symbols, used to mark the floor plan, are shown in Figure 3-7.

- Worksheets — Two worksheets are provided to record site data (refer to Appendix D). These worksheets are:

  Network Site Requirements Worksheet – Used to record general site information; that is, location, size of building, construction, and so on. One sheet should be made out for each floor.

  Station Transceiver Drop Cable Worksheet – Used to record specific information on cable lengths needed in the area of each installed station.

MEASURING TOOLS

- Tape Measure — Primary measuring tool. Most measurements will be less than 10 m (32.8 ft).

- Measuring Wheel — Used to take measurements on floors as the surveyor walks the proposed cable route.

NOTE

Metric measuring tools should be used whenever possible as DIGITAL Ethernet coaxial cables and transceiver drop cables are supplied in metric lengths only.

TAPE RECORDING UNIT

A pocket dictation unit can be helpful for noting details of building construction without pausing to make written notes. These tapes can later be transcribed.

2.5 THE SURVEY

The purpose of the site survey is to provide the system planner with information to help in the selection of the proper Ethernet physical channel components for the proposed network. This is done by:

- Determining the type of building construction,
- Locating the stations to ensure that they are appropriate for the installation of the various components, and
- Measuring the actual distances at the site.

These measurements and other data are recorded on the floor plans and worksheets.

The following sections discuss the actual procedure for laying out the Ethernet host systems on the floor plans.

2.5.1 Floor Plan Layout Procedure

This phase deals with the actual layout of the Ethernet physical channel on the floor plan. This floor plan layout procedure is as follows.

- Obtain a scaled floor plan from an appropriate source.

- Locate and identify all known components on the floor plan, along with stations, entry points, risers, building obstructions, and wall penetrations. Use the appropriate symbols (refer to Figure 3-7 to make the correct identifications). Also, include any planned future station locations.

  Entry points are where transceiver drop cables enter an area from a concealed location (ceiling or floor). In suspended ceiling cable installations, the entry point is the nearest riser pole. In subfloor cable installations, the entry point is a floor service fitting (if minimum bend radius can be maintained) or a cable access hole in the raised floor itself.

  WARNING

  Exercise caution when routing coaxial or transceiver drop cables in environmental airspaces (refer to Section 2.5.3).

  Environmental airspaces are enclosed areas that carry ventilating air for building occupants. Only material approved for installation in such environmental airspaces is to be used.

- Fill out the Station Transceiver Drop Cable Worksheet (Appendix D). Use one worksheet space per station. Measure the riser length and floor run for each station, and record these measurements on the worksheet.

- Identify ac power sources for both the DELNI interconnects and repeaters.

- Identify the proposed network earth reference point(s) on the floor plan. Only a qualified electrician should perform the qualification tests as described in Section 2.6. Record the results of this test on the Network Site Requirements Worksheet (Appendix D).

- Submit the marked-up floor plan(s), Station Transceiver Drop Cable Worksheet(s), the Network Site Requirements Worksheet, and estimates for components and contractor services to the system planner for approval.

2.5.2 Survey Considerations

When a potential coaxial cable pathway is being surveyed, the following should be considered.

- The proposed pathway should be accessible so that the installer can physically position the cable and other physical channel components (refer to Section 2.5.4 for transceiver space requirements).

- When surveying the proposed pathway through several rooms, note all interior walls and any obstructions encountered. Note especially where the cable penetrates through these walls.

NOTE
Information that cannot be noted on the floor plans or worksheets should be entered in a separate notebook. This notebook should then be given to the system planner.

- If the coaxial cable penetrates a fire-rated wall or floor, note this on a separate sheet of paper and give it to the system planner. The system planner is responsible for providing any necessary fire-rated collars.

- Record the locations where the coaxial cable can be secured every 3 m to 5 m (9.8 ft to 16.4 ft).

- Record on the floor plans any areas where accessibility is inadequate. This information enables the system planner to avoid locating any transceivers in this area.

- Indicate (by shading or cross-hatching) on the floor plan those areas that are considered exposed to extreme temperatures, above 50°C (122°F) or below 5°C (41°F), or high humidity (condensing atmosphere).

- Should the proposed coaxial cable installation be in environmental airspaces, this fact must also be noted on the floor plans by outlining the area in red. Note if the cable installation varies from room to room.

- If the installation of the proposed coaxial cable pathway involves more than one floor of a building, the following measurements are to be taken and noted on the floor plan.

  - Measure and record the distance between each floor.

  - Record the location(s) of all interfloor risers on the floor plans.

- If using conduits, troughs, or cable raceways, make sure that adequate space for the cable and pulling apparatus is available within the conduit, trough, or cable raceway. Visual inspection of the location may be necessary.

- If the installation of the coaxial cable pathway involves more than one building, the following measurements are to be taken and noted on the floor plan.

  - Measure and record the actual conduit length between buildings.

  - Indicate on the floor plans the conduit entry points for each building.

2.5.3 Environmental Airspace

Recent changes in the National Electrical Code (NEC) requires that "remote" and "signal" cables being installed inside environmental airspaces unprotected (without using a metal conduit) be approved (listed) for such installations by a licensed authority or Underwriters' Laboratories (UL).

As defined by the NEC, Ethernet physical channel cables, both coaxial and transceiver drop cables, are considered "signal" cables.

NOTE

The NEC is a set of recommendations that many, but not all, government agencies adopt intact with the force of law. However, some agencies adopt stricter requirements, and these requirements supersede the NEC. A local building inspector or licensed professional engineer can advise the site surveyor on local codes.

In some Ethernet physical channel cable installations, the coaxial cable, transceiver, and transceiver drop cables are installed in the space above a suspended ceiling (refer to Figure 2-3). In many such installations, this above-ceiling space is an environmental airspace that acts as a warm-air return for a building's air-conditioning system. Figure 2-5 shows an above-ceiling environmental airspace, and Figure 2-6 shows an above-ceiling nonenvironmental airspace.

These warm-air return openings feed into a duct work (plenum) above the suspended ceiling. If there is no such duct work, then the entire space above the ceiling tiles (of the suspended ceiling) is the environmental airspace (refer to Figures 2-5 and 2-6). See NEC Article 300-22(c) for a detailed definition.

UL approved cables may be installed in air carrying spaces that are designated as "other environmental airspaces" (such as the space above suspended ceilings when such spaces are used to carry ventilating air, heating, and cooling, without the use of ducts).

NOTE

Only UL listed cables and components, tested and rated specifically for flame and smoke production [per NEC Article 725-2(b)], can be installed in an environmental airspace. These NEC guidelines are subject to approval by local codes.

The following DIGITAL Ethernet components are UL-listed for installation in environmental airspaces where local codes permit.

- **Ethernet FEP coaxial cable, P/N BNE2A-XX**
- **Ethernet FEP transceiver drop cable, P/N BNE3C-XX**
- **Ethernet FEP transceiver drop cable, P/N BNE3D-XX**
- **Ethernet transceiver, P/N H4000**

DIGITAL PVC transceiver drop cables (BNE3A and BNE3B, BNE4A and BNE4B) and PVC coaxial cables (BNE2B), are not UL-listed for installation in environmental airspaces. However, they may be used in nonenvironmental airspace applications. Office or laboratory nonenclosed areas are considered to be nonenvironmental airspaces.

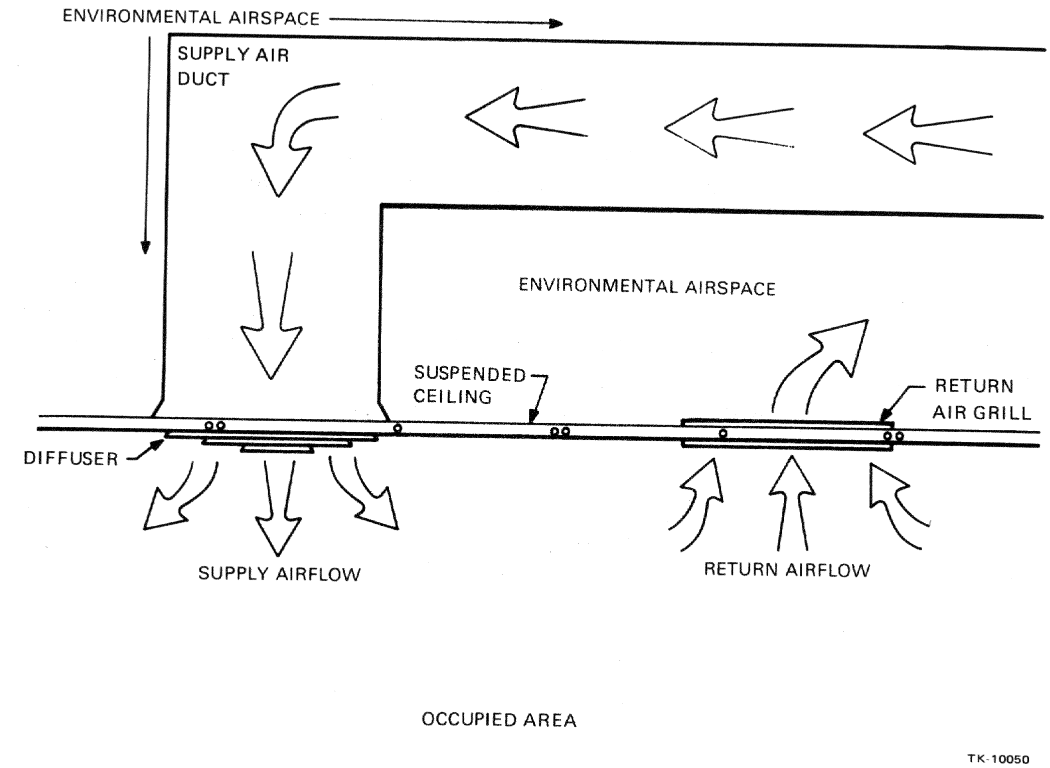


Figure 2-5 Typical Above-Ceiling Environmental Airspace

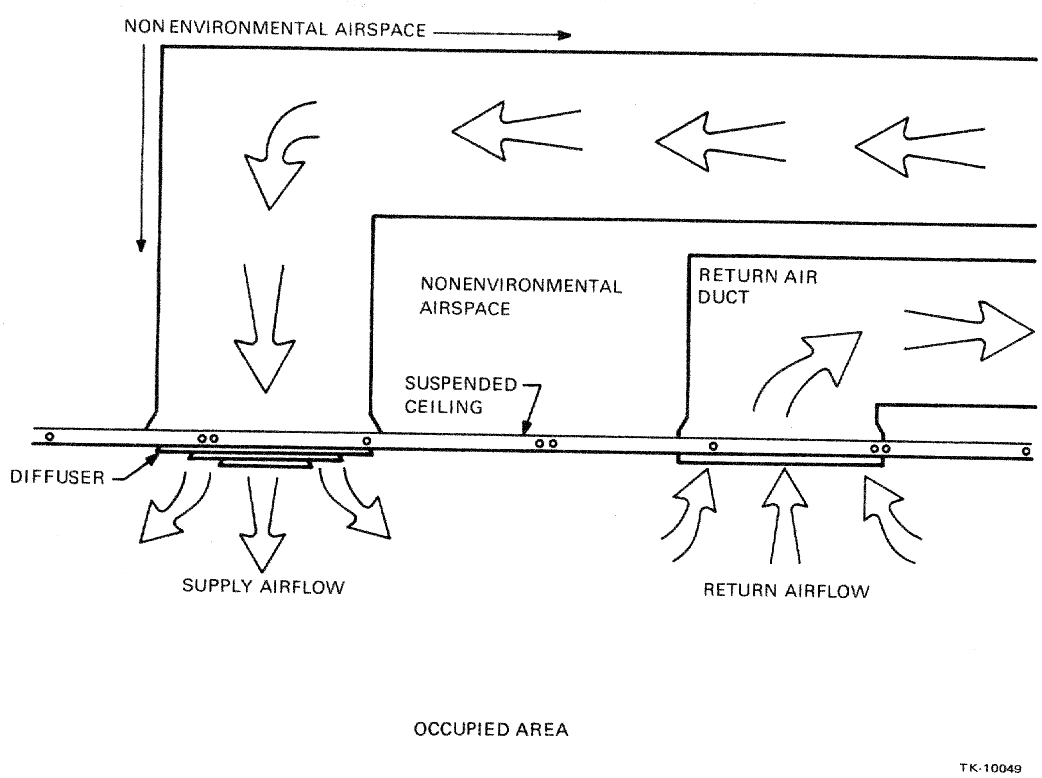


Figure 2-6 Typical Above-Ceiling Nonenvironmental Airspace

2.5.4 Transceiver Location

An H4000 transceiver is attached to the coaxial cable in the vicinity of the proposed station. Certain conditions must be observed when surveying for the installation of the H4000 transceiver. These conditions are:

Temperature	The proposed transceiver installation area should be maintained at a temperature of between 5°C and 50°C (41°F to 122°F) in a noncondensing atmosphere.
Support Structure	The structure that supports the coaxial cable must also be able to support the transceiver. Each transceiver weighs about 1.36 kg (3.0 lbs). If the structure cannot support this additional weight, record this information for the system planner. It may be that cable racks or other supports will be required.
Clearance	Each proposed H4000 transceiver location must have sufficient clearance to permit transceiver installation. The following clearances are suggested as minimum clearances for transceiver installation.

- Length 20 cm (7.9 in) either side of the black attachment bands.
- Width 15 cm (5.9 in) on either side of the coaxial cable.
- Height 30 cm (11.8 in) above and below the coaxial cable.

  If adequate clearance does not exist near the station to be served, note any areas within 30 m (98.4 ft) that do have the required clearances. Record this information for the system planner.

2.5.5 Transceiver Drop Cable

Each transceiver requires its own drop cable that connects the transceiver to the host system, server, repeater, or DELNI interconnect. Transceiver drop cable lengths generally do not exceed 40 m (131.2 ft).

When surveying for the transceiver drop cable path, the surveyor should check for:

- Adequate pulling clearances to allow the connector head (D-connector) of the transceiver drop cable to clear various openings, such as the entry point of the riser.
- Adequate packing clearances (room for additional cables) within the riser to permit more than one transceiver drop cable to be installed. Each cable is about 1 cm (0.4 in) in diameter.
- Minimum practical bend radius [10 cm (4.0 in)]. Any bend or corner that might require a sharper bend should be noted on the floor plans for the system planner.
- The ability to secure the transceiver drop cable to the Ethernet coaxial cable within 15 cm (6 in) of the connector on the transceiver. This is to provide strain relief.

The following measurements and notations should be made on the Station Transceiver Drop Cable Worksheet (refer to Appendix D).

- Record each station name and number.

- Measure and record the riser length. This is the vertical path length needed to reach from the station floor to the level plane of the coaxial cable and transceivers.

  For suspended ceilings, this is the drop pole length.

  For subfloor installation, this is the floor to subfloor distance.

- Measure and record the riser floor run. This is the horizontal distance that the transceiver drop cable needs to reach the station after it has left the riser.

  Measure the possible paths the cable will follow along the floor, including all corners and bends. Allow approximately 1 m (3.281 ft) for slack.

An example of riser length, riser floor run, and coaxial cable entry point distance is shown in Figure 2-7.

- Record on the floor plan:

  - Station location including the station name and number used on the worksheet.

  - Location of the nearest riser/drop pole with adequate room for the transceiver drop cable(s).

2.5.6 Fiber-Optic Cable (BNE25B-XX)

It is important that the surveyor understand the unique characteristics of the fiber-optic cable, and to adhere to the fiber-optic cable specifications at all times. If a network owner is to provide their own fiber-optic cable, the specifications will be made available by a DIGITAL Account Manager or the installation manual that supports the fiber-optic product.

During the site survey, conducting a walk-through (with or without a contractor) or preparing the drawings for installation, the surveyor should be aware of the following important considerations.

- Fiber-optic cable is very sensitive to bend radius. Strain relief is difficult to provide for the cable as it passes through conduits and ducting that are normally suitable for copper cables. Improper tying of a fiber-optic cable may produce a kink that puts the cable out of specification. Extra looping is recommended at corners in order to provide for smooth turns, and for inadvertent pulling of the cable when additional pairs are added to the same conduit.

- Avoid right-angle bends within a conduit that exceed the fiber-optic cable specifications.

- When surveying for vertical cable paths (elevator shafts), ensure that the fiber-optic cable is accessible and is capable of tie-downs at the interval required in the specification. Free-hanging cable may result in excessive stress on the fiber-optic elements.

- Add 10 m to 20 m (32.8 ft to 65.6 ft) of extra cable at each end of the installation to allow for the movement of equipment and/or for future maintenance.

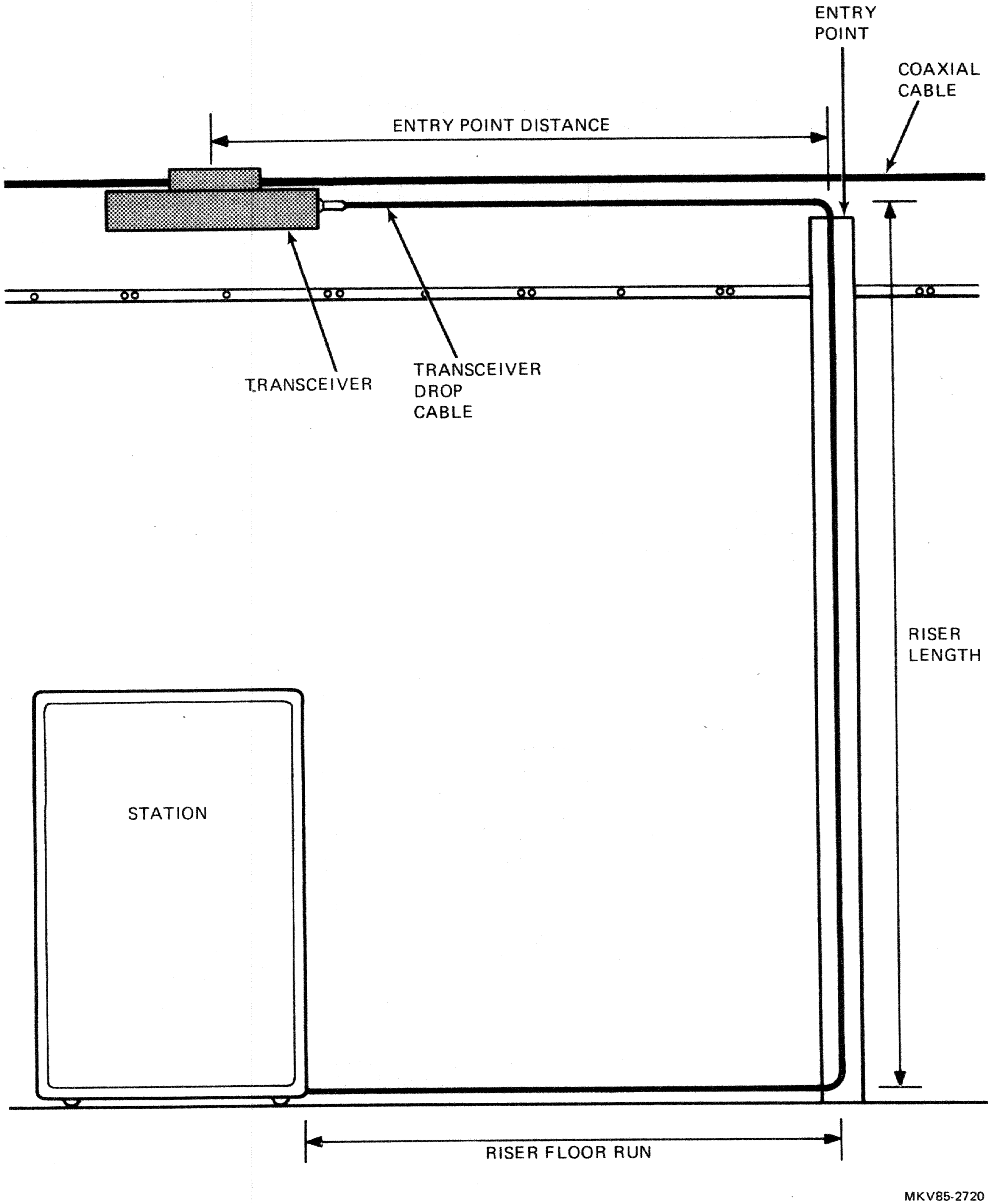


Figure 2-7 Transceiver Drop Cable Length Measurements

2.6 SYSTEM GROUND (NETWORK EARTH REFERENCE)

Electrical codes generally require that a system ground be selected and installed to connect the coaxial cable shield with a reference point for the site's electrical service system (refer to Figure 2-8). This system ground consists of:

- **Network Earth Reference** – A metallic connection point, tested and found to be in continuity with the building's grounding electrode system.
- **Coaxial Cable Shield Connection Point** – A selected barrel connector or terminator used to give a metallic access to the shield.
- **Earthing Conductor** – A length of wire used to connect the network earth reference to the coaxial cable shield connection point.

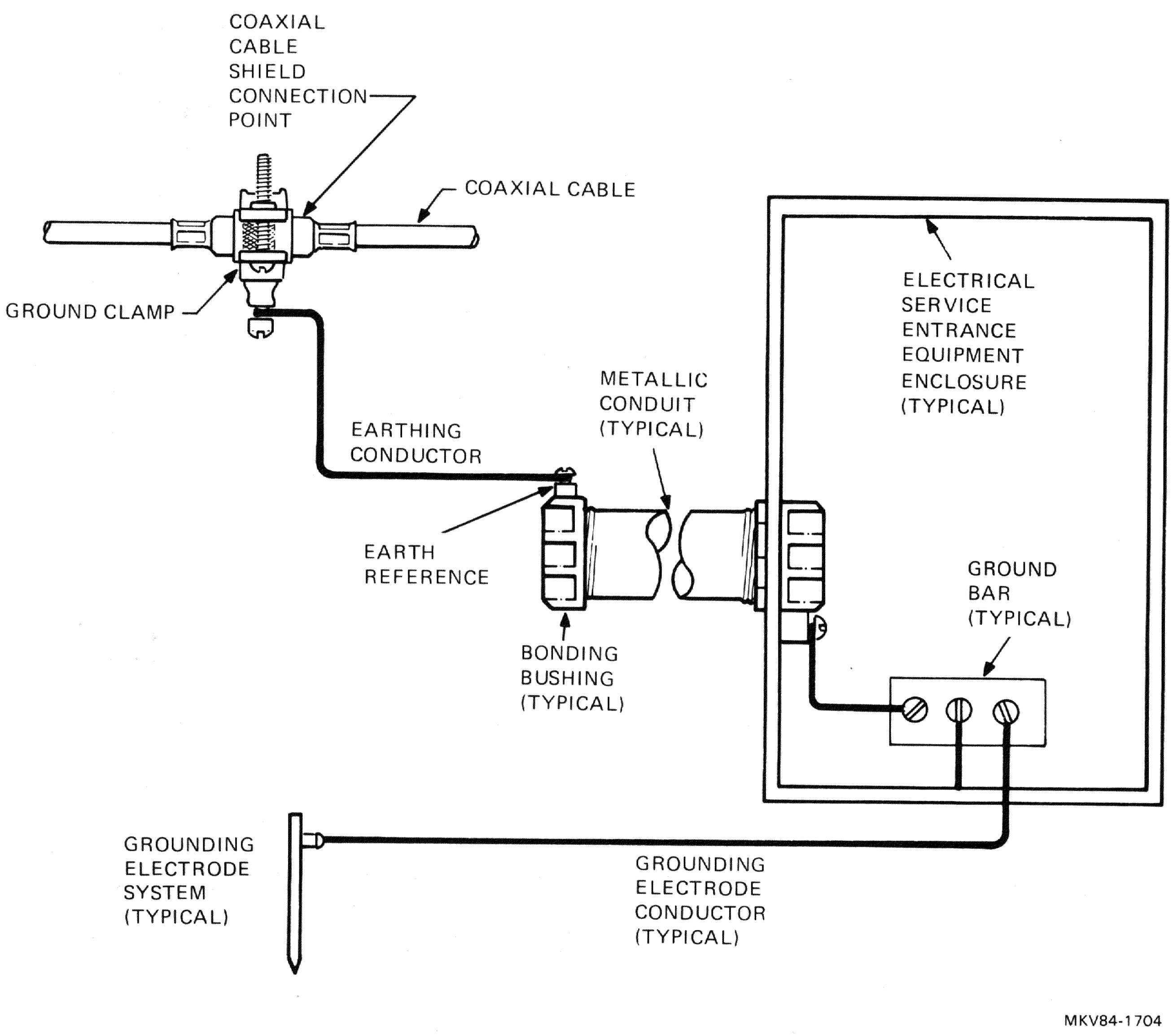


Figure 2-8 Network Earth Reference System Components

Additional pieces of hardware (ground clamps, terminals, and so on) may be required to complete the system ground.

The Ethernet Local Area Network requires a single ground for each coaxial cable segment.

Installation of the Ethernet Local Area Network between two or more buildings using a single coaxial cable segment requires that a system ground be selected in each building. However, in a multibuilding installation, it is strongly recommended that remote repeaters be used with fiber-optic cables. In this way, grounding problems between buildings are avoided.

Use a volt-ohmmeter (VOM) and a long test lead to perform network earth reference qualification tests.

NOTE

A licensed electrician should locate a suitable system ground (network earth reference) point for each coaxial cable segment of the Ethernet network. In certain cases, the ground bus or bar of the electrical service entrance will be concealed behind an electrical power panel or box.

Where possible, existing earth reference wiring or bonding points should be used. In order of preference these include:

- Metallic conduits that are traceable back to the building's electrical service entrance.
- Metallic building structural components that are traceable back to the building's electrical service entrance.

In multibuilding configurations, the preferred earth reference point will be the one nearest the interbuilding conduit. A site is considered multibuilding if:

- Two structures exist that do not share conductive and structural connections (common structural steel).
- The proposed coaxial cable pathway uses an underground metal conduit to reach stations between the structures.

NOTE

Using a remote repeater (DEREP-RA) with fiber-optic cables simplifies multibuilding installations by eliminating the possibility of interbuilding grounding problems.

Ideally, if the interbuilding conduit is a metallic conduit buried in contact with the earth, the ends where the interbuilding conduit appear back in each building may be selected as the earth reference points within each building. This selection must be verified by testing.

The network earth reference attaches to the coaxial cable shield at a connector. The surveyor should select at least two possible network earth reference points in each building to give the system planner flexibility. Figure 2-8 shows a typical earth reference system.

2.6.1 Measuring Earth Reference (Ground) Characteristics

The quality of the earth reference should be checked by measuring its electrical characteristics.

Single Building –	Check the continuity of the earth reference to the grounding electrode system.
Multibuilding –	Check the continuity of each intrabuilding earth reference. Also, measure the voltage difference between the two buildings.

These measurements verify that the selected earth reference(s) are at ground potential. In single-building installations these tests check that the Ethernet coaxial cable is not placed at an elevated voltage. In multibuilding installations these tests ensure that excessive ground loop current does not flow between buildings (refer to Figure 2-9).

2.6.2 System Ground Test Tools

Ground system testing requires the following tools.

SINGLE BUILDING

- **Volt-Ohmmeter** – Capable of measuring 0 Vac – 1.0 Vac full scale, with an accuracy of 0.01 Vac (10 mV). Also capable of measuring 3.0 ohms ± 0.1 ohm (100 milliohms).

- **Test Lead** – The test lead is used to perform the voltage differential and resistance measurements. The test lead must be capable of extending the network earth reference to the electrical service grounding electrode system.

MULTIBUILDING (in addition to the tools needed for single building)

- **Wire, AWG 12 or larger** – Stranded wire to be used as a test lead between buildings. This wire must be able to reach the proposed network earth references in each building at the same time.

- **Clamp-On Style AC Ammeter (Optional)** – Capable of measuring 0.1 A (100 milliamps).

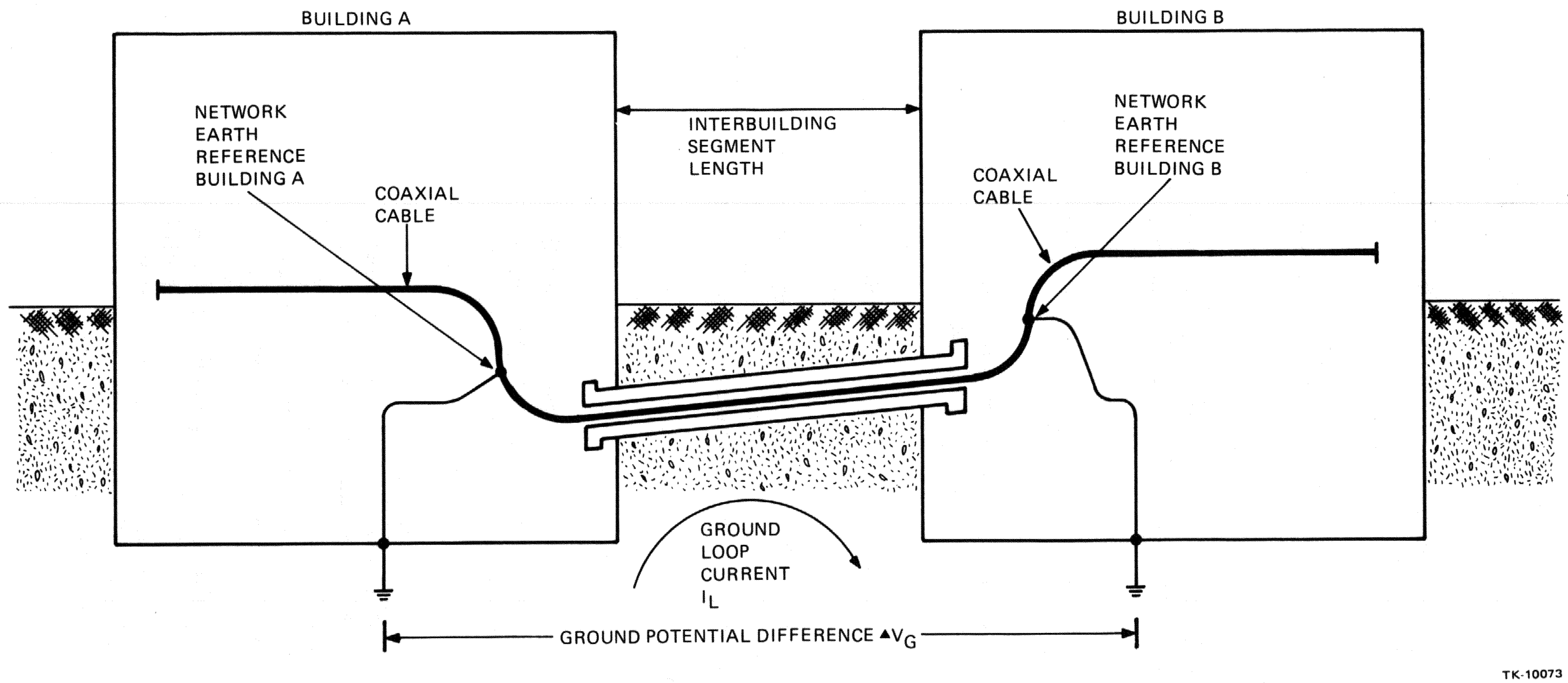


Figure 2-9 Model of Multibuilding Ground Loop Current Flow

2.6.3 Ground Test Procedures

The following are ground test procedures for single-building and multibuilding installations.

SINGLE-BUILDING INSTALLATION

To check the grounding system for a single-building installation, refer to Figures 2-10 and 2-11 and measure the voltage difference from the proposed network earth reference to the grounding electrode system.

A voltage of up to 1.0 Vac may be due to RF (radio frequency) pickup on the volt-ohmmeter and is acceptable.

WARNING

Care should be taken as assumed ground potential may actually be at dangerously elevated voltages.

If the voltage measured is lower than 1.0 Vac, check continuity using the ohm scale on the volt-ohmmeter. Be sure to calibrate the meter by shorting the test leads together to zero the meter. The reading should be less than 2.5 Ω.

The 2.5 Ω value is based on communications station equipment grounding standards developed by USITA (United States Independent Telephone Association, Washington, DC).

MULTIBUILDING INSTALLATION

Perform the following steps to check the grounding system for a multibuilding installation (refer to Figures 2-12 and 2-13).

- First, make intrabuilding voltage and resistance measurements on the selected network earth references inside each building. Voltage from each proposed network earth reference in each building must be under 1.0 Vac, and the resistance must be 2.5 Ω or less.

- Measure and record the interbuilding voltage once the intrabuilding voltage and resistance are known.

WARNING

Elevated voltages may exist between the two building earth references. When performing this test, treat the conductors and probes as if they are at high voltage.

NOTE

There should be no more than a 0.475 Vac difference from the induced reading. Potential differences in excess of this figure may cause excessive ground loop current to flow in the coaxial cable shield between the two buildings (refer to Figure 2-13).

Excessive interbuilding ground potential difference is usually difficult to correct. The advice of a professional electrical contractor should be sought. A straightforward alternative is the use of a DEREP-RA remote repeater and fiber-optic cable.

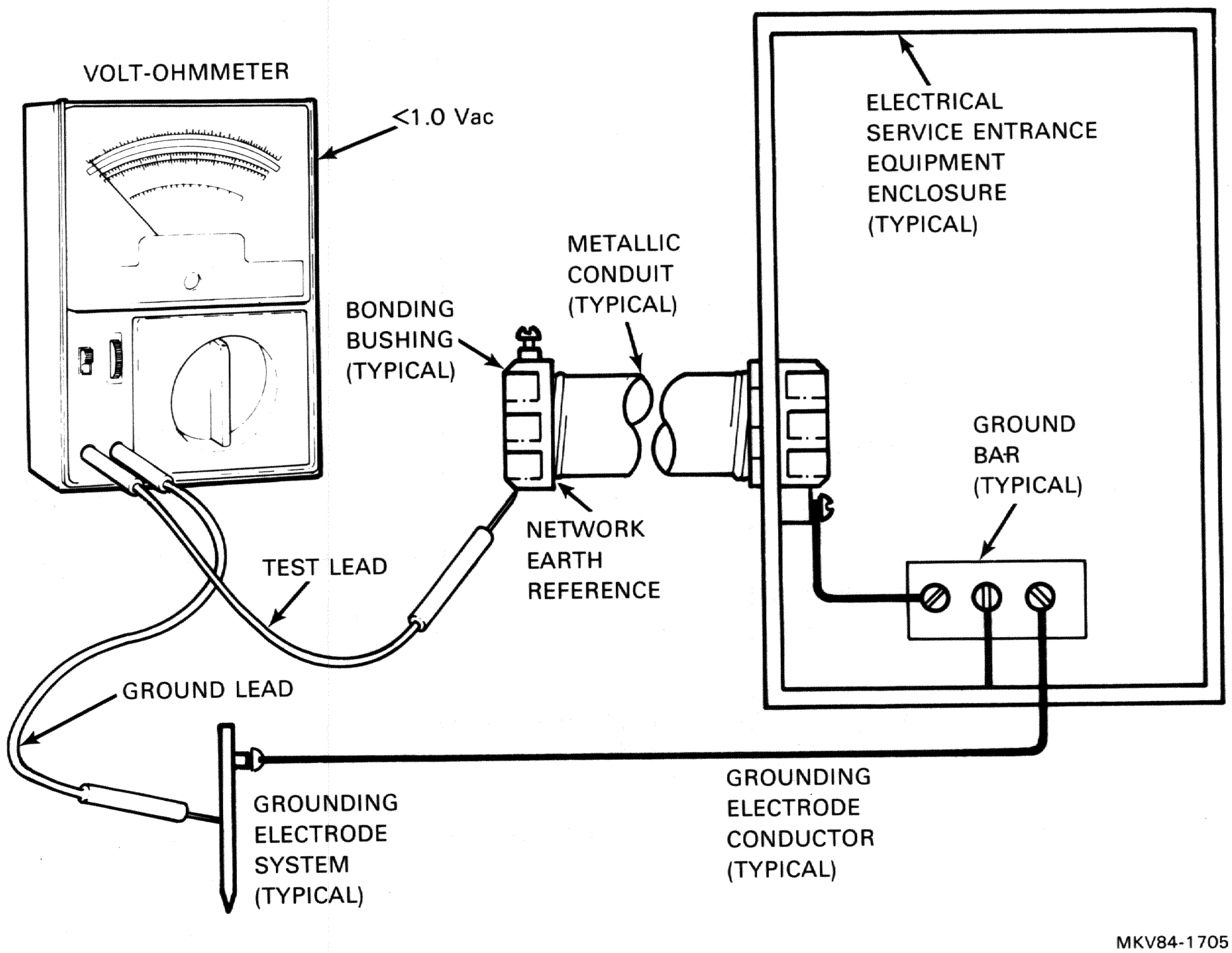


Figure 2-10 Test Setup for the Single-Building Network Earth Reference Connection (Voltage and Resistance)

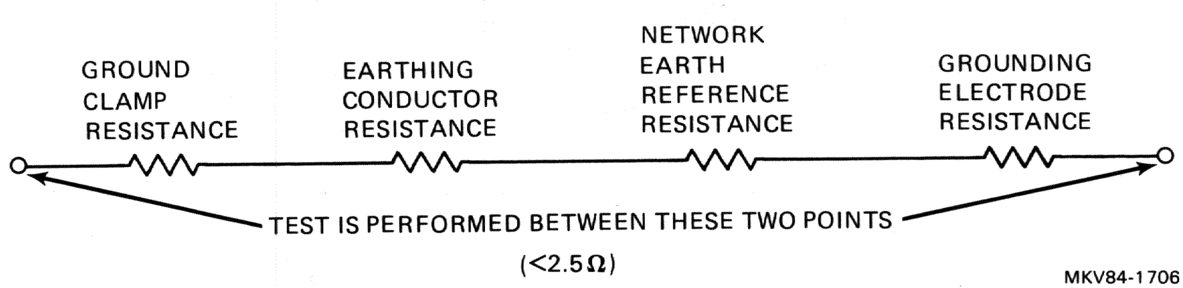


Figure 2-11 Network Earth Reference System – Single-Building Resistances and Conductors Model

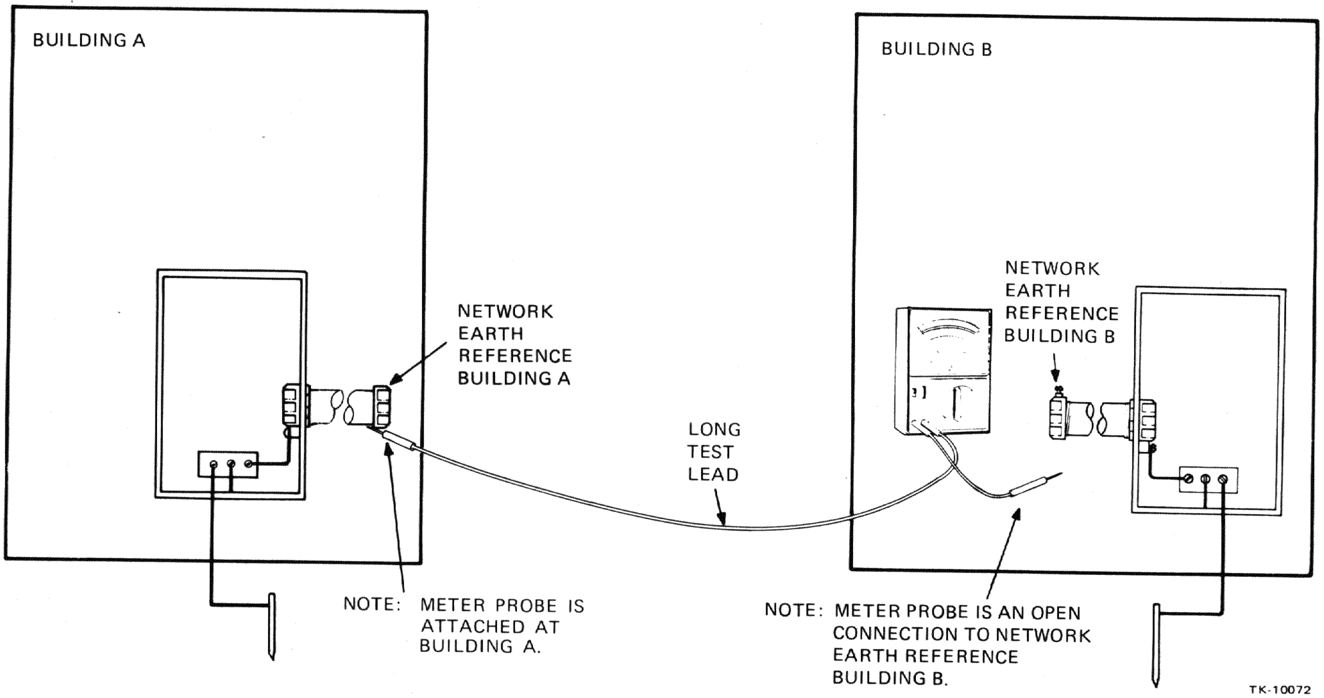


Figure 2-12 Test Setup for the Actual Multibuilding Ground Potential Difference

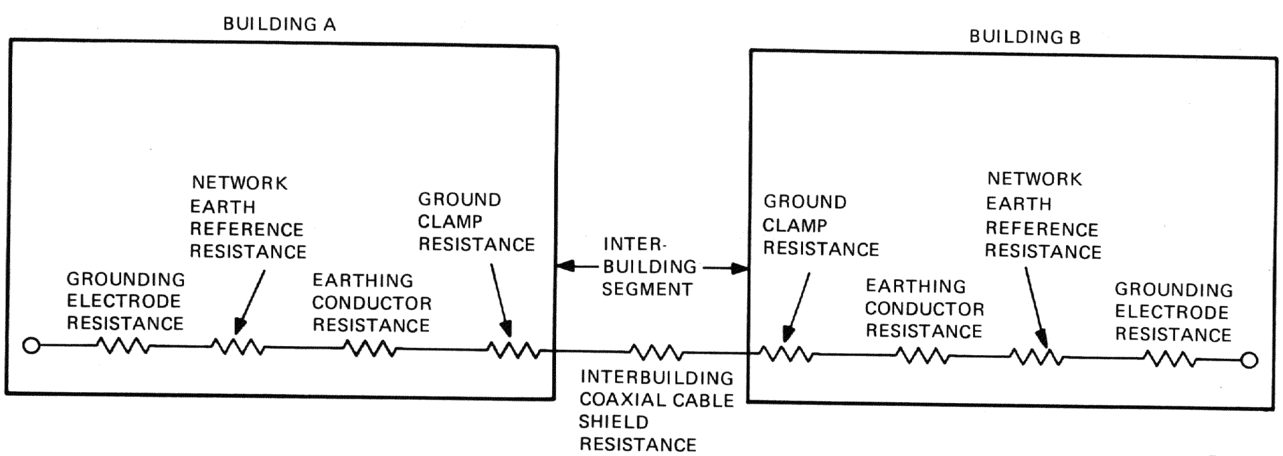


Figure 2-13 Network Earth Reference System – Multibuilding Resistances and Conductors Model

CHAPTER 3
CONFIGURATION PLANNING

3.1 INTRODUCTION

After completing the survey, the next phase is to choose components and plan for installation. This chapter discusses this phase, called *configuration planning*, and is organized around four major elements.

- Planning the coaxial cable path
- Physical channel component configurations
- Planning a system ground
- Ethernet network schematics

Additional help in this planning phase can be found in Appendix B, where sample floor plans are provided.

At this point in the planning cycle, it is important to consider future expansion of not only the host network, but the addition of office automation equipment, such as terminal servers and personal computers. When routing coaxial cable, run additional cable through future expansion areas.

Placement of the physical channel components must be carefully planned and marked on a physical channel floor plan. Two floor plans are required because of the amount of information that needs to be shown.

The first floor plan should show the placement of the coaxial cable, grounding points, barrel connectors, and terminators (refer to Figure 3-1). This plan shows the relatively stable *backbone* components.

The second floor plan should show the placement of H4000 transceivers, transceiver drop cables, DELNI interconnect, repeaters, and host systems (refer to Figure 3-2).

The first plan, or *backbone*, is often filed with facility drawings, while the second plan is kept and updated by the network manager.

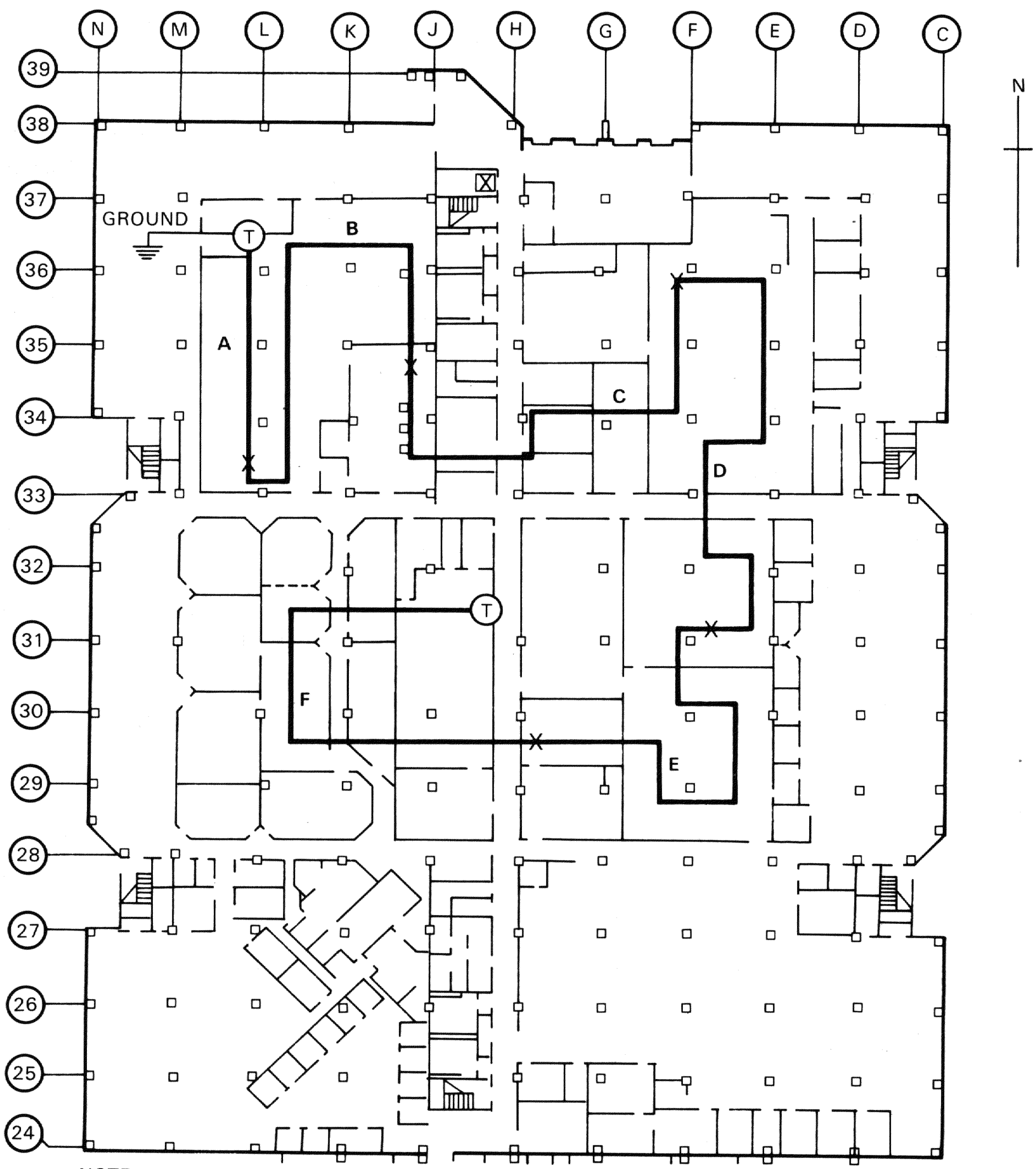
The objectives of this chapter are to help the system planner to:

- Incorporate the configuration rules, and
- Produce a Network System Plan.

Before determining where to place the various components of the Ethernet physical channel, the system planner should become familiar with all the hardware and components (refer to Chapter 1 and Appendix A).

The system planner should be aware that if all the systems (up to 64 maximum) to be interconnected are within a 90 m (295.3 ft) radius, then only DELNI interconnects are needed to interconnect the various systems. This eliminates the need for coaxial cables and transceivers (refer to Appendix E).

The physical channel layout plan starts with the building floor plan. The placement of the coaxial cable, transceivers, and repeaters are marked on this floor plan along with the placement of the host systems and servers.



NOTE:

ETHERNET COAXIAL SEGMENT = 374.4 M (1236.0 FT)
COAXIAL CABLE SECTION A = 23.4 M (76.8 FT)
COAXIAL CABLE SECTION B-F = 70.2 M (230.2 FT)

LEGEND:

COAXIAL CABLE
TERMINATORS
EARTH-NETWORK GROUND
BARREL CONNECTORS

MKV84-1707

Figure 3-1 Proposed Ethernet Cable Layout in a Typical Plant

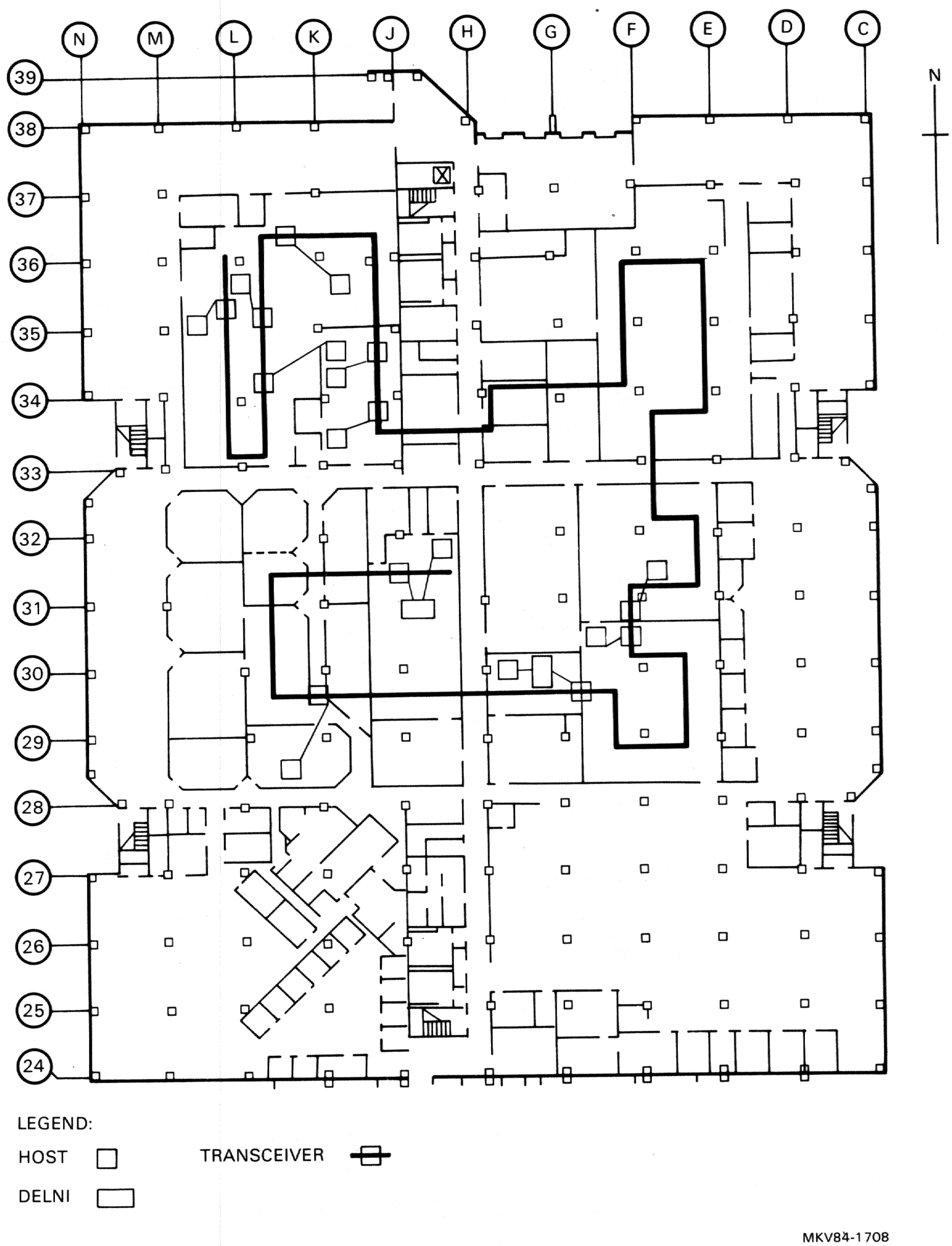


Figure 3-2 Ethernet Component Layout

3.2 PLANNING THE COAXIAL CABLE PATH

The coaxial cable is the *backbone* of the Ethernet Local Area Network. A coaxial cable segment can be a maximum of 500 m (1640.5 ft) long and can consist of shorter cable sections joined by barrel connectors. Each segment must have terminators installed at each end, and the overall segment must connect to the earth network ground (refer to Figure 3-1). Larger areas can be covered by multiple segments through the use of repeaters.

Carefully plan where to run the coaxial cable and where to use repeaters to connect branching segments (refer to Figure 3-3).

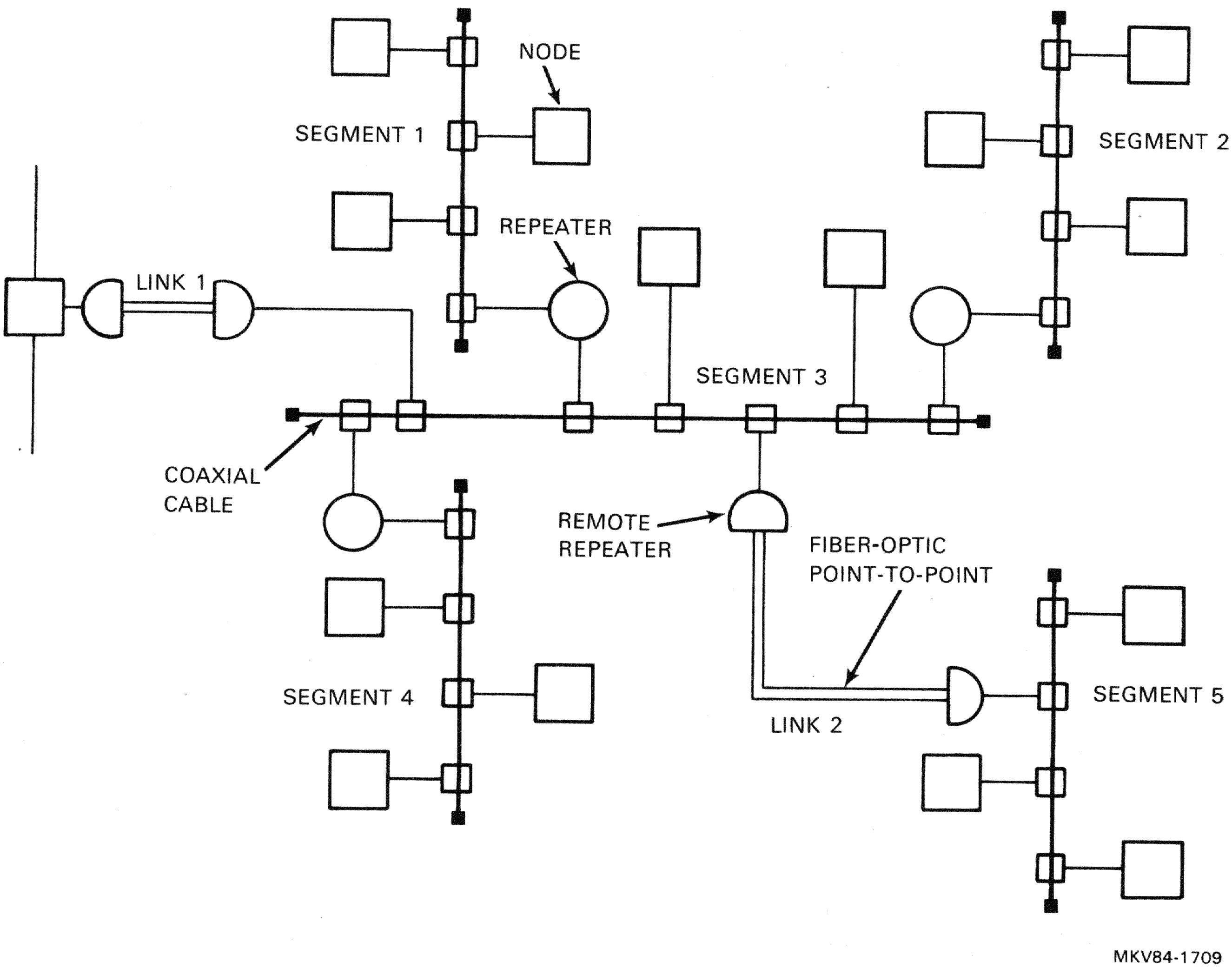


Figure 3-3 Large-Scale Ethernet Configuration

The following constraints must be observed when planning the Ethernet Local Area Network.

- Each coaxial cable segment can have a maximum length of 500 m (1640.5 ft).
- A maximum of 100 transceivers can be attached to each coaxial cable segment.
- The transceiver drop cable, connecting the transceiver to a station, can be a maximum of 40 m (131.2 ft).

- Steps followed for configuring a single segment are repeated for each segment in a multiple segment installation.
- Cable segments separated by up to 100 m (328.1 ft) are generally interconnected using local repeaters. Remote repeaters may be used if special environmental problems exist.
- Multiple remote and local repeaters may be used.
- For cable segments separated by greater than 100 m (328.1 ft) to 1000 m (3281.0 ft), use remote repeaters.
- If more than one remote repeater is used, the longest total fiber-optic path must not exceed 1000 m (3281.0 ft).

3.2.1 Planning Guidelines

The following general planning guidelines are presented in the preferred order of execution.

- To determine the coaxial cable pathway, the system planner should:
  - Locate the host systems on the floor plan.
  - Locate the nearest riser pole or floor access hole to the system.
  - Draw a 3 m (9.8 ft) radius circle around the riser pole or floor access fitting (refer to Appendix B).
  - Try and have the coaxial cable path intersect each of these circles (refer to Appendix B).
- Using a central hallway, the coaxial cable will be more accessible for future expansion.

3.2.2 Recorded Information

Record the following information on the marked-up floor plans, along with any critical dimensions of cableways developed during the site survey.

- Locations of all planned (current) stations, including servers and personal computers.
- Locations of all proposed (expansion) stations, including terminal servers and personal computers.
- Locations of all between-floor risers.
- Locations of any hidden obstructions to the coaxial cable path found during the survey.
- Location of the environmental airspaces for each room or floor.
- Location of the proposed system grounds.
- Locations of all riser poles or floor cable service fittings.
- Recording of ceiling heights and all interfloor distances.
- Location of drop ceilings.
- Location of raised floors.
- Location of cable troughs and conduits.

- Location of interbuilding cable paths, such as; conduits, cable troughs, and underground tunnels.
- Location of currently used floor-to-floor cable paths.
- Recording of floor thickness and type of material if the installation of coaxial cables is to pass through the floor.

3.2.3 Transceiver Drop Cable Targeting

The system planner must first determine where all the existing and planned systems' or active systems' components are located, and where they could be connected to the coaxial cable.

Next, the planner must determine the length of transceiver drop cable that is required to connect the planned system or active system components to the H4000 transceiver at the coaxial cable. The length of the proposed transceiver drop cable is calculated as follows.

- Allow 1 m (3.2 ft) to reach from the system's (host) connection panel to the floor.
- Use the floor plan to measure the distance (floor distance) from the host or active system's components, to the nearest entry point (riser pole, floor fitting, or hollow wall).
- Add to the sum of these values, the length of transceiver drop cable rise needed to reach the plane of the coaxial cable. Remember, in an above ceiling installation, the coaxial cable is typically 0.5 m (1.6 ft) above the suspended ceiling.
- Allow an additional 3 m (9.8 ft) to permit the attachment of the transceivers at the appropriate mounting locations. This is done because the H4000 transceivers are attached to the coaxial cable only at the installation bands on the coaxial cable.
- Choose a standard transceiver drop cable length that is greater than the above sum. Do not exceed 40 m (131.2 ft) in length overall when connecting to a host or server.

  Multiple cables may be joined to obtain the desired length, but single cables are easier to pull and are more rugged.

An equation to determine the radius of the target circle can now be used.

$\Sigma =$ Floor Distance + Riser Length + [1 m (3.2 ft)] + [3 m (9.8 ft)]

Target Radius = Cable Length − Σ

Once the radius has been determined, use the floor plan drawing scale to draw a target circle around the selected entry point with a radius equal to the radius just calculated. This indicates graphically, the area where a connection to the coaxial cable can be made.

The coaxial cable pathway is then drawn on the floor plans connecting each of the target areas. The proposed Ethernet coaxial cable pathway is then measured. If the coaxial cable path is over 500 m (1640 ft), the planner can readjust the path, or multiple segments can be specified and are connected through the use of an Ethernet repeater.

The system planner should be aware that if a maximum length of transceiver drop cable is selected, the radius is maximized. This results in a shorter coaxial cable. If on the other hand a minimum length of transceiver drop cable is used, the target circles are smaller and this requires that a longer coaxial cable be specified. Generally, it is more cost effective to minimize transceiver drop cables. When systems are clustered, consider the use of a DELNI interconnect to reduce transceiver count and cost of drop cables.

Add an arrow to the circle pointing to the system to be served from that particular riser pole or floor fitting.

An example of transceiver cable targeting is shown in Appendix B.

3.2.4 Coaxial Cable Path Layout

Three different procedures are discussed: single-floor, multifloor, and multibuilding installations.

SINGLE-FLOOR INSTALLATIONS

For single-floor installations, the following procedure should be used for laying out the coaxial cable path on the floor plans.

- Start near a proposed station location and draw a line on the plan representing the proposed coaxial cable path.

  This path should follow main hallways, where possible, and pass through all target circles. If possible, the coaxial cable path should cover the building, including floor areas to be served in any expansion plans.

- Extend the coaxial cable so that the ends can be located at or near floor level for access of test equipment. These cable ends should be concealed to prevent tampering. The cable ends may be coiled up and placed in the ceiling.

MULTIFLOOR INSTALLATIONS

The same procedures for laying out the cable path for a single-floor installation apply for multifloor installations as well. In addition, the following steps must also be followed.

- Locate a common riser (such as an elevator shaft) that goes between all the floors that are to be served.
- Start the coaxial cable pathway, on each floor, at the common interfloor riser.
- Attempt to encircle each floor with the coaxial cable if the building is a high-rise office tower or other structure that contains a doughnut-shaped floor with a utility core in the center of the site floor.

MULTIBUILDING INSTALLATIONS

Buildings that are physically connected to each other may use local repeaters to join the individual Ethernet coaxial cable segments in each building. For short runs, a single coaxial cable segment may service two buildings.

In cases where buildings are not physically connected, Digital Equipment Corporation recommends that the system planner specify the use of remote repeaters and fiber-optic cables to connect the individual networks in each building. Use of remote repeaters and fiber-optic cables:

- Eliminates any potential interbuilding grounding problems, and
- Isolates the between-building links from the individual building coaxial cable. Individual operation of one of the networks is possible should problems arise with one network or with the between-building link.

3.2.5 Plan Iteration

If the total path length of any coaxial cable is over 500 m (1640.5 ft), divide the cable into two segments joined together by repeaters or reduce the cable length. The use of repeaters is recommended. There are several ways that the cable length can be reduced. Each method involves trading off the length of the transceiver drop cable for coaxial cable length. In general, it is more efficient and cost effective to use longer coaxial cable and shorter transceiver drop cables. This also has the advantage of providing greater coverage for future expansion. Various methods of reducing the length of the coaxial cable are:

- Eliminating lengths of coaxial cable path that reach proposed (future) stations. Additional repeaters and coaxial cable segments can be added later, if required.
- Replotting the coaxial cable pathway using target-to-target runs between stations and running the cable along diagonals instead of following the building hallways.
- Using longer transceiver drop cables.

Multiple passes may be needed to achieve a workable coaxial cable pathway layout.

3.3 PHYSICAL CHANNEL COMPONENT CONSIDERATIONS

Various Ethernet physical channel component considerations must be taken into account when planning the Ethernet Local Area Network. These considerations are discussed in the following sections.

3.3.1 Coaxial Cables

The Ethernet coaxial cable is the main transmission medium of an Ethernet network through which all Ethernet data traffic flows. The following sections should help the system planner to plan a trouble-free installation of the coaxial cable.

COAXIAL CABLE RULES

The following rules should be observed.

- Do not subject the coaxial cable to bends of less than 20 cm (7.9 in) radius. This bend limit ensures the concentricity of the center conductor and cable shield.
- Connect each coaxial cable segment to a network earth reference ground.
- Where transceivers are used, install the coaxial cable in an area that remains between 5°C to 50°C (41°F to 122°F) and 10% to 90% humidity (noncondensing).

  Ethernet coaxial cables without connectors or H4000 transceivers may be exposed to a temperature range of −18°C to 150°C (0°F to 302°F), and a condensing atmosphere.

FEP COAXIAL CABLE MATERIAL

Digital Equipment Corporation's BNE2A Ethernet coaxial cable has been manufactured to meet current electrical code requirements governing the installation of nonconduit cables in environmental airspaces.

The model BNE2A coaxial cable contains a Teflon® FEP (fluoridated ethylene propylene copolymer) fluorocarbon insulation and jacket covering. This material is "classified as fire and smoke only" in accordance with the National Electrical Code (NEC) Article 725-2(b) entitled "*Remote-Control, Signaling and Power-Limited Circuits*". This cable is approved as a "low-smoke" cable, and where local building codes approve, it may be installed in environmental airspaces without a conduit.

NOTE

Using FEP insulated coaxial cables does not preclude the need to investigate building code requirements for cable installation in environmental airspaces. Although the FEP cable has been approved by a national authority (Underwriters' Laboratories), this does not constitute approval by the local authorities. Always check the local codes before purchasing cables.

PVC COAXIAL CABLE MATERIAL

The model BNE2B coaxial cable is made with polyvinyl chloride (PVC) insulation and jacket covering. PVC cables are not approved for installation in environmental airspaces per the requirements of NEC Article 725-2(b). PVC cables may be used in:

- Cable troughs in open areas,
- Open spaces, such as factory ceilings, or
- Beneath raised floors, if not an environmental airspace.

Additional information on the coaxial cables may be found in Appendix A.

COAXIAL CABLE, STANDARD LENGTHS

Digital Equipment Corporation can supply, off-the-shelf, four standard lengths of coaxial cables. These standard lengths of cable come prefitted with male type N connectors at each end, and require no special tools when they are joined together with barrel connectors to make one contiguous coaxial cable segment. Standard coaxial cable lengths may be joined together in any combination as long as the 500 m (1640.5 ft) length is not exceeded. Standard lengths of coaxial cable are listed in Table 1-1.

When the total length of the coaxial cable has been calculated, refer to Table 3-1 to select the necessary cable sections to make up the required coaxial cable segment. Select the cable lengths (sections) necessary that equal or exceed the total length required.

COAXIAL CABLE TOOLS

If the coaxial cable is to be repaired, the following tools are required for the proper installation of coaxial connectors.

- Coaxial cable cutter
  - DIGITAL P/N 29-24667, or
  - Benner-Nawman P/N UP-B76, or equivalent
    (Benner-Nawman, Inc., Pleasant Hill, California)
- Coaxial cable stripper
  - DIGITAL P/N 29-24668, or
  - Ideal P/N 445-164, or equivalent
    (Ideal Industries, Sycamore, Illinois)

Table 3-1 Cable Lengths vs Building Application

Length of Installation* Meters	Feet	Number of Cable Sections Required 23.4 m‡	70.2 m‡	117.0 m‡
1 - 23	3 - 75	1		
23 - 46†	75 - 151†	2		
46 - 70	151 - 230		1	
70 - 93†	230 - 305†	1	1	
93 - 117	305 - 384			1
117 - 140	384 - 459	1		1
140 - 163†	459 - 535†	2		1
163 - 187	535 - 614		1	1
187 - 210†	614 - 689†	1	1	1
210 - 234	689 - 768			2
234 - 257	768 - 843	1		2
257 - 280†	843 - 919†	2		2
280 - 304	919 - 997		1	2
304 - 327†	997 - 1073†	1	1	2
327 - 351	1073 - 1152			3
351 - 374	1152 - 1227	1		3
374 - 397†	1227 - 1302†	2		3
397 - 421	1302 - 1381		1	3
421 - 444†	1381 - 1457†	1	1	3
444 - 468	1457 - 1535			4
468 - 491	1535 - 1611	1		4
400 - 500	1311 - 1640	(BNE2A/B-ME)		

*Lengths are approximates.

†These lengths are composed of multiple short sections. To minimize the number of connectors in a segment, it may be preferable to select the next longer cable (the next line entry in the table) instead of using multiple short sections that have many connectors.

These specific lengths are selected to minimize the successive in-step buildup (in-phase addition) of reflections from connectors.

‡23.4 m (76.8 ft) DIGITAL P/N BNE2A/B-MA
70.2 m (230.3 ft) DIGITAL P/N BNE2A/B-MB
117.0 m (383.9 ft) DIGITAL P/N BNE2A/B-MC

- Connector crimp tool and die set
  - DIGITAL tool P/N 29-24662
    DIGITAL die set P/N 29-24663
  - Military P/N MIL-T-22520
  - Amphenol tool P/N 227-944, or equivalent
    Amphenol die set P/N 227-1221-25, or equivalent
    (Amphenol North America Division, Bunker Ramo Corporation, Oak Brook, Illinois)
- Male N connectors
  - DIGITAL P/N H4056-00 (package of two)
  - Military P/N M39012/01-0502
  - Amphenol P/N 82-4426, or equivalent

The procedures for installing coaxial cable connectors on coaxial cable are provided in Volume II of this manual.

3.3.2 Transceivers

The H4000 transceiver is the interface that connects stations physically and electrically to the Ethernet coaxial cable. The following sections should help the system planner to plan a trouble-free installation of the H4000 transceiver. The transceiver has a male type D connector for connection of the transceiver drop cable.

TRANSCEIVER PLACEMENT

The H4000 transceivers are attached to the coaxial cable at the installation bands. These installation bands appear as dark colored annular rings on the coaxial cable. The bands are about 0.5 cm (0.2 in) long. These bands are spaced every 2.5 m (8.2 ft) (refer to Figure 3-4) to minimize the effects of signal reflection from transceivers.

The maximum number of transceivers allowed on a Ethernet coaxial cable segment is 100. This ensures that all installed transceivers can receive signals broadcast from any other transceivers on the coaxial cable. At 2.5 m (8.2 ft) spacing, 100 transceivers require about 250 m (820.2 ft) of coaxial cable.

The nominal number of transceiver installation bands per cable section are as follows.

- 23.4 m (76.8 ft) – 9 transceiver installation bands
- 70.2 m (230.3 ft) – 27 transceiver installation bands
- 117.0 m (383.9 ft) – 45 transceiver installation bands
- 500.0 m (1640.5 ft) – 199 transceiver installation bands

NOTE

Although a 500 m (1640.5 ft) segment has more than 100 installation bands, the 100 transceiver limit still applies.

These figures are based on the minimum number of transceiver installation bands that appear along a length of coaxial cable. On the two longer sections of cable, there may be one or two additional installation bands due to manufacturing tolerances.

Normally, any transceiver installation band on a coaxial cable may be used. Position the transceivers so that no interference occurs near the cable end or at the barrel connectors.

Where the placement of H4000 transceivers is especially dense, the system planner should consider the use of a DELNI interconnect that can serve up to eight stations from one H4000 transceiver.

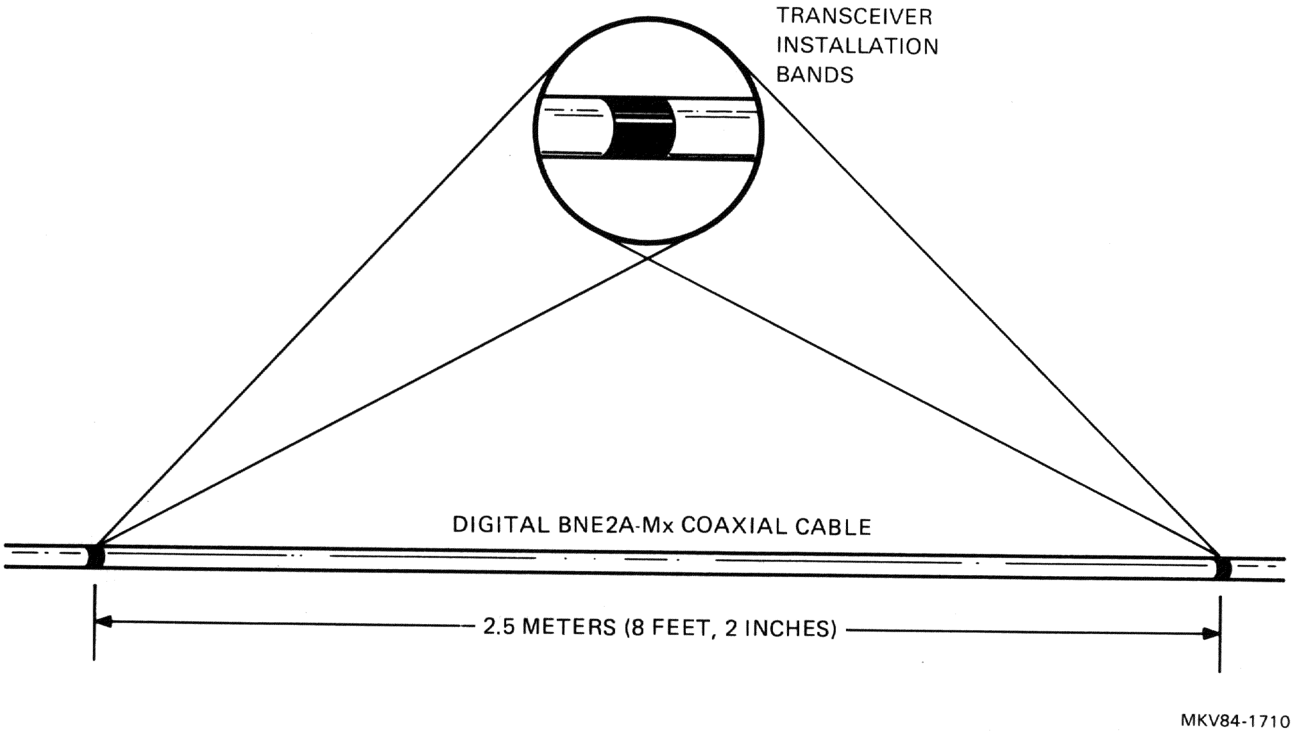


Figure 3-4 Coaxial Cable Installation Bands

3.3.3 Transceiver Drop Cables

To assist the planner, Digital Equipment Corporation can supply three types of cables; PVC type drop cables, FEP type drop cables, and office PVC drop cables.

TRANSCEIVER DROP CABLE MATERIALS

The model BNE3A (straight connector) and BNE3B (right-angle connector) transceiver drop cables are made with polyvinyl chloride (PVC) insulation and jacket covering. PVC cables are not approved for installation in environmental airspaces (refer to Figure 2-5) per the requirements of NEC Article 725-2(b).

NOTE

The BNE3A (straight connector) and BNE3B (right-angle connector) transceiver drop cables have a recommended minimum bend radius of 5 cm (2 in).

The model BNE3C (straight connector) and BNE3D (right-angle connector) transceiver drop cables contain a Teflon® FEP (fluoridated ethylene propylene copolymer) fluorocarbon insulation and jacket covering. This material is "classified as fire and smoke only" in accordance with the National Electrical Code (NEC) Article 725-2(b) entitled "*Remote-Control, Signaling and Power-Limited Circuits*". This cable is approved as a "low-smoke" cable, and where local building codes approve, it may be installed in environmental airspaces (refer to Figure 2-5) without a conduit.

NOTE
The BNE3C (straight connector) and BNE3D (right-angle connector) transceiver drop cables have a recommended minimum bend radius of 10 cm (4 in).

The model BNE4A (straight connector) and BNE4B (right-angle connector) transceiver drop cables are made with polyvinyl chloride (PVC) insulation and jacket covering. These cables come in only two short lengths and are intended for office installations only. These cables would generally be routed from a wall-mounted Etherjack connection box to the nearby host system. Their gray color generally blends into the office decor. These cables are considerably more flexible than the other types of transceiver drop cables. The maximum cable length rules shown in Table 3-2 must be observed.

TRANSCEIVER DROP CABLE RULES

- DIGITAL transceiver drop cables, models BNE3A, BNE3B, BNE4A, and BNE4B PVC insulated cables, *may not* be used in environmental airspaces. These cables may be used in applications where the transceiver drop cable would not be exposed to environmental or building ventilation airflow.

  DIGITAL transceiver drop cables, models BNE3C and BNE3D FEP insulated cables, *may* be used in any environment where nonconduit cables are permitted.

- Both FEP and PVC type cables may be combined in a single run. If this is done, the FEP-insulated cable would be used within the environmental airspace, and the PVC-insulated cable would be used outside the environmental airspace. In this configuration, the FEP cable must be joined to the PVC cable outside the airspace [an Etherjack connection box (DEXJK) may be used for this connection].

- The transceiver drop cables, all types, should be installed only in environments that range from 5°C to 50°C (41°F to 122°F, noncondensing atmosphere).

TRANSCEIVER DROP CABLES, STANDARD LENGTH

Any combination of drop cable lengths may be connected together to achieve the necessary total length. It is recommended that no more than two cables be used.

The procedure for installing cable connectors on the transceiver drop cable is provided in Volume II of this manual.

Digital Equipment Corporation supplies transceiver drop cables as listed in Table 3-2. The table provides a cross-reference of application length and recommended cable type.

Transceiver drop cables can be supplied with two different types of connector heads.

- Straight Head – Installed on the BNE3A, BNE3C, and BNE4A cables to allow the transceiver drop cable to be strain-relieved to the coaxial cable at the H4000 transceiver connection. Replacement kit number, H4054.

- Right-Angle – Installed on the BNE3B, BNE3D, and BNE4B cables for bulkhead applications Replacement kit number, H4055.

Table 3-2 Transceiver Drop Cable Applications

Condition	Cable Types	Maximum Lengths
H4000 transceiver to host or server	BNE3 (only) BNE3 + BNE4-02 BNE3 + BNE4-05 BNE4 (only)	40 m (131.2 ft) 32 m (105.0 ft) 25 m (82.0 ft) 10 m (32.8 ft)
DELNI interconnect to host or server	BNE3 (only) BNE3 + BNE4-02 BNE3 + BNE4-05 BNE4 (only)	40 m (131.2 ft) 32 m (105.0 ft) 25 m (82.0 ft) 10 m (32.8 ft)
H4000 transceiver to DELNI interconnect to host or server (total of both cables)	BNE3 (only) BNE3 + BNE4-02 BNE3 + BNE4-05 BNE4 (only)	40 m (131.2 ft) 32 m (105.0 ft) 25 m (82.0 ft) 10 m (32.8 ft)
H4000 transceiver to repeater	BNE3 (only) BNE3 + BNE4-02 BNE3 + BNE4-05 BNE4 (only)	50 m (164.1 ft) 42 m (137.8 ft) 30 m (98.4 ft) 12 m (39.4 ft)
DELNI interconnect to DELNI interconnect (cascaded)	BNE3 (only) BNE3 + BNE4-02 BNE3 + BNE4-05 BNE4 (only)	50 m (164.1 ft) 42 m (137.8 ft) 30 m (98.4 ft) 12 m (39.4 ft)

ADJUSTING TRANSCEIVER DROP CABLE LENGTHS

In estimating the transceiver drop cable length, a standard slack length of 3 m (9.8 ft) is used. This length provides sufficient slack to serve two transceivers from the same entry point. When three transceivers are served by a single entry point, one of the drop cables must be lengthened to accommodate the spacing of installation bands on the coaxial cable (refer to Figure 3-5). If more than three transceivers are to be served by a single entry point, the planner should consider the use of a DELNI interconnect that can serve up to eight host systems.

Any adjustments made to the transceiver drop cable lengths should be noted on the Station Transceiver Drop Cable Worksheet (Appendix D) along with the: riser length, floor run, entry point distance, and the actual total drop cable length for each station.

LOCATING TRANSCEIVER DROP CABLES ON THE FLOOR PLANS

After determining the lengths of the drop cables needed to serve each station, the planner should draw the cables on the second sheet of the floor plan (refer to Figure 3-2). This floor plan is given to the installer and shows where each cable goes for each specific system. The planner should also indicate on the floor plan if there is more than one drop cable being used to serve a station, and also what type material is being specified.

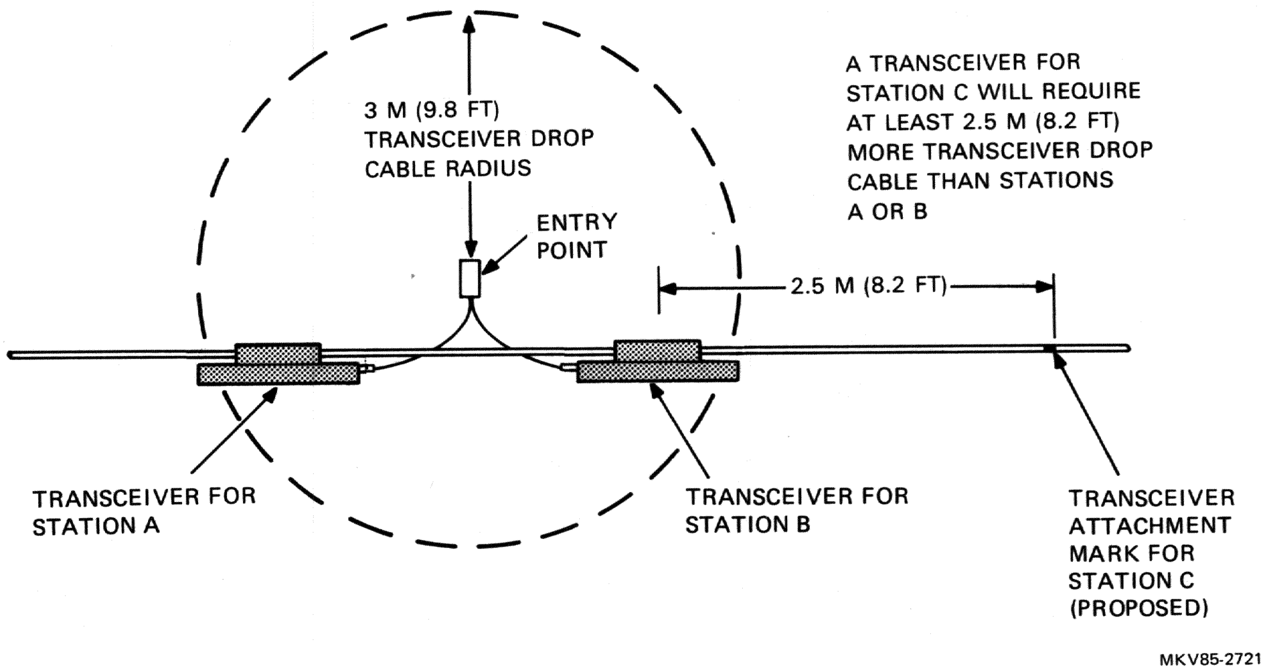


Figure 3-5 Multiple Station Transceiver Drop Cable Adjustment

3.3.4 DELNI Configuration

The DELNI Local Network Interconnect is a clustering device that can interconnect up to eight devices that have an Ethernet communications controller (DEUNA, DEQNA, DECNA). The DELNI interconnect can be used in either the local or global modes of operation (refer to Appendix E).

If a DELNI interconnect is to be used, the planner should consider the following.

- The DELNI interconnect requires ac power and comes with a 190.5 cm (75 in) power cord.
- For global mode operation, the DELNI interconnect is connected to an H4000 transceiver on a coaxial cable segment.
- When configured for global mode operation, the DELNI interconnect has a maximum total transceiver drop cable length of 40 m (131.2 ft).

Calculate the total drop cable length by adding together the length of the cable going from the transceiver to the DELNI interconnect, plus the length of the cable coming from the communications controller to the DELNI interconnect.

3.3.5 Repeater Configuration

The Ethernet repeater is used to expand a network beyond the 500 m (1640.4 ft) segment limitation. Two types of repeaters may be specified; a local repeater (DEREP-AA/AB) for connecting two coaxial cable segments together that are no more than 100 m (328.1 ft) apart, or remote repeaters (DEREP-RA/RB) which consist of two local repeaters that are a maximum of 1000 m (3281.0 ft) apart and are connected by fiber-optic cable.

LOCAL REPEATER DEREP-AA/AB
The local repeater connects to each coaxial cable segment via a transceiver drop cable and an H4000 transceiver.

If a local repeater is to be used, the planner should consider the following.

- The local repeater has a transceiver drop cable length limitation of 50 m (164.1 ft).
- The local repeater requires ac power and comes with a 190.5 cm (75 in) power cord.
- The rear panel contains status LEDs.

REMOTE REPEATERS DEREP-RA/RB
A remote repeater consists of two repeater halves. Each half is similar to the local repeater but includes additional electronics for the fiber optics.

If a remote repeater is to be used, the planner should consider the following.

- Each remote repeater half requires ac power and comes with a 190.5 cm (75 in) power cord.
- Each remote repeater half connects to a coaxial cable segment through a transceiver drop cable and an H4000 transceiver.
- Each transceiver drop cable can be up to a maximum of 50 m (164.1 ft) in length.
- Each remote repeater half connects to a duplex fiber-optic cable.

3.3.6 Fiber-Optic Cable

A fiber-optic cable is an optical transmission medium and is required whenever remote repeaters are used to connect separate segments. The following summarizes the fiber-optic cable specifications.

The remote repeater DEREP-RA/RB is designed to accept 100 micron Corning type 1508™, graded index, glass-on-glass fiber.

OPTICAL REQUIREMENTS

- Bandwidth greater than, or equal to, 300 MHz per kilometer at 850 nm.
- Cable attenuation less than, or equal to, 6 dB per kilometer at 850 nm over the operating temperature range.

CONNECTOR TYPE
Amphenol type 906™ SMA style connector.

TOTAL SYSTEM LOSS
Less than 10 dB to be verified after the installation.

ENVIRONMENTAL
General purpose 0°C to 70°C (32°F to 158°F)   95%, noncondensing

Some cable vendors provide aerial and plenum cable. Aerial cable may be used to connect two buildings through the air or in conduit underground. Plenum cable should be selected where the cable path is through return air plenums.

Corning 1508 is a trademark of Corning Glass Works.
Amphenol 906 is a trademark of Amphenol North America, Division of Bunker Ramo Corp.

If a fiber-optic cable is to be used, the planner should consider the following.

- A fiber-optic cable connects each of the two remote repeater halves.
- The fiber-optic cable has two separate glass elements (Corning 1508™ type fiber).
- The maximum fiber-optic cable length is 1000 m (3281.0 ft).

3.4 PLANNING A SYSTEM GROUND

Installation of the Ethernet coaxial cable requires that the shield of each coaxial cable segment be grounded to comply with electrical code requirements (refer to Figure 2-8). The system planner must select three components when planning the system's ground.

- Coaxial segment shield connection point.
- Network earth reference point.
- Earthing conductor (ground wire) length.

The actual location of the network earth reference point is selected by the planner from a list of pretested alternatives.

The planner specifies a coaxial cable connector near the earth reference point, determines the necessary hardware (ground clamp, earthing conductor, and mounting hardware) to connect the shield to the ground, and determines the length of the earthing conductor.

The planner should remember the following points.

- The shield of each coaxial cable segment should connect to the ground at a coaxial cable connector.
- The length of the earthing conductor should be kept to a maximum 15 m (49.2 ft).
- The network earth reference point should be physically wired to a grounding electrode by:
  - A direct separate conductor.
  - A metallic conduit that is connected to the grounding electrode.

NOTE

This is to comply with the ground bonding practices outlined in Article 250 of the National Electrical Code.

If the nearest coaxial cable connector is more than 15 m (49.2 ft) from the network earth reference point, the coaxial cable sections must be repositioned to move one of the connectors nearer to the reference point.

The earthing conductor should be:

- Solid AWG 8 wire
- Black insulation

WARNING

DO NOT use a green insulated earthing conductor, as electrical workers may later confuse this green wire for a safety ground.

If the network earth reference point is the threaded end of the metallic conduit, use bonding wedges or other hardware available from an electrical supply house to connect the conductor.

3.4.1 Single-Point Grounding

Single-point grounding should be used on all Ethernet coaxial cable segments that remain inside the building. The installer should be supplied with either electrical tape or insulation boots for insulating all other exposed connectors on the coaxial cable (except the network earth reference connection).

3.4.2 Multipoint Grounding

A coaxial cable that spans the distance between two buildings must be enclosed in a conduit so that the cable is not exposed to the outside environment (the coaxial cable is not suitable for direct burial applications).

When multipoint grounding is appropriate, a barrel connector must be located as close as possible to the coaxial cable entry point in each building to provide a connection for the earthing reference conductor.

Use the shortest length of coaxial cable that spans the distance between the two buildings. A connector must not be located within the conduit.

NOTE

If the interbuilding conduit is greater than 117 m (383.9 ft), then a custom length cable has to be used. Do not pull sections of coaxial cables that are joined by barrel connectors.

Should the coaxial cable be longer than necessary to reach between buildings, excess cable should be coiled up close to the building entrance point. This enables the use of a short earthing conductor to reach from the connector to the ground point (refer to Figure 3-6).

3.5 ETHERNET NETWORK SCHEMATICS

A schematic is a simplified diagram of the Ethernet Local Area Network. A schematic cannot show the detailed placement of the network equipment, but it can provide a functional overview of the system's design. A schematic can show the number of coaxial cable sections that make up a segment and their lengths, barrel connectors, transceivers, transceiver drop cables and their lengths, repeaters, and DELNI interconnects.

The schematic is created from information on the floor plan and is used to summarize and cross check the physical channel component Bill of Material. Figure 3-7 shows the Ethernet floor plan symbols and Figure 3-8 shows a sample Ethernet schematic.

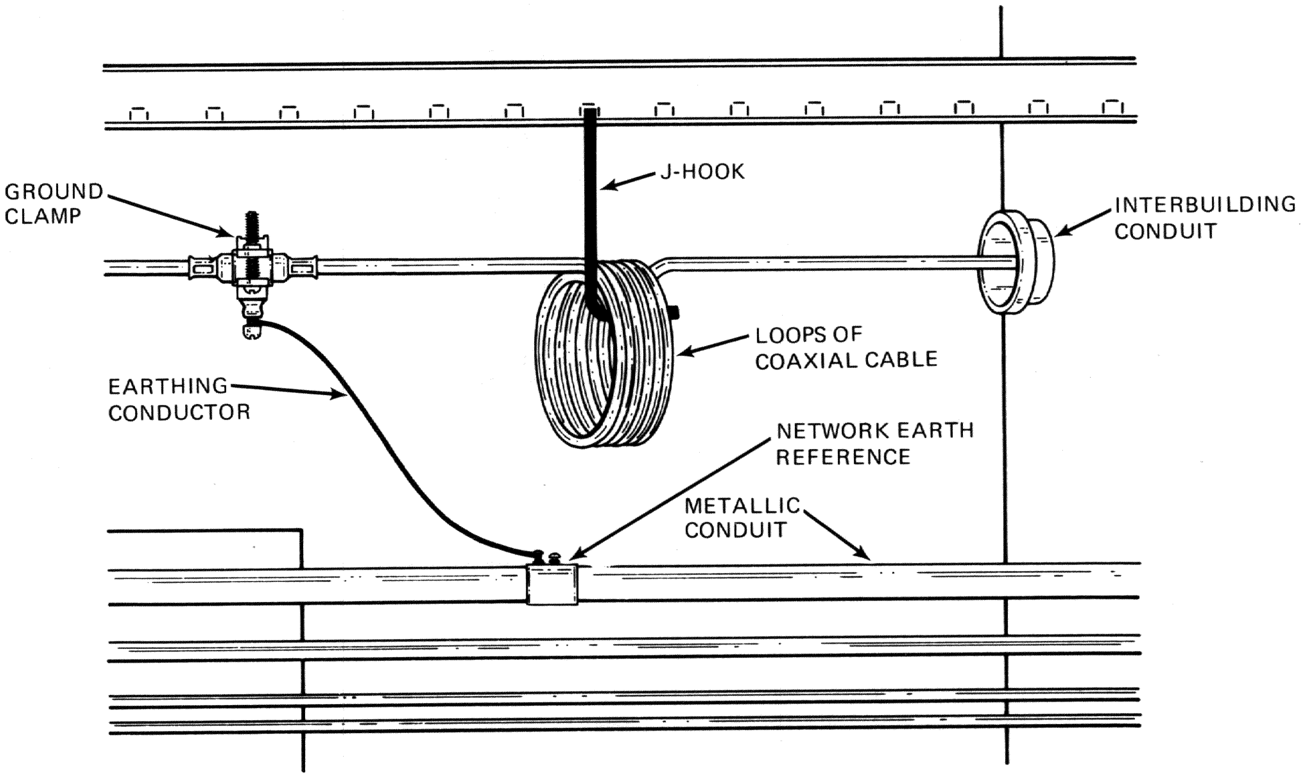


Figure 3-6 Excess Coaxial Cable Coiled to Minimize the Length of the Earthing Conductor

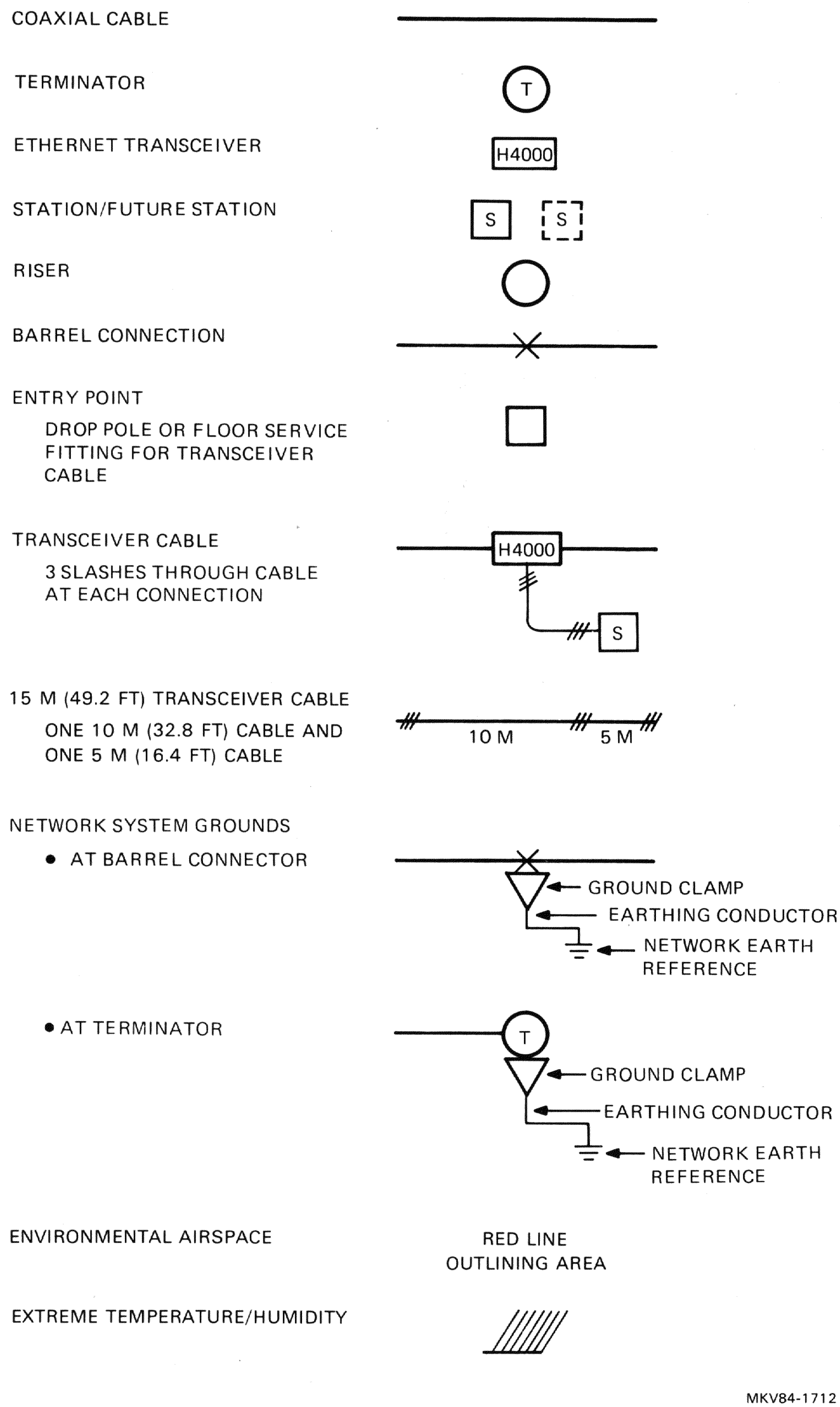


Figure 3-7 Ethernet Floor Plan Symbols

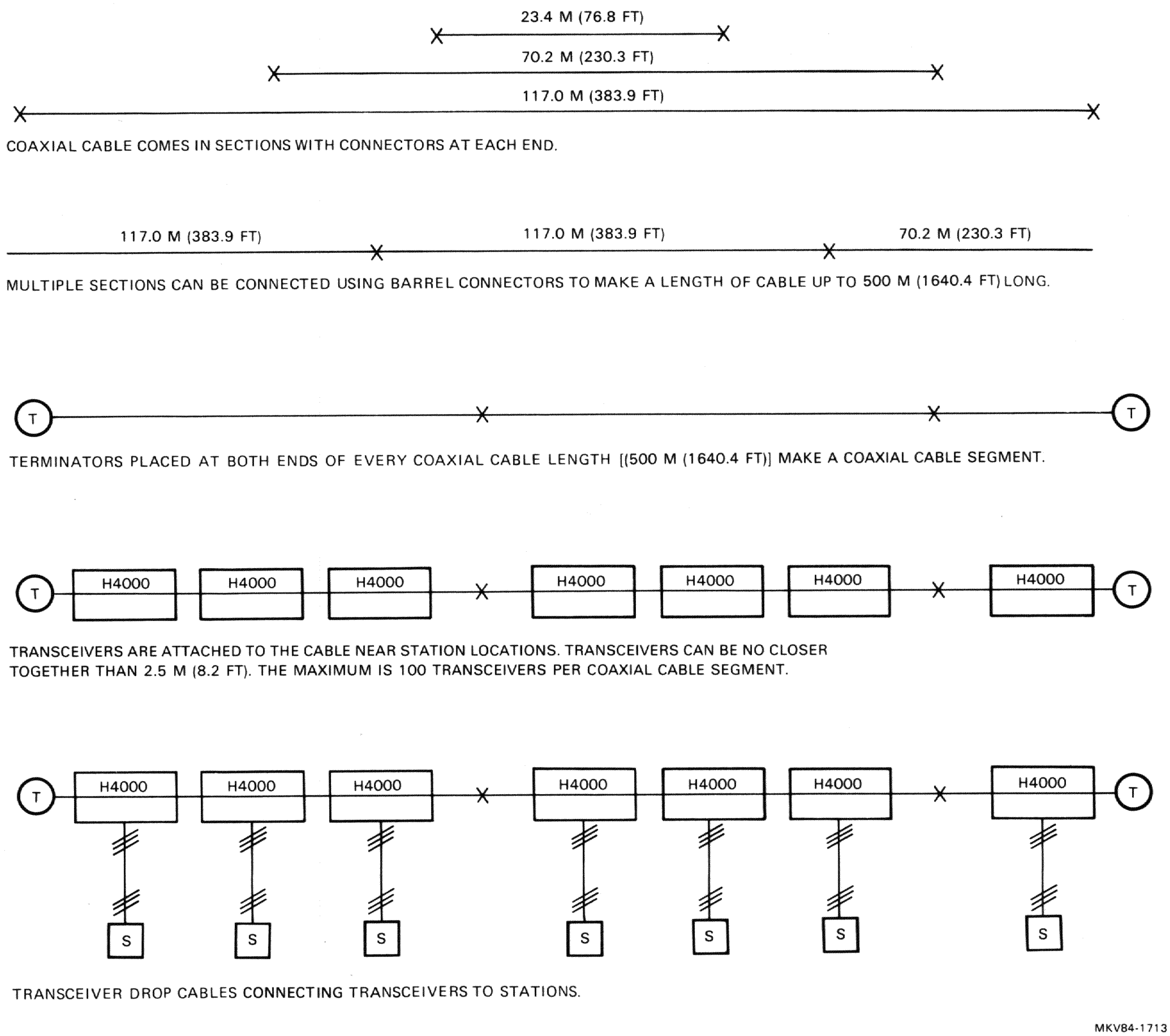


Figure 3-8 Sample Ethernet Schematic

APPENDIX A
ETHERNET PHYSICAL CHANNEL COMPONENTS

A.1 ETHERNET PHYSICAL CHANNEL COMPONENTS

DIGITAL Ethernet physical channel components consist of:

- Ethernet coaxial cables, barrel connectors, and terminators
- H4000 transceivers
- Transceiver drop cables
- Repeaters (DEREP)
- Fiber-optic cables
- Local area interconnects (DELNI)

A.2 COAXIAL CABLE COMPONENTS

The following sections describe the components that make up the coaxial cable.

A.2.1 Ethernet Coaxial Cables

The Ethernet coaxial cable is the transmission medium for the Ethernet Local Area Network. This coaxial cable is a round, 1.0 cm (0.4 in) diameter, insulated, shielded coaxial cable. This cable is supplied in four different lengths shown in Table A-1.

Table A-1 Ethernet Coaxial Cable Lengths

Lengths Meters/Feet	DIGITAL Part Number FEP	PVC
23.4 m (76.8 ft)	BNE2A-MA	BNE2B-MA
70.2 m (230.3 ft)	BNE2A-MB	BNE2B-MB
117.0 m (383.9 ft)	BNE2A-MC	BNE2B-MC
500.0 m (1640.5 ft)	BNE2A-ME	BNE2B-ME

A.2.2 Connectors

The Ethernet backbone coaxial cable incorporates three types of connectors.

- Coaxial cable end connectors
- Barrel connectors
- Terminators

Table A-2 lists the physical dimensions of these connectors.

Table A-2 Coaxial Cable Connector Sizes

Type Connector	Outside Diameter	Maximum Length
End Connector	2.1 cm (0.83 in)	4.1 cm (1.61 in)
Barrel Connector	1.9 cm (0.75 in)	4.6 cm (1.81 in)
Terminator	1.9 cm (0.75 in)	3.6 cm (1.41 in)

COAXIAL CABLE CONNECTORS
Each Ethernet coaxial cable section has a male type N connector installed at each end that can be ordered separately (2 per package).

- Connector: Male type N, crimp-on connector

  DIGITAL P/N: H4056

BARREL CONNECTORS
Barrel connectors are used to join Ethernet coaxial cable sections together to form a coaxial cable segment.

- Barrel connector: Type N, female-to-female

  DIGITAL P/N: 12-19817-01
  Assembled connection: 10.5 cm (4.13 in)

TERMINATORS
Terminators must be installed at each end of the Ethernet coaxial cable segment to provide a resistive match to the characteristic impedance of the coaxial cable.

- Characteristics: 49.9 $\Omega \pm 1$ percent

  DIGITAL P/N: 12-19816-01

GROUND CLAMP
Ground clamps are used for attaching the ground wire to the coaxial cable.

- DIGITAL P/N: 12-21766-01.

A.2.3 Ethernet H4000 Transceiver

The DIGITAL H4000 transceiver is the interface that connects computer stations physically and electrically to the Ethernet coaxial cable. The transceiver transmits and receives signals to and from connected stations, while at the same time, it is capable of detecting Ethernet message collisions. The transceiver provides electrical isolation and high impedance to the coaxial cable.

The H4000 transceiver consists of a small printed circuit board contained in a rugged, compact, plastic housing. The housing also contains a nonintrusive cable tapping assembly that is used to make physical contact with the Ethernet coaxial cable.

- DIGITAL P/N: H4000

Length	27.7 cm (10.9 in)
Width	9.5 cm (3.7 in)
Height	9.0 cm (3.5 in)
Weight	1.4 kg (3.0 lbs)

A.2.4 Transceiver Drop Cable

Transceiver drop cable components include the transceiver drop cable and the drop cable connectors.

The transceiver drop cable provides the connection between the H4000 transceiver and the Ethernet controller mounted in the host system or the DELNI interconnect. Drop cables may be joined together to meet the required length. However, transceiver drop cable lengths must not exceed the values listed in Table 3-2.

There are three styles of drop cables available.

- BNE3A (straight connector) or BNE3B (right-angle connector) – polyvinyl chloride (PVC) insulation. These cables *are not* approved for installation in environmental airspaces as defined by NEC Article 300-22(c).

- BNE3C (straight connector) or BNE3D (right-angle connector) – flouridated ethylene propylene copolymer (FEP) insulation. These cables *are* approved by UL for installation in environmental airspaces and meet the requirements of NEC Article 725-2(b).

- BNE4A or BNE4B – a special, short length office cable made with polyvinyl chloride (PVC) insulation. These cables *are not* approved for installation in environmental airspaces as defined by NEC Article 300-22(c).

  This 0.6 cm (.24 in) diameter cable is flexible and has molded end connectors. The attenuation is four times that of the BNE3 cables. When using the BNE4 cables, be sure to refer to Table 3-2 for maximum transceiver drop cable lengths.

Transceiver drop cables come in various lengths as shown in Table A-3.

Table A-3 Transceiver Drop Cable Lengths

Lengths	BNE3	BNE4
2 m (6.6 ft)		X
5 m (16.4 ft)	X	X
10 m (32.8 ft)	X	
20 m (65.6 ft)	X	
40 m (131.2 ft)	X	

Transceiver drop cables have a diameter of 1.3 cm (0.5 in) except for the BNE4 cable which is 0.6 cm (0.2 in).

Transceiver drop cable connectors consist of a:

- 15-pin "D" subminiature type connector.
- Female connector with a slide-latch locking assembly (for mounting to the H4000 transceiver).
- Male connector with locking posts (for mounting to the station controller).
- Straight-head backshell (A or C versions).
- Right-angle backshell (B or D versions).

Table A-4 lists the dimensions of the drop cable connector heads.

Table A-4 Dimensions of Drop Cable Connector Heads

	Straight Entry P/N H4054	Right-Angle Entry P/N H4055
Length*	5.4 cm (2.1 in)	6.0 cm (2.4 in)
Width	4.4 cm (1.7 in)	3.9 cm (1.5 in)
Height	1.8 cm (0.7 in)	1.8 cm (0.7 in)

*Length measures the connector body only. Allow 1.9 cm (0.7 in) additional length for cable ferrule.

A.3 FIBER-OPTIC CABLES

Digital Equipment Corporation offers a general purpose fiber-optic cable. This cable is suited for use inside a building where the cable will not be routed through air plenums. It may also be used in conduit, between buildings where the environmental conditions of temperature and humidity do not exceed the cable specifications.

Option Designation	Description
BN25B-60	60 m (196.9 ft)
BN25B-90	90 m (295.3 ft)
BN25B-A5	150 m (492.1 ft)
BN25B-C0	300 m (984.3 ft)
BN25B-E0	500 m (1640.5 ft)
BN25B-H5	750 m (2460.8 ft)
BN25B-L0	1000 m (3281.0 ft)

APPENDIX B
SAMPLE FLOOR PLANS

B.1 INTRODUCTION

This appendix shows the sample layout process for a small Ethernet Local Area Network. This appendix is divided into two distinct areas; Site Survey, and Configuration Planning. In preparing this sample layout process, the following conditions have been defined.

- The installation is a suspended ceiling installation.
- The suspended ceiling is 3 m (9.8 ft) high.
- The suspended ceiling is an environmental airspace acting as the return air plenum for the air-conditioning system.
- Local building codes allow the use of authority-approved (UL listed) nonconduit cables in the environmental airspaces.
- Riser poles can accommodate multiple transceiver drop cables.
- The Ethernet coaxial cable is being routed to accommodate as many stations as possible.

B.2 SITE SURVEY PROCEDURES

Using a copy of the floor plan (refer to Figure B-1), it is the responsibility of the surveyor to:

- Locate all stations and proposed stations on the floor plan and assign a number to each station.
- Locate all riser poles, or floor fittings, that can be used to route the transceiver drop cable to serve each station.
- Locate the network earth reference ground. This point is usually near the electrical power service entrance.
- Locate any DELNI interconnects or DEREP repeaters on the floor plans, as required, and assign a number to each.
- Record any pertinent construction details and measurements. In this example, Station 5 is located in a computer room having a raised floor. Because of this, two riser poles have been noted; one to serve the station through the raised floor, the other to route the drop cable from the raised floor to the suspended ceiling.
- Mark the floor plan to show construction details, such as, the rear wall being a double-plastered wall, and that drilling is required to enable the cable to penetrate the wall.
- Record the riser length and measure the riser floor run for each station, on the Station Transceiver Drop Cable Worksheet.
- Submit the marked-up floor plan along with the Station Transceiver Drop Cable Worksheet to the system planner.

B.3 CONFIGURATION PLANNING PROCEDURES

Using the floor plan that the surveyor marked-up, the system planner generates two additional floor plans. One plan shows the actual routing of the Ethernet coaxial cable, as well as the placement of the terminators and barrel connectors. The other plan shows the locations of the H4000 transceivers, DELNI interconnects, repeaters, and stations.

The system planner must perform several different steps to configure the sample Ethernet Local Area Network.

STATION TARGETING AND COAXIAL CABLE PATH PLANNING

To target the stations, the system planner must:

- Choose a 20 m (65.6 ft) transceiver drop cable as a first estimate, where 1 m (3.3 ft) is allocated for the floor-to-host panel rise, and 3 m (9.8 ft) is allocated for the floor-to-ceiling rise. The remaining 16 m (52.5 ft) is divided between the floor run and the above ceiling run, [8 m (26.2 ft) each].

- Draw circles having a radius of 8 m (26.2 ft) around the entry point closest to each station (as shown in Figure B-2). Dashed lines are used since these circles are tentative. Stations 3 and 4 share a circle since they share a common riser as an entry point. Station 5 is an exception because it is located in a raised floor laboratory and no riser is needed to reach the coaxial cable. The station is used as the center of this circle.

  NOTE
  A 20 m (65.6 ft) cable is the most commonly used length. Longer or shorter cables may be used to optimize the design. The longest standard drop cable available from Digital Equipment Corporation is 40 m (131.2 ft).

  Not all stations are within the initial circles. Stations 2 and 3 require repositioning of their drop cables or the use of longer cables. Since both stations are quite close to their respective circles, the planner realizes that by lengthening the floor run to reach the appropriate station, the ceiling run is shortened by the same amount.

- Measures (on the floor plan) the distance between the initial circle and any station outside its circle. Any new circle is drawn for that station with a radius of 8 m (26.2 ft) minus the distance just measured. This is the area reachable by the reduced ceiling run.

- Redraw the circles using solid lines when the final target positions are determined (see Figure B-3).

- Draw the coaxial cable path (see Figure B-4). This path should follow hallways and aisles, and must intersect all target circles. This path must also be located within a reasonable distance of the network earth reference ground.

In the sample floor plan shown in Figure B-4, the coaxial cable path begins under the raised floor of the computer room where Station 5 is located. This location allows easy access to the terminator for testing purposes if necessary. It also reduces the length of the transceiver drop cable that serves that station.

The cable goes up the riser, near Station 5, to the suspended ceiling.

The path continues down the hallways and intersects each target circle. The pathway ends in a small utility room where the electrical service box is located (refer to Figure B-4).

When the pathway has been drawn on the floor plans, the system planner then:

- Measures the total length of the cable pathway. In this example, the length has been determined to be 172 m (564.3 ft).

- Refers to Table 3-1. From this table the planner determines that a standard coaxial cable of this length is not available. Therefore, the planner must specify the next longest coaxial cable combination that meets the installation requirements.

  In this example, that is 187 m (614 ft); in two sections, 70.2 m (230.3 ft) and 117 m (383.9 ft).

Using a new floor plan that shows only the coaxial path and station locations, the planner must:

- Locate the various hardware components on the floor plan (refer to Figure B-5). This hardware includes:

  - Terminators (2)
  - Barrel connector
  - Grounding components
  - H4000 transceivers

NOTES

The H4000 transceivers are located as close as possible to the entry points for their respective stations.

For stations 3 and 4, the transceivers are located on each side of the riser pole to comply with the 2.5 m (8.2 ft) spacing rules.

Now that the details of the Ethernet Local Area Network have been entered on the floor plans, the system planner must record data that is pertinent to the station transceiver drop cable lengths. To record this information, the planner uses the Station Transceiver Drop Cable Worksheet (a blank worksheet is provided in Appendix D and may be copied as many times as it is needed).

The surveyor will have already started entering data on this worksheet. This data will consist of:

- Station number
- Riser length
- Floor run

To this information, the system planner will:

- Enter information about the distance from the coaxial cable to the entry points.

- Total the transceiver drop cable lengths for each station.

- Select the appropriate lengths of drop cables for each station.

- Select the type connector heads that are needed for each cable, and specify the type of insulation that each cable uses.

- Determine the number of DELNI interconnects and DEREP repeaters together with H4000 transceivers and transceiver drop cables.

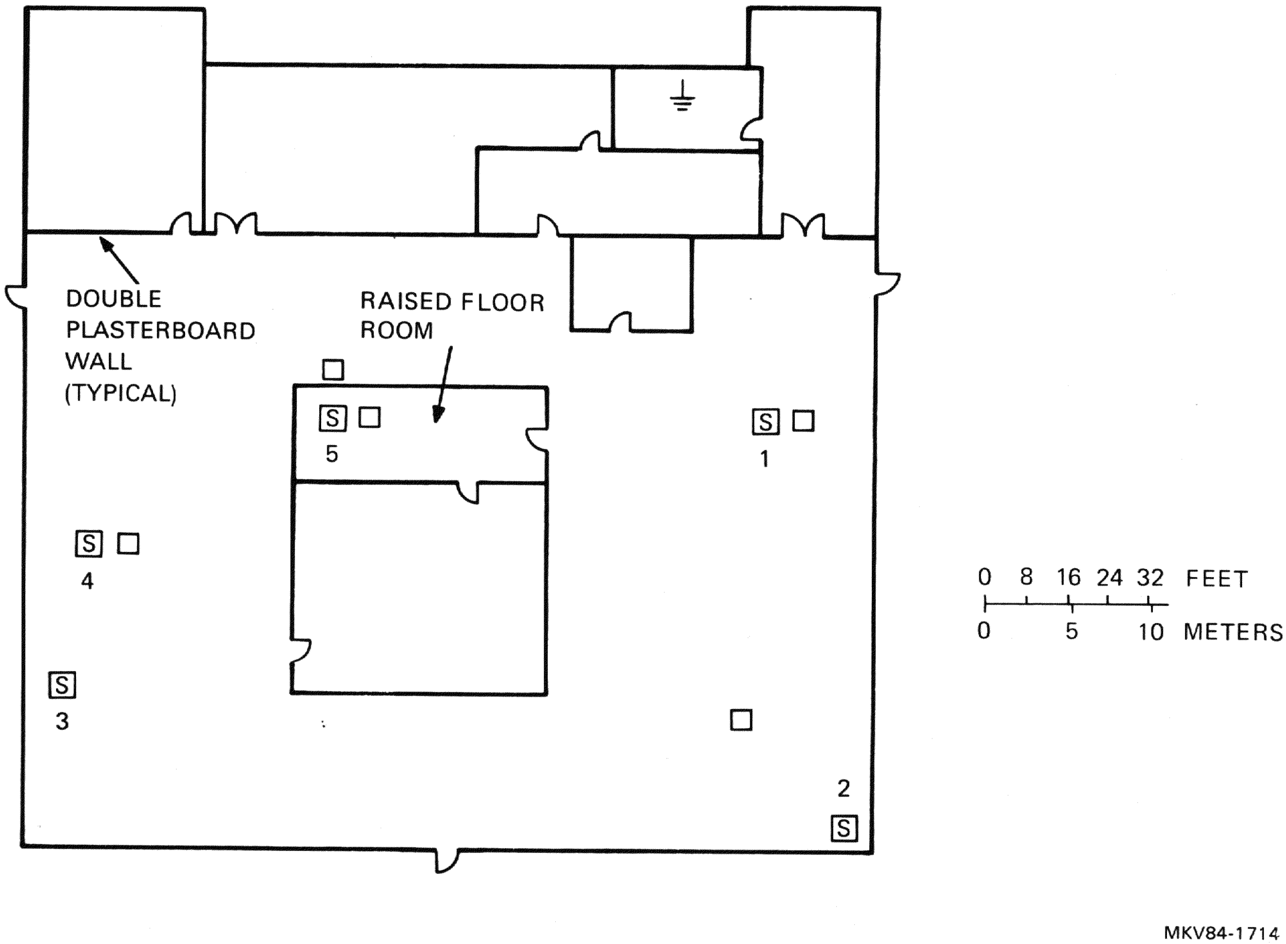


Figure B-1 Surveyor's Marked-Up Floor Plan

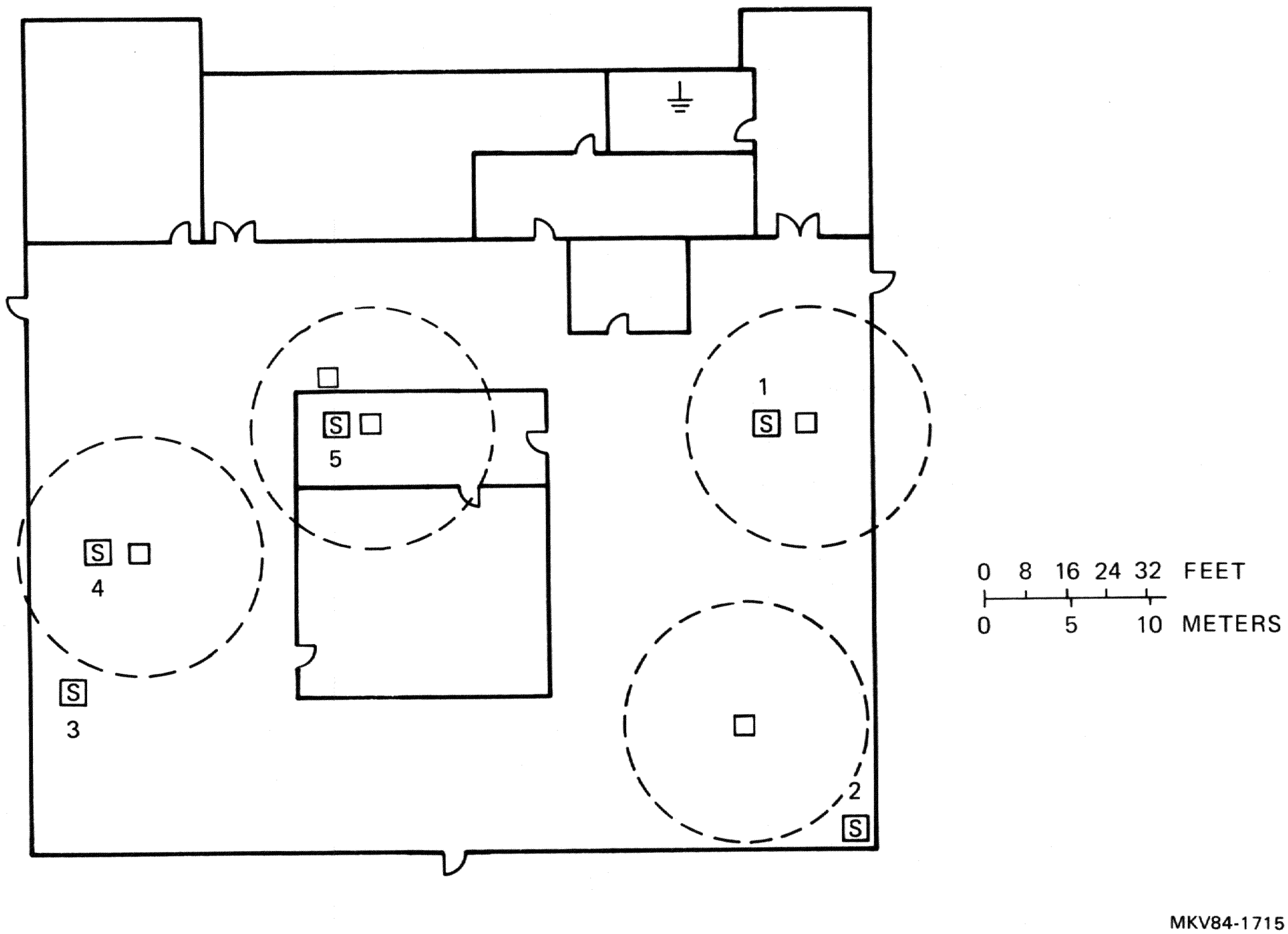


Figure B-2 Initial Station Targeting

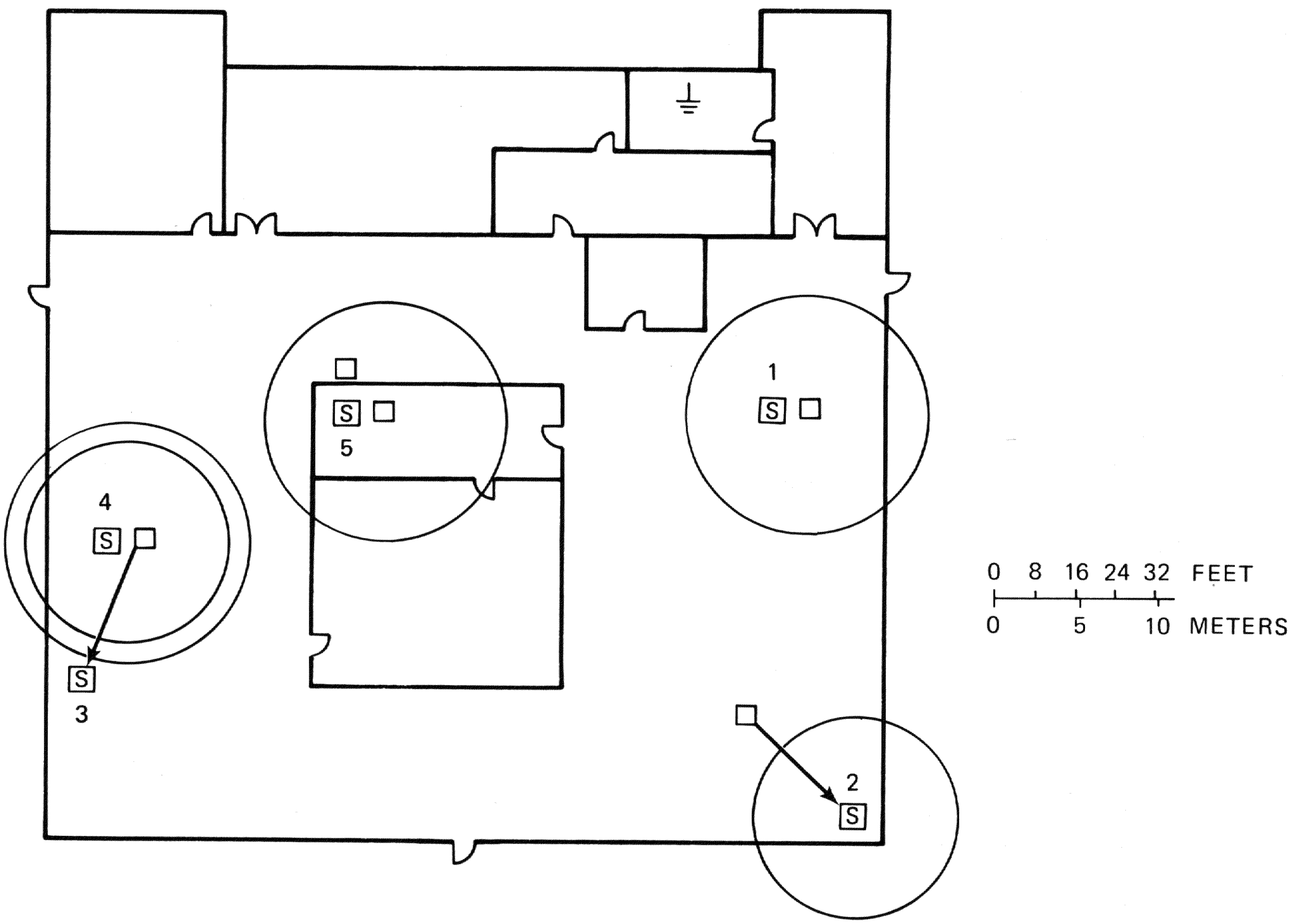


Figure B-3 Final Station Targeting

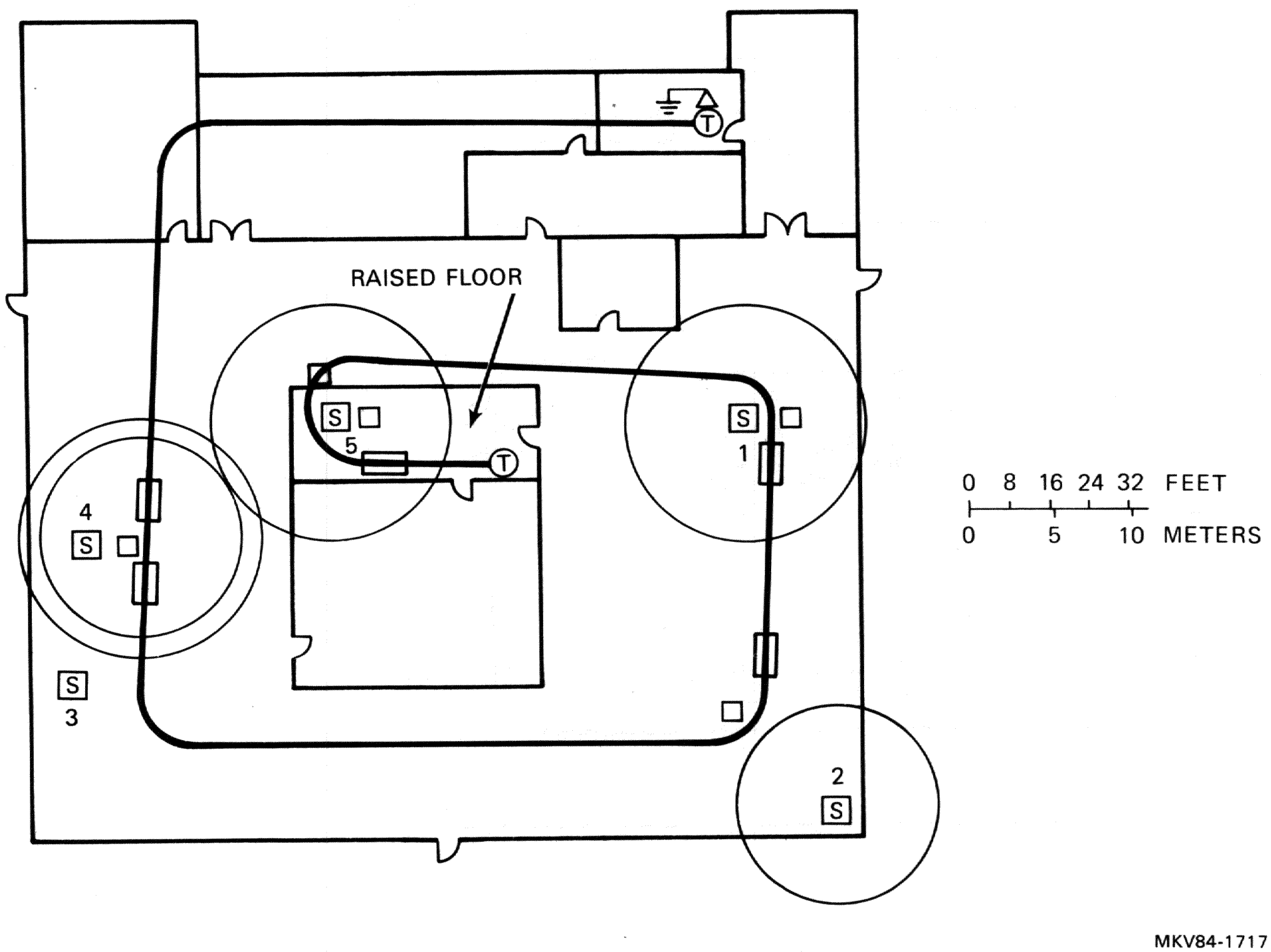


Figure B-4 Plotting the Coaxial Cable Pathway and Hardware Locations

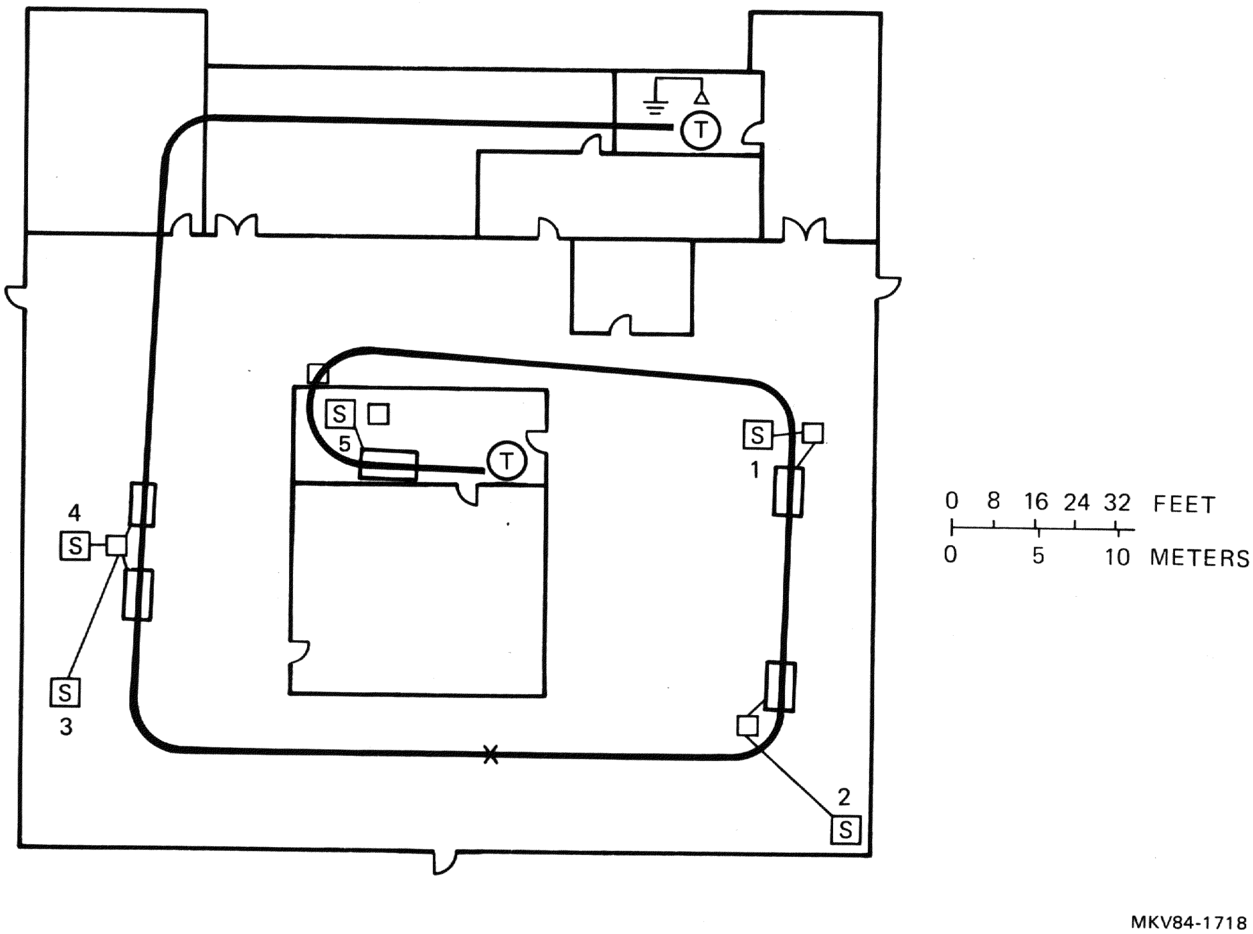


Figure B-5 Second Floor Plan Showing Stations, Transceivers, and Transceiver Drop Cables

APPENDIX C
SAMPLE NETWORK LOG

The following Network Log entries are based on the sample floor plan presented in Appendix B. This Sample Network Log represents only one of many possible ways in which a system planner may document a proposed Ethernet Local Area Network.

For the purpose of cable identification, the DELNI interconnects and DEREP repeaters are treated as stations because they require transceiver drop cables.

Included in this Appendix are samples of cable tags (refer to Figure C-1) that should be applied to the ends of each cable section.

SAMPLE NETWORK LOG

ETHERNET COAXIAL CABLE SEGMENT

______	Section No. 1	117.0 m (383.9 ft)
______	Section No. 2	70.2 m (230.3 ft)
______	Segment Total	187.2 m (614.2 ft)

H4000 TRANSCEIVERS

______	Section No. 1	5
______	Section No. 2	0
______	Segment Total	5

NETWORK EARTH REFERENCE LOCATION

______ Electrical service entrance panel box at the rear of the building in the small utility room.

COAXIAL CABLE SECTION NO. 1

______	Length	117.0 m (383.9 ft)
______	Near-End Connection	Terminator
______	Near-End Location	Subfloor, in computer room
______	Far-End Connection	Section No. 2
______	Far-End Location	In ceiling, 5 m (16.4 ft) southwest of Station 4

H4000 TRANSCEIVER LOCATIONS

______	Station No. 5	5 m (16.4 ft)
______	Station No. 1	35 m (114.8 ft)
______	Station No. 2	50 m (164.0 ft)
______	Station No. 3	95 m (311.7 ft)
______	Station No. 4	100 m (328.1 ft)

GROUNDING COMPONENTS

______ None this section

COAXIAL CABLE SECTION NO. 2

______	Length	70.2 m (230.3 ft)
______	Near-End Connection	Section No. 1
______	Near-End Location	In suspended ceiling, 5 m (16.4 ft) southwest of Station 4
______	Far-End Connection	Terminator
______	Far-End Location	In ceiling, near electrical service panel box No. 1

H4000 TRANSCEIVER LOCATIONS

______ None this section.

GROUNDING COMPONENTS Yes

______	Network Earth Reference	Electrical service entrance panel box No. 1
______	Ground Clamp Location	Terminator, at far end of Section No. 2

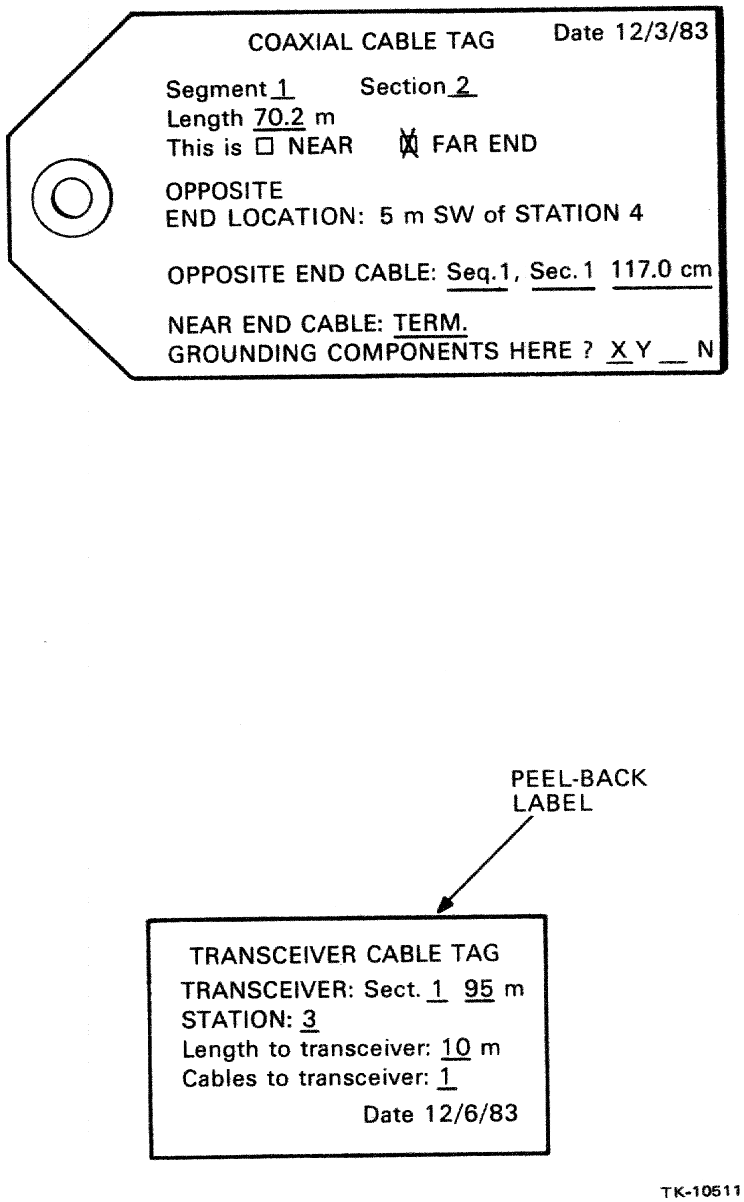


Figure C-1 Sample Cable Tags

APPENDIX D
BLANK SURVEY PLANNING FORMS

D.1 SURVEY FORMS

The Network Site Requirements Worksheet and Station Transceiver Drop Cable Worksheet are provided to assist the surveyor in conducting the site survey. The surveyor may use as many copies of these forms as necessary to cover all floors and or buildings on the site.

D.2 STATION TRANSCEIVER DROP CABLE WORKSHEET

Various parts of the Station Transceiver Drop Cable Worksheet are to be filled out by both the surveyor and the system planner.

INSTRUCTIONS FOR THE SURVEYOR

Measure and record the following distances for each station.

- Riser length
- Floor run

INSTRUCTIONS FOR THE SYSTEM PLANNER

After the coaxial cable path has been drawn on the floor plan, fill in the following information.

- Measure (on the floor plan) and record, for each station, the distance of the entry point to the coaxial cable.

NOTE
The closest transceiver installation band may be up to 1.5 m (4.9 ft) away from the closest entry point.

- Total the lengths of transceiver drop cables required for each station.
- Select the appropriate transceiver drop cable lengths for each station.
- Select the appropriate transceiver drop cable connectors.
- Select the appropriate transceiver drop cable material for each station.
- Use this worksheet and Appendix A to develop a Bill of Materials.

NETWORK SITE REQUIREMENTS WORKSHEET

Date:__________ Time:__________

I. CUSTOMER INFORMATION

Name:______________________________
Building Address:______________________________
City:__________ State:__________ Zip:__________
Customer Contact/Title:__________ Phone:__________
Facility Manager:__________ Phone:__________

II. BUILDING INFORMATION

Customer-Owned Facility: Yes__________ No__________
Lease Restrictions: Yes__________ No__________
Describe Lease Restrictions:______________________________
____
____

Number of Floors:__________
Raised Floors: Yes__________ No__________ Dimensions: __________
Ceiling Type: Spline Lock__________ Suspended__________Plaster__________
Plasterboard__________
"Above Ceiling Environmental Airspace": Yes__________No__________
Interior Walls: Solid__________ Hollow__________

III. NETWORK SIZE REQUIREMENTS

Number of Floors Having Stations:__________Future:__________
Number of Planned Stations:__________Future:__________

NOTE: The following information should be marked on the floor plan and checked off when completed.

Location of Stations:__________
Location of Entry Points:__________
Location of; Interfloor__________ Raised Floor__________
Suspended Ceiling Risers__________
Locations of Potential Network Earth Reference Ground:__________

IV. INSTALLATION REQUIREMENTS

Target Installation Completion Date:______________________________
Installation Managed By: DIGITAL__________Customer__________

NOTE: If the installation is for a multifloor or multibuilding site, use extra copies of this form.

Attach floor plans and drawings and route to the system planner.

STATION TRANSCEIVER DROP CABLE WORKSHEET

		BNE4X-02	BNE4X-05	BNE3X-05	BNE3X-10	BNE3X-20	BNE3X-40	STRAIGHT	RIGHT ANGLE	PVC	FEP
STATION NO.__________											
FLOOR RUN (M)	____										
RISER LENGTH (M)	____										
ENTRY POINT DISTANCE (M)	____										
STATION RISE + H4000 ALLOWANCE	4M										
TOTAL (M)	____										
STATION NO.__________											
FLOOR RUN (M)	____										
RISER LENGTH (M)	____										
ENTRY POINT DISTANCE (M)	____										
STATION RISE + H4000 ALLOWANCE	4M										
TOTAL (M)	____										
STATION NO.__________											
FLOOR RUN (M)	____										
RISER LENGTH (M)	____										
ENTRY POINT DISTANCE (M)	____										
STATION RISE + H4000 ALLOWANCE	4M										
TOTAL (M)	____										
STATION NO.__________											
FLOOR RUN (M)	____										
RISER LENGTH (M)	____										
ENTRY POINT DISTANCE (M)	____										
STATION RISE + H4000 ALLOWANCE	4M										
TOTAL (M)	____										

MKV84-1720

SITE SURVEY AND DESIGN CHECKLIST

______ Meet with the facility manager. Evaluate the facility and complete the Network Site Requirements Worksheet.

______ Obtain floor plans of all floors and for all buildings where the Ethernet Local Area Network will be installed.

______ Identify all station locations, current and future, on the floor plans.

______ Complete Station Transceiver Drop Cable Worksheet for all stations.

______ Examine each station location for possible cable installation methods; measure clearances.

______ Examine the ventilation system for environmental airspace cable installation.

______ Have a qualified electrician identify and measure the voltages at possible network earth reference ground locations.

______ Obtain all permits, licenses, and inspections required by local codes.

______ Submit the marked-up floor plans, worksheets, and preliminary station count to the system planner.

______ Copy and distribute as appropriate:

- ______ Original floor plan(s)
- ______ Network Site Requirements Worksheet(s)
- ______ Station Transceiver Drop Cable Worksheet(s)

______ Locate all DELNI interconnects, current and future, on the floor plans.

______ Locate all DEREP repeaters, current and future, on the floor plans.

NETWORK COMPONENT ORDER WORKSHEET

(Sample Only)

Using the building floor plans, summarize the required network components.

	Quantity	Unit Price	Price
ETHERNET COAXIAL CABLE			
Coaxial Cable Sections			
FEP Cables			
BNE2A-MA [23.4 m (76.8 ft)]	______	______	______
BNE2A-MB [70.2 m (230.3 ft)]	______	______	______
BNE2A-MC [117.0 m (383.9 ft)]	______	______	______
BNE2A-ME [500.0 m (1640.5 ft)]	______	______	______
PVC Cables			
BNE3A-MA [23.4 m (76.8 ft)]	______	______	______
BNE3A-MB [70.2 m (230.3 ft)]	______	______	______
BNE3A-MC [117.0 m (383.9 ft)]	______	______	______
BNE3A-ME [500.0 m (1640.5 ft)]	______	______	______
TRANSCEIVER DROP CABLES			
PVC Drop Cables (Straight Connectors)			
BNE3A-05 [5 m (16.4 ft)]	______	______	______
BNE3A-10 [10 m (32.8 ft)]	______	______	______
BNE3A-20 [20 m (65.6 ft)]	______	______	______
BNE3A-40 [40 m (131.2 ft)]	______	______	______
PVC Drop Cables (Right-Angle Connectors)			
BNE3B-05 [5 m (16.4 ft)]	______	______	______
BNE3B-10 [10 m (32.8 ft)]	______	______	______
BNE3B-20 [20 m (65.6 ft)]	______	______	______
BNE3B-40 [40 m (131.2 ft)]	______	______	______
FEP Drop Cables (Straight Connectors)			
BNE3C-05 [5 m (16.4 ft)]	______	______	______
BNE3C-10 [10 m (32.8 ft)]	______	______	______
BNE3C-20 [20 m (65.6 ft)]	______	______	______
BNE3C-40 [40 m (131.2 ft)]	______	______	______

NETWORK COMPONENT ORDER WORKSHEET (CONT)

	Quantity	Unit Price	Price
FEP Drop Cables (Right-Angle Connectors)			
BNE3D-05 [5 m (16.4 ft)]	______	______	______
BNE3D-10 [10 m (32.8 ft)]	______	______	______
BNE3D-20 [20 m (65.6 ft)]	______	______	______
BNE3D-40 [40 m (131.2 ft)]	______	______	______
PVC Office Drop Cables (Straight Connectors)			
BNE4A-02 [2 m (6.6 ft)]	______	______	______
BNE4A-05 [5 m (16.4 ft)]	______	______	______
PVC Office Drop Cables (Right-Angle Connectors)			
BNE4B-02 [2 m (6.6 ft)]	______	______	______
BNE4B-05 [5 m (16.4 ft)]	______	______	______
Fiber-Optic Cable			
BNE25B-60 60 m (196.9 ft)	______	______	______
BNE25B-90 90 m (295.3 ft)	______	______	______
BNE25B-A5 150 m (492.1 ft)	______	______	______
BNE25B-C0 300 m (984.3 ft)	______	______	______
BNE25B-E0 500 m (1640.4 ft)	______	______	______
BNE25B-H5 750 m (2460.8 ft)	______	______	______
BNE25B-L0 1000 m (3281.0 ft)	______	______	______
COAXIAL CABLE ACCESSORIES			
Barrel Connector P/N 12-19817-01	______	______	______
Terminator P/N 12-19816-01	______	______	______
Ground Clamp P/N 12-21766-01	______	______	______

NETWORK COMPONENT ORDER WORKSHEET (CONT)

	Quantity	Unit Price	Price
TRANSCEIVER INSTALLATION KIT			
With Drill P/N H4090-KA	______	______	______
Without Drill P/N H4090-KB	______	______	______
TRANSCEIVER (TAP)			
Coaxial Cable Tap P/N H4000	______	______	______
LOCAL NETWORK INTERCONNECT			
(8 Device Interconnect) P/N DELNI-AA	______	______	______
ETHERNET REPEATERS			
Local Repeater P/N DEREP-AA	______	______	______
Remote Repeater P/N DEREP-RA	______	______	______
FIBER-OPTIC PULLING DEVICE			
Pulling Device P/N 033-29-1015	______	______	______
Swivel P/N 203-08001	______	______	______
REPAIR COMPONENTS			
Coaxial Cable			
Male Type N Connector P/N H4056	______	______	______
Coaxial Cable Cutter P/N 29-24667	______	______	______

NETWORK COMPONENT ORDER WORKSHEET (CONT)

	Quantity	Unit Price	Price
Coaxial Cable Stripper P/N 29-24668	________	________	________
Connector Crimp Tool and Die Set P/N 29-24662 P/N 29-24663	________ ________	________ ________	________ ________
Transceiver Drop Cable			
Straight Connector Kit P/N H4054	________	________	________
Right-Angle Connector Kit P/N H4055	________	________	________
D-Connector Pin Crimp Tool AMP P/N 90302-1	________	________	________
Cable Ferrule Crimp Tool and Die Set AMP P/N 91239-7	________	________	________

APPENDIX E
DELNI LOCAL NETWORK INTERCONNECT

E.1 INTRODUCTION
The DELNI Local Network Interconnect is used to connect multiple host systems and communications servers in a network. There are two modes of operations: global and local.

E.2 GLOBAL MODE
Global mode is used when the DELNI interconnect is connected to an H4000 transceiver on an Ethernet coaxial cable. This *Ethernet Installation Guide* has exclusively discussed this type of network interconnection. It is also used for cascaded mode as discussed in Section E.3.

E.3 LOCAL MODE
The local mode is used when the DELNI interconnect is not connected to the Ethernet coaxial cable. In this mode of operation, the DELNI interconnect forms its own Ethernet network. The local mode of the DELNI Local Network Interconnect is shown in Figure E-1.

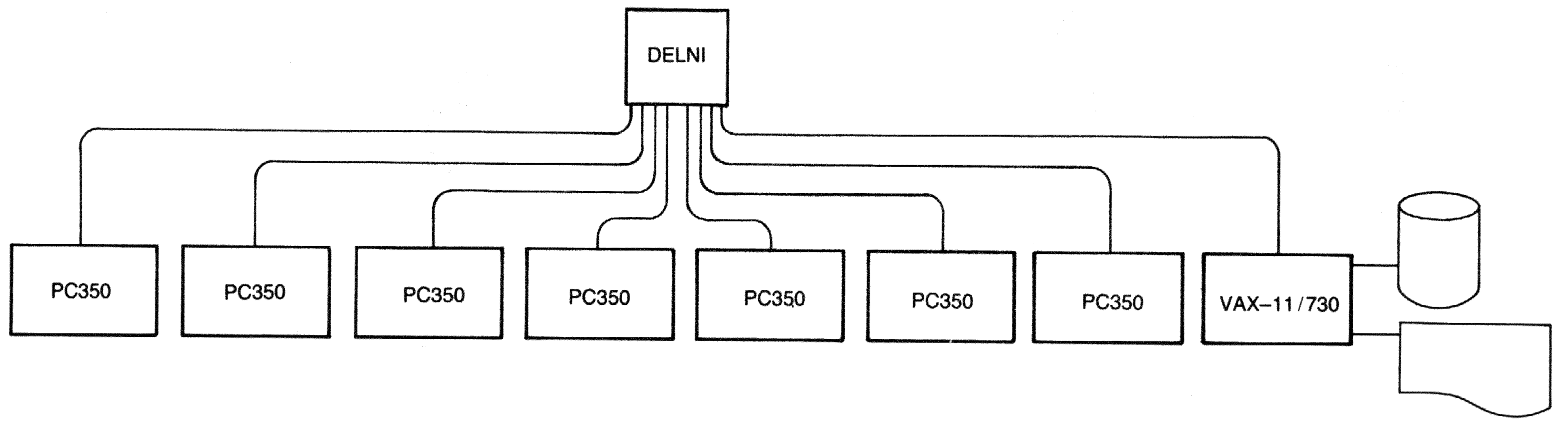
As can be seen in Figure E-1, up to eight host systems can be connected to a single DELNI interconnect. If all host systems are within a 40 m (131.2 ft) radius circle, a single DELNI interconnect can provide the interconnection, and an Ethernet coaxial cable is not required.

The DELNI Local Network Interconnect, local mode, may be expanded by connecting a combination of DELNI interconnects and devices to the top DELNI interconnect. By cascading DELNI interconnects in this manner (refer to Figure E-2), it is possible to create a very powerful, standalone Ethernet network with many nodes. However, a cascaded network must not extend more than 90 m (295.3 ft).

NOTE

It is possible to have up to eight DELNI interconnects in the second layer. However, Digital Equipment Corporation recommends that for networks of this size, connection to the Ethernet coaxial cable should be considered.

If DELNI interconnects are cascaded, the top DELNI interconnect cannot connect to an Ethernet coaxial cable. A maximum of two layers of DELNI interconnects are permitted, with the second layer of DELNI interconnects operating in the global mode.



MKV84-1753

Figure E-1 DELNI Local Network Interconnect (Local Mode)

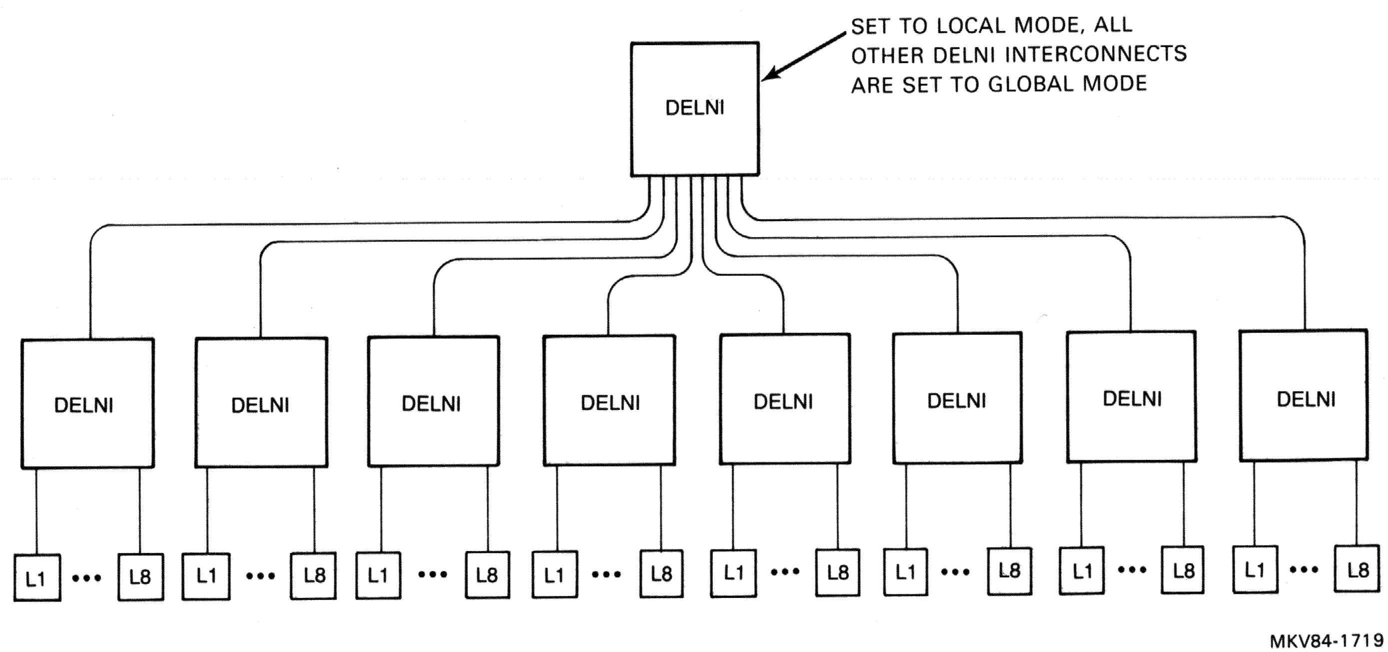


Figure E-2 Cascaded Standalone DELNI Local Network Interconnect (Local Mode)

EK-ETHV1-IN-003