

**METRIC/INCH POUND**

**KSC-STD-E-0021**  
**October 31, 2002**

**KSC TELECOMMUNICATION PREMISES  
DISTRIBUTION SYSTEMS, DESIGN OF,  
STANDARD FOR**

**October 31, 2002**

**SPACEPORT SERVICES**

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National Aeronautics and  
Space Administration

**John F. Kennedy Space Center**

KSC FORM 16-12 (REV. 6/95) PREVIOUS EDITIONS ARE OBSOLETE (CG 11/95)



**KSC-STD-E-0021**  
**October 31, 2002**

**KSC TELECOMMUNICATION PREMISES  
DISTRIBUTION SYSTEMS, DESIGN OF,  
STANDARD FOR**

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Director of Spaceport Services

**JOHN F. KENNEDY SPACE CENTER, NASA**

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## ABBREVIATIONS AND ACRONYMS

A	ampere
ac	alternating current
ACR	Attenuation to Crosstalk Ratio
ACS	Access Control Subsystems
ADA	Americans With Disabilities Act
ANSI	American National Standards Institute
ATC	Attenuation to Crosstalk Ratio
ATM	asynchronous transfer mode
ATS	automatic transfer switch
AT&T	American Telephone and Telegraph
AWG	American Wire Gauge
BCDS	Broadband Communication Distribution System
BICSI	Building Industry Consulting Service International
BNC	Bayonet Neil Concelman connector
BPS	bits per second
Btu	British thermal unit
°C	degree Celsius
CAD	computer-aided design
Cat. 5e	Category 5 Cabling (100 MBPS rated UTP)
CATV	community antenna television
CCS	Complex Control System
CCT	closed circuit television
CFP	customer faceplate
CIO	Chief Information Officer
CM	Communications Cable
CMP	Communications Plenum Cable (NEC)
CMR	Communications Riser Cable (NEC)
COTS	commercial off the shelf
CSMA/CD	Carrier Sense Multiple Access With Collision Detection
dB	decibel
dBmV	decibel referenced to 1 millivolt
dBu	decibel unit
dc	direct current
DCE	Data Communication Equipment
DDE	Dynamic Data Exchange
DLL	Dynamic Link Library
DTE	Data Terminal Equipment
EH	equalizer number
EI	End Instrument
EIA	Electronic Industries Alliance

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## ABBREVIATIONS AND ACRONYMS (cont)

EISA	Extended Industry Standards Architecture
ELFEXT	Equal Level Far End Crosstalk
ESS	Electronic Security Systems
°F	degree Fahrenheit
fc	footcandle
FDDI	Fiber Distributed Data Interface
FDM	frequency division multiplexing
FEP	fluorinated ethylene propylene
FEXT	Far End Crosstalk
FM	factory mutual
FOT	fiber optic terminal
FOTP	Fiber Optic Test Procedure
FSK	Frequency Shift Keying
ft	feet
ft <sup>2</sup>	square feet
GB/s	gigabyte per second
GHz	gigahertz
GPA	Group Processor Assemblies
HDTV	high-definition television
HSD	high-speed data
HVAC	heating, ventilating and air conditioning
Hz	hertz
IBM	International Business Machines
IC	intermediate cross connect
ID	identifier
IDF	intermediate distribution frame
IDS	Intrusion Detection Subsystem
IED	Innovative Electronic Designs
IEEE	Institute of Electrical and Electronics Engineers
in	inch
IO	Information Outlet
IRIG-B	Interrange Instrumentation Group-B
ISA	Instrumentation, Systems, and Automation Society
ISDN	Integrated Services Digital Network
ISO	International Standards Organization
Kb/s	kilobit per second
KCCS	Kennedy Complex Control System
KDN	Kennedy Data Network
KHz	kilohertz
KIMS	Kennedy Inventory Management System

## ABBREVIATIONS AND ACRONYMS (cont)

km	kilometer
kN	kilonewton
kPa	kilopascal
KSC	Kennedy Space Center
KVA	kilovoltampere
LAN	local area network
lbf/f <sup>2</sup>	pound-force per square foot
LSD	low-speed data
lx	lux
m	meter
m <sup>2</sup>	square meter
MBPS	megabit per second
MC	main cross connect
MDF	main distribution frame
MF	Main Frame
MHz	megahertz
MILA	Merritt Island Launch Area
MIL SPEC	military specification
MIPS	millions of instructions per second
mm	millimeter
NASA	National Aeronautics and Space Administration
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NEXT	Near End Crosstalk
NFPA	National Fire Protection Association
nm	nanometer
ODBC	Open Data Base Connectivity
OEM	Original Equipment Manufacturer
OIS-D	Operational Intercommunication System – Digital
OPC	OLE for Process Control
OTV	operational television
PACAS	Personnel Access Control Accountability System
PAWS	Paging and Area Warning System
PBX	private branch exchange
PDN	Public Data Network
PDS	Premises Distribution System
pF	picofarad
PON	Payload Operations Network
PSN	Packet Switching Network
PVC	polyvinylchloride
RCDD	Registered Communications Distribution Designer

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## ABBREVIATIONS AND ACRONYMS (cont)

RF	radio frequency
RFI	radio frequency interference
RFP	Request for Proposal
RS	recommended standard
SCADA	Supervisory Control and Data Acquisition
SMDS	Switched Multimegabit Data Service
SNA	System Network Architecture
SODN	Shuttle Operations Data Network
SONET	Synchronous Optical Network
SOW	Statement of Work
SP	splitter number
ST	straight tip
STD	standard
STP	shielded twisted pair
TA	amplifier number
TC	telecommunications closet
TCP/IP	Transmission Control Protocol/Internet Protocol
TDMM	Telecommunications Distribution Methods Manual
TDR	time delay reflectometer
Telco	telephone company
TIA	Telecommunications Industry Association
TNC	threaded Neil Councilman, contrast ENC
TP	twisted pair, tap number
TV	television
UL	Underwriters' Laboratories Inc.
UPS	uninterrupted power supply
USA	United Space Alliance
USOC	Universal System Ordering Code
UTP	unshielded twisted pair
V	volt
VABR	Vehicle Assembly Building Repeater
WAN	wide area network
$\mu\text{m}$	micrometer

## KSC TELECOMMUNICATION PREMISES DISTRIBUTION SYSTEMS, DESIGN OF, STANDARD FOR

### 1. SCOPE

1.1 Design Guidance. – This standard provides design guidance to premises distribution designers and facility contractors in the design, bid/proposal cycle and implementation phases of a Premises Distribution System (PDS). Typically, the PDS will operate in a multiproduct, multivendor environment at the Kennedy Space Center (KSC) and provide an infrastructure for the entire communication network.

Designs for future facilities and modifications to existing facilities will require a specific and structured design approach. This approach will contribute to systems being more easily designed and maintained, provide open-ended growth, simplify parts sparing, and reduce the time required to support moves and changes within a facility.

Every facility PDS design is unique. There are, however, many similarities between the subsystems when the designer follows the suggestions in this standard. The purpose of this standard is to standardize the overall approach of the design and implementation of Premises Distribution Systems at KSC. This approach will yield benefits in the areas of maintenance, spare parts provisioning, moves, and changes and will provide a better bid and proposal process. This standard also provides direction to the designer and installer to enable a structured approach to be used.

1.2 Illustrations Used in This Standard. – It should be noted that some of the illustrations used in this standard are modifications of documentation used in previous designs and are provided only for clarity. Although the illustrations are not intended to imply a given design, a designer shall follow the standard approach provided in this standard.

Information contained in this document, though very detailed and directive in nature, is not sufficient to complete a satisfactory Premises Distribution System design. Early planning and coordination with architects, building contractors, and National Aeronautics and Space Administration (NASA) will ensure a successful facility distribution design and implementation.

### 2. APPLICABLE DOCUMENTS

The following documents form a part of this document to the extent specified herein. When this document is used for procurement, including solicitations, or is added to an existing contract, the specific revision levels, amendment, and approval dates of said documents shall be specified in an attachment to the Solicitation/Statement of Work/Contract.

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## 2.1 Governmental.

### 2.1.1 Standards.

#### John F. Kennedy Space Center (KSC), NASA

KSC-STD-E-0004                      Pneumatic and Hydraulic Mechanical Components, Electrical Design, Standard for

KSC-STD-E-0012                      Facility Grounding and Lightning Protection, Standard for

### 2.1.2 Other Documents.

KSC-DD-804                              Complex Control System (CCS) Design Guide

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the procuring activity or as directed by the Contracting Officer.)

## 2.2 Non-Governmental.

#### Building Industry Consulting Service International – Telecommunications Distribution Methods Manual

BICSI TDMM                              8th Edition, Chapter 13

(Applications for copies should be addressed to the Building Industry Consulting Service International – Telecommunications Distribution Methods Manual, 8610 Hidden River Pkwy, Tampa, FL 33637.)

#### Telecommunications Industry Association (TIA) Electronic Industries Alliance (EIA)

EIA 310-D                                  Cabinets, Racks, Panels, and Associated Equipment

TIA/EIA/TSB-67                          Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems

TIA/EIA-472COOO-A	Sectional Specification for Fiber Optic Communications Cable for Indoor Use
TIA/EIA-492AAAA-A	Detail Specification for 62.5-Micrometer Core Diameter/125-Micrometer Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers
TIA/EIA-568-A	Commercial Building Telecommunications Cabling Standard
TIA/EIA-606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

(Applications for copies should be addressed to the Electronic Industries Alliance, 2500 Wilson Blvd., Arlington, VA 22201-3834.)

Institute of Electrical and Electronics Engineers (IEEE), Inc.

IEEE 488.1	Standard for Digital Interface for Programmable Instrumentation
IEEE 802.3	Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks – Specific Requirements – Part 3: Carrier Sense Multiple Access With Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications IEEE Computer Society Document
IEEE 802.7	Recommended Practice Broadband Local Area Networks IEEE Computer Society Document

(Applications for copies should be addressed to the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331.)

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International Standards Organization (ISO)

ISO 9002

Quality Systems – Model for Quality Assurance in Production, Installation and Servicing

(Application for copies should be addressed to the American National Standards Institute, 11 West 42<sup>nd</sup> Street, New York, NY 10036.)

National Fire Protection Association (NFPA) 70

NFPA 70

National Electrical Code (NEC)

Article 725

Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power-Limited Circuits

Article 760

Fire Alarm Systems

Article 770

Optical Fiber Cables and Raceways

Article 800

Communications Circuits

Article 820

Community Antenna Television and Radio Distribution Systems

(Applications for copies should be addressed to the National Fire Protection Association, One Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101.)

SPECSINTACT

Software products

(Application for copies should be addressed to IDI-196, Kennedy Space Center, FL 32899.)

### 3. REQUIREMENTS

#### 3.1 Premises Distribution System.

3.1.1 System Overview. – KSC has a variety of Premises Distribution Systems on site and will implement additional ones in the future. Implementation of these systems shall occur in large landscape office areas, operational facilities, and areas where mission-unique configurations could frequently change. All new facilities should include a PDS as part of the overall construc-

tion facility contract. Some existing facilities will be updated to include state-of-the-art premises distribution designs. The services that use PDS include telephones, faxes, modems, local area networks (LAN's), broadband communications, and data terminals.

Components of a distribution system include cables, adapters, and supporting equipment. These components link faxes, modems, telephones, computer terminals, and other communication devices.

A Premises Distribution System also provides a method for arranging products within a facility in a logical, coherent, and economical fashion. As such, a distribution system can be organized as a set of subsystems tailored to meet specific needs, which allows changes to be done to one part of the system without affecting other parts of the system.

A distribution system consists of products from the following families of components:

- a. Transmission Media. A variety of copper and optical fiber cabling for transmitting signals for voice, data, sensor, video, and other applications.
- b. Cross Connect and Interconnect Hardware. Panels or frames and modular components that make up connecting points, also called circuit administration points, where circuits can be conveniently routed and rerouted.
- c. Connectors, Plugs, and Jacks. Hardware used in a variety of applications to join cables together and connect equipment cords from communication devices to horizontal wiring cables at the cross connects and interconnects and at cabling to equipment.
- d. Adapters. Devices that modify the physical functions of jacks or plugs, passively match electrical characteristics, or fit larger or smaller cables to permit connection not otherwise possible.
- e. Support Hardware. The modular cabinets, cable trays, brackets, backboards, ground clamps, and other equipment for housing and supporting cable runs and connections.

The various Premises Distribution Systems routinely employed at KSC include the following (see 3.1.1.1 through 3.1.1.9):

- a. Voice communications (telephone)
- b. Data communications (LAN)
- c. Paging and Area Warning System (PAWS)

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- d. Operational Intercommunication System - Digital (OIS-D)
- e. Broadband Communication Distribution System (BCDS)
- f. Kennedy Complex Control System (KCCS)
- g. Timing and Countdown System
- h. KSC Computer Network
- i. Other systems

3.1.1.1 Voice Communications (Telephone). – The telephone distribution system is the intra-facility cabling system that, through a combination of outside cable plant cross connects, distributors, and customer faceplates, facilitates the delivery of voice communications to telephone instruments at the desktops. The telephone interface to external facilities utilizes both analog and digital means for communication. Horizontal distribution media currently employed for telephone signals is a 100-ohm, 4-pair, unshielded twisted pair (UTP), Cat. 5e copper-type cable.

3.1.1.2 Data Communications (LAN). – Data communications is implemented through the premises distribution cabling system (through a combination of frames, cross connects, or patch panel), which facilitates the delivery of several types of communication services to the desktop. Systems providing these services include Local Area Networks. Currently standard horizontal distribution medium for data communication is a 100-ohm, 4-pair, UTP, Cat. 5e copper cable. With the need for higher bandwidth capabilities at the LAN level, multimode fiber optic cable is also provided to the customer faceplate.

3.1.1.3 Paging and Area Warning System (PAWS). – The Paging and Area Warning System provides configurable zones for audible area warning announcements, emergency operational and administrative paging, as well as alert capability for facilities at KSC. Standard horizontal distribution media currently used for this system consists of jacketed, shielded, twisted-pair 300-volt (V) copper cable.

3.1.1.4 Operational Intercommunication System – Digital (OIS-D). – OIS-D is a fully digital, multichannel conferencing communication system. It interfaces directly with the existing audio bridge distribution system and with standard T1 format voice circuits. Provisions for this system typically include an empty raceway system only, provided within the construction contract. Cable, terminations, equipment, end instruments, testing, and system commissioning shall be provided and installed by a NASA Support Contractor. However, due to certain types of requirements, it may be necessary to include cable installation and termination as part of the construction contract.

3.1.1.5 Broadband Communication Distribution System (BCDS). – BCDS provides a frequency-division-multiplexed radio frequency (RF) communication network for video, audio, and IEEE 802.7. The services provided are used Centerwide by NASA Support Contractors. The NASA Support Contractors currently broadcast technical and safety training programs under assigned BCDS broadcast channels. The trunk cable for this system presently is a broadband video cable, semi-rigid coax. The outlet drop cable is a flexible coax video cable, type RG-6 or RG-59 depending on system design criteria. Other video services at KSC such as operational television (OTV), closed circuit television (CCTV), and high-definition television (HDTV) would be supported by a structured distribution system similar to BCDS.

3.1.1.6 Kennedy Complex Control System (KCCS). – The KCCS is an intended update and replacement for the existing Complex Control System (CCS). The KCCS is a Supervisory Control and Data Acquisition (SCADA) System, which supports Open Data Base Connectivity (ODBC), OLE for Process Control (OPC), Dynamic Data Exchange (DDE), and Dynamic Link Library (DLL) interfaces. The existing KCCS SCADA system uses facilitywide Ethernet network, using Transmission Control Protocol/Internet Protocol (TCP/IP). Physical connectivity to the existing SCADA system is via an asynchronous transfer mode (ATM) edge switch connecting the Ethernet-based SCADA equipment to the ATXS facility switch. KCCS Ethernet connectivity within a facility is supported by Cat. 5e network cabling as described in 3.1.1.2. A separate structured distribution cabling system employing the design criteria for Cat. 5e and fiber network cabling, as described within this standard, may be developed for support of the KCCS system within a facility.

3.1.1.7 Timing and Countdown System. – The timing system at KSC is provided to allow timing commonality between instrumentation systems, allowing reference of data with respect to time. Timing signals are distributed between buildings on communication pairs in the outside cable plant in multipair copper cables. The signals are distributed within the building on comm pairs in the backbone riser cable. Currently, horizontal distribution from the terminal distributor in the communication closet at each floor is composed of 50-ohm coax cable terminated at a 50-ohm Bayonet Neil-Concelman connector (BNC) at the user end. Type F connectors may be required for customer faceplates (CFP's) at the user end.

3.1.1.8 KSC Computer Network. – The KSC Computer Network consists primarily of Shuttle Operations Data Network (SODN), Payload Operations Network (PON), and Kennedy Data Network (KDN). The KSC Computer Network provides LAN support and connection to the KSC areawide network by providing switched 10/100/1000 MB Ethernet connectivity to the desktop and computing resource servers. The KSC Computer Network is supported on the PDS Network as described in 3.1.2.

3.1.1.9 Other Systems. – The following systems are described for informational purposes only. Distribution criteria are not contained herein and will need to be verified on a project-specific basis.

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3.1.1.9.1 Facility Management Control System. – The Payloads facilities in the Industrial Area are all networked using a dedicated Andover Ethernet LAN. All other facility management control systems are standalone systems. KSC-DD-804 describes the points to be connected to the CCS and KCCS.

3.1.1.9.2 Electronic Security Systems. – Premises wiring for Electronic Security Systems (ESS) is categorized by the type of subsystem being provided. The three main subsystems are Access Control, Intrusion Detection, and Perimeter Protection. Perimeter protection is actually a form of intrusion detection, but since it uses radically different technologies and covers such large areas, it is approached differently. All premise wiring for ESS shall have at least an overall shield and drain conductor.

- a. Access Control Subsystems (ACS) require a reader at the portal (door, turnstile, etc.) where personnel enter and exit the facility. Present systems use Personnel Access Control Accountability System (PACAS) card readers with Wiegand wire technology. The entry and exit readers need premises wiring to the locking device at the portal to the controller and to a power source. Typically, the reader is close to the portal, but may be some distance from the 12 or 24 V direct current (dc) power supply, requiring the use of No. 20 American Wire Gauge (AWG) to No. 16 AWG multiple pair cables. The dc power supply must have alternating current (ac) power wired to it. An auxiliary box may be used for housing power components and terminating cabling in an ACS installation and is located near the portal being controlled. Premises wiring for ACS is a 25 pair, No. 18 to No. 20 AWG cable from an auxiliary box to the controller, a 12 pair, No. 18 to No. 20 AWG cable from the auxiliary box to each reader assembly, and a 3 pair, No. 16 AWG cable to each locking device. If intrusion detection is also installed at this portal, an additional 2 pair, No. 22 AWG cable is required from the sensor at the portal to the auxiliary box.
- b. Wiring for the Intrusion Detection Subsystem (IDS) requires a 2 pair, No. 22 AWG cable per portal being protected by inert devices, such as balanced magnetic switches. This cable runs all the way to the controller, which can be up to 1000 cable feet away. There are also some powered devices used in IDS such as glass break sensors and infrared detectors. These require either a 2 or 3 pair No. 20 to No. 22 AWG cable back to the controller.
- c. Perimeter protection subsystems are all presently protecting fences. These can be piezo-electric devices or special sensitive fiber optic sensing cable. Premises wiring for this type of subsystem is basic ac or dc power to the processor and signal cable from the processor to a controller or reporting device such as a radio transmitter. The signal cable is typically No. 20 AWG, with a pair count matching the zone count of the processor, plus one or two pairs for trouble and tamper reporting. Therefore, a four-zone processor enclosure would require one cable pair for

power, four pairs for zone alarms, and two pairs for supervisory signals. Normal overhead would dictate a 12 pair, No. 20 AWG cable to each processor from the controller.

3.1.2 Distribution Subsystems. – A PDS is composed of six subsystems: (1) building entrance, (2) equipment room, (3) backbone cabling, (4) communications closet, (5) horizontal cabling, and (6) work area. To what extent these subsystems are used in a facility design depends on the implementation requirements for that facility.

The following paragraphs provide an overview of these subsystems, and appendix A, figure A-1, shows the layout of the subsystems in a typical multiple story facility.

- a. Building Entrance. Building entrance facilities provide the point at which outside cabling interfaces with the intrabuilding backbone cabling.
- b. Equipment Room. Equipment rooms usually house equipment of higher complexity than communications closets. Any or all of the functions of a communications closet may be provided by an equipment room. The wiring subsystem consists of the cables and connectors that link voice, video, and data equipment and other devices to shared equipment or cross connections in the equipment room. Interconnection wiring between equipment is not normally a part of the construction contract.
- c. Backbone Cabling. The backbone cabling provides interconnection between communications closets, equipment rooms, and entrance facilities. It consists of the backbone cable, intermediate and main cross connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross connection. This subsystem represents the central or feeder group of cables in a building. In a multiple-story facility, these cables run from the main communication/equipment room to other floors where they are terminated in the communication/equipment room at the termination hardware. In a single-story facility spread out over a large area, the backbone cables will run horizontally between communication rooms.
- d. Communications Closet. A telecommunications closet is the area within a building that houses the telecommunications cabling system equipment. This includes the mechanical terminations and/or cross connect for the horizontal and backbone cabling system. Similar to the equipment room, the subsystem consists of the cables and connectors that link voice, video, and data equipment and other devices to shared equipment or cross connections in the communications closet/equipment room.

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- e. Horizontal Cabling. The horizontal cabling extends from the work area, communications (information) outlet to the communications closet and consist of the following:
  - (1) Horizontal cabling
  - (2) Telecommunications outlet
  - (3) Cable terminations, including remote distributors
  - (4) Remote distribution points (in some cases, they will be used between the communications closet and the work location and must be as close as possible to group user locations)
  
- f. Work Area. The work area components extend from the communications (information) outlet to the station equipment. Work area wiring is designed to be relatively simple to interconnect, so that moves, adds, and changes are easily managed. Components consist of the device cables, adapters, and connectors that link station equipment such as telephones, fax, and printer terminals, and workstations to the communications outlets in rooms in office spaces. As with the equipment wiring subsystem, this wiring is not normally part of the construction contract.

3.1.3 Design Rationale. – A well-designed PDS is relatively independent of the equipment it serves. The PDS is capable of interconnecting many different communication devices, such as data terminals, analog and digital telephones, faxes, modems, personal computers, as well as system-common equipment.

Every attempt shall be made to follow industry standards. There will be occasions, however, when this will not be possible. In some cases, modifications to existing facilities where the data distribution design was not taken into account in the initial facility design and where cost is a major issue, make it difficult to follow standards precisely. Any deviation from standards shall be submitted to NASA for approval.

Premises Distribution Systems shall be designed using the backbone (riser) and horizontal wiring subsystems as the major building blocks. Because of the complex designs and building arrangements, a letter designation is required for the segments of the wiring system. These segments are designated as A, B, and C. This nomenclature is useful in describing and documenting the system. Refer to figure A-2.

The remote distributors shown in figure A-2 suggest two possible schemes for distribution - wall and ceiling mount. Designs should place these distribution points as close as possible to the end users. This will make moves and changes easier to accomplish, as well as lower the costs that would be encountered if all cables were directly connected to the communications closet/equip-

closet/equipment room. The type of remote distribution used will depend on the physical layout in a given facility. An example of where remote distribution is useful is in facilities with landscape furniture used in large open office spaces or where another facility would mainly use closed office work areas.

A third possible option for the location of a remote distributor is under a raised floor. This option may be necessary in operational areas where raised floors are extensively used and ceiling-mounted distribution would not be practical.

Whenever possible, particularly in new construction, the horizontal cable should home run from the communication outlet to the communications closet/equipment room. NASA shall specify if remote distribution is required for a given project.

All designs need to account for the cable length budget allowed for in the referenced TIA/EIA-568-A specification. This could have an impact on the type of remote distribution chosen.

**3.1.4 Premises Distribution Concept.** – Figures A-3 through A-8 provide examples of typical distributions that were designed and implemented at KSC. These drawings show the use of the premises distribution subsystems described in 3.1.2 and how these subsystems, combined with associated hardware components, will provide the following distribution arrangements:

- a. Telephone Distribution
- b. Cat. 5e Unshielded Twisted Pair Data Distribution
- c. Fiber Optic Data Distribution
- d. Broadband Communications Distribution

These arrangements, though only conceptual, show how NASA expects distribution subsystems and associated hardware components to be arranged to satisfy networking requirements. Each of the conceptual drawings shows the distribution subsystems used, associated hardware that completes the arrangement, and an indicator referencing where additional information can be found in this section.

**3.1.5 Distribution Planning Concept.** – The success of a premises distribution design depends on close coordination between the Premises Distribution Design Contractor, the NASA Support Contractor, and the users during the early phases of a facility design. To cover every detail that should be considered in a distribution design is beyond the scope of this standard. The more important items, however, are discussed in the following paragraphs. Computer-aided design (CAD) files of drawings in the appendix are available for use as templates by the Premises Distribution Designer. The Premises Distribution Designer can use copies of these templates for distribution system designs.

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**3.1.5.1 Zone Concept.** – In large facilities, it is difficult for the Premises Distribution Designer to do his job unless the facility is first divided into manageable areas identified as “zones.” Aside from making the design process easier, the zoning concept will benefit the documentation process, future modifications to a facility, configuration control, and in design modifications required for “moves and changes” within a facility.

Zones are used to identify a physical portion of a facility, and the size of a given zone is optional. The zone plan may be related to the architectural plans of a large facility or to obvious physical attributes of a smaller facility. One approach to zoning that has been successfully used at KSC for a large facility has been to zone the facility according to the Premises Distribution Designer’s use of “F” size drawings. See figures A-7 and A-8. This approach used six zones for each floor in the facility approximately 154.40 meters (m) x 104.40 m [500 feet (ft) x 300 ft]. In this design, the Premises Distribution Designer identified each zone by an alpha character.

**3.1.5.2 Remote Distribution.** – Paragraph 3.1.1 provides an overview of the Distribution Subsystem and figure A-2 shows the relationship of the remote distribution in the horizontal wiring subsystem. Remote distributors should only be employed in large, open, landscape furniture areas, populated with 20 or more individuals. Use of remote distributors should be discussed early in the design process and finalized no later than the 30-percent submittal stage. Through the zoning process, zones shall be identified and the personnel occupancy numbers shall be attached to each zone. For each group of 20 users in a zone, one remote distributor shall be allocated. The location for a remote distributor shall be mounted in the wall, the ceiling, or in the communication’s closet. Each remote distributor within a zone should be identified with an alpha character and a numeric indicator (e.g., B3 denotes zone B, distributor 3).

The area served by a given remote distributor will depend on user density of the area. In the absence of specific office plans, one communications outlet is allocated for each 9.29 square meters (m<sup>2</sup>) [100 square feet (ft<sup>2</sup>)] of office floor space.

During the zoning and remote distributor location process, two significant considerations must be kept in mind: wiring distance constraints as specified in 3.2.4 and 3.3.4 and the balance between communications closet/equipment room assignments where a choice can be made on which room will support a given remote distributor.

For the construction of a new facility, service entrances shall support 100 percent expansion. A minimum of four 100 millimeter (mm) [4-inch (in)] ducts shall be provided for a building entrance.

**3.1.5.3 Communications Closets/Equipment Rooms.** – The first consideration in locating a communications closet/equipment room is to select a location that meets the distances described in 3.2.4 and 3.3.4. In some cases, this will not be possible, and then as a result, a second or additional communications closet/equipment rooms will have to be added to the design.

The location of the communications closet/equipment rooms is driven by several parameters: (1) density and location of user population, (2) distances to user locations, (3) relative position in a multistory facility, and (4) building entrance wiring requirements.

If feasible, communications closet/equipment rooms in a multistory facility should be stacked above each other. This will simplify the initial installation and reduce the cost of future modifications. In addition, one room that is near the center of activities shall be identified as a central communications closet/equipment room. This will enable the implementation of star-wired configurations, provide a location for the installation of common equipment, and enhance the network management process. Provisions shall also be made to satisfy the facility entrance requirements for such interfaces as the main telephone system and wide area networks (WAN's).

**3.1.5.4 Pathways.** – Outside cable plant shall be routed into the building in dedicated service entrance ducts, terminating into the communications equipment room. Conduit sleeves routed through the floor shall provide connectivity between stacked communication equipment rooms, up through a multistory building. Vertical trays will be required to support cabling in the vertical backbone subsystem in the rooms between floors.

Cable trays shall be used to support the routing of the backbone and horizontal subsystem cables in the horizontal plane on each floor. These cable trays shall be sized and routed to accommodate multipair cables to remote distributors, multipair cables routed between communications closets/equipment rooms, and individual horizontal station outlet drops to customer faceplates.

Vertical pathways from above ceiling areas down to customer faceplate locations shall be via conduit in fixed partitions or communications/power pole raceways to modular furniture units. Conduits or raceways shall be stubbed into the space above the ceiling and terminated. Bridle rings or cable straps sized and spaced in accordance with manufacturer's instructions shall be utilized to carry cables in the space between the cable tray and the vertical raceway stubbed into the ceiling space.

Specific attention is noted to space above the ceiling for cable tray routing. Careful planning is essential to ensure that there are no conflicts between cable trays and other above ceiling items such as air ducts, lighting, piping, and other conduits. Cable trays should also be accessible to installation and maintenance personnel. A minimum of 305-mm (12 in) clear space shall be maintained above the tray along its routing for access.

In areas with fixed partition walls, cable trays should generally be run in the corridors. In areas with modular furniture, the tray should be run along walkways in the layout and not over cubicles (workstations).

For firewall penetrations, fire protection integrity shall be maintained with approved techniques. Cable trays passing through any fire-rated partitions shall have an Underwriters' Laboratories Inc. (UL) or factory mutual (FM) approved fire stop. An optimal method shall consist of transition-

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ing from cable tray to conduit sleeves, sized to accommodate the number of cables required, through the fire-rated partition and then retransitioned on the opposite side to continue with the cable tray. Approved fire stopping methods shall be employed in sealing around the conduit sleeves.

3.1.6 Specific Instructions. – The following instructions are unique NASA requirements and shall be followed for all distribution designs. These instructions relate to communications outlets, system expansion, and horizontal-to-backbone (riser) cable ratios. Deviations from these instructions are subject to NASA approval.

3.1.6.1 Communications Outlets or Customer Faceplates. – The specific instructions for allocating communications outlets to facility areas shall be as described in 3.4.2.1. Refer to 3.4.2 for details on the communications outlet.

3.1.6.2 System Expansion. – Two types of expansion shall be included in the design task: expansion capability of installed hardware and expansion capability for uninstalled hardware.

- a. Installed hardware. Twenty percent expansion capability shall be allowed for installed hardware. This includes unused pairs in Segment A and B wiring, unused intermediate distribution frame (IDF) punch blocks for telephone and low-speed data, unused panels for high-speed data, and unused ports for remote distributors.
- b. Uninstalled hardware. One hundred percent expansion shall be allowed for the installation of future hardware. This includes wall space in communications/equipment rooms, space for cables in cable trays, and space for distribution panels in both the communications/equipment rooms and the remote distribution areas.

3.1.6.3 Cable Specifications. – This paragraph covers the guidelines for the cables, which comprise the backbone (riser) and horizontal wiring segments. All cables shall meet the criteria cited in this specification. Any deviations from the cable specifications in this document shall be submitted for approval by NASA.

UTP cables are categorized by EIA/TIA and defined according to their electrical and physical characteristics. Cable Categories 1 and 2 do exist but are not recognized in EIA/TIA-568-A.

Category 3 is recognized by EIA/TIA 568-A, paragraph 10.1a, as applicable to 100 ohm UTP cable and connecting hardware whose transmission characteristics are specified up to 16 megahertz (MHz). Category 3 cables may be utilized for telephone riser application.

Cat. 5e (enhanced) cables and hardware were developed as a replacement for Cat. 5 rated components. They are designed and manufactured to specifically meet higher testing parameters that otherwise pushed Cat. 5 components to their limit. Like Cat. 5, Cat. 5e components are also

tested to 100 MHz bandwidth and data transfer rates of 100 megabit per second (MBPS), in the horizontal segment only. However, Cat. 5e testing evaluates all four pairs of the cable with the “power sum” parameter. Cat. 5e cables shall be utilized for telephone horizontal distribution and shall be used for all LAN applications supported on 100-ohm UTP cable.

For higher bandwidth applications (250 MHz) and data rates beyond 100 MBPS [1 gigabyte per second (GB/s)] fiber optic cable shall be utilized in the horizontal level. Cable shall be 50/125 micrometer, multimode utilizing type MT-RJ small form factor modular connectors, for a standard 90-m (295-ft) horizontal link.

Each EIA level is backward compatible. For example, while 10BaseT is not supported by Category 1 cable, Categories 2 through 5 cable can handle voice.

When uncertain, use “worst case” scenarios to evaluate different backbone wiring alternatives. The higher the uncertainty, the more flexible the backbone wiring system should be.

All cables shall be commercially available, commercial off the shelf (COTS) types. In cases where a riser cable penetrates an air plenum, the cable shall be plenum rated or enclosed in a conduit or closed tray that meets the latest NEC requirements.

**3.1.6.4 National Electrical Code.** – The NEC is the most widely adopted set of electrical safety requirements in the world. Included in the Code are fire-resistance requirements for both wire and fiber cables. The two most important hazards addressed by the Code are the initiation of fire by electrical circuits and the spread of fires by cables.

Cables for telephone (voice) communications shall be certified by an independent testing laboratory as satisfying the fire-resistance, mechanical, and electrical standards of the NEC.

The NEC requires that communications signaling wires and cables in a building be listed according to their suitability for a given use.

Article 770 applies to the installation of fiber optic cables and optical fibers woven in with electrical conductors in the same cable. Marking and ratings are as follows:

- OFC Conductive fiber optic cable
- OFPC Conductive fiber optic plenum cable
- OFRC Conductive fiber optic riser cable
- OFN Nonconductive fiber optic cable
- OFNP Nonconductive fiber optic plenum cable
- OFNR Nonconductive fiber optic riser cable

Article 800 concerns wire communications cable types and lists them by category and marking. They are marked and rated as follows:

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CMP Communications Room  
 CMR Communications Risers  
 CM General purpose use (except plenums and risers)  
 CMX Residential and restricted commercial use  
 MP Multipurpose Plenum  
 MPR Multipurpose Riser

3.1.7 Design Example. – The following example shows a portion of a premises design using the criteria stated in this section.

3.1.7.1 Architectural Key Plan. – Figure A-7 shows the architectural key and zone plan. Refer to section 3.1.5.1, which outlines the reasons for zone documentation and configuration control.

3.1.7.2 Zone “A” Utilization. – The details in figure A-8 show the communications closet/equipment rooms located near the center of activities. The communications closet/equipment room supports Zone “A” while complying with the 90 m (295 ft.) cable length limitation. Note the scale of the drawing. This figure illustrates the utilization of floor space within the zone. Four office areas are identified; one with 1033.7 m<sup>2</sup> (11,128 ft<sup>2</sup>) which may support approximately 112 users, one with 174.6 m<sup>2</sup> (1,880 ft<sup>2</sup>) supporting 19 users, one area of 408.7 m<sup>2</sup> (4,400 ft<sup>2</sup>) supporting 44 users, and one with 432.5 m<sup>2</sup> (4,656 ft<sup>2</sup>) supporting 47 users. Identifying user density expedites the location of remote distributors.

3.1.7.3 Remote Distributors. – Eleven ceiling distributors each supporting 24 ports are shown in figure A-8 and designated A1 through A11. They are strategically placed to accommodate each area of 20 users. Note that 4 ports of each distributor are reserved as spares for future growth.

The 1033.7 m<sup>2</sup> (11,128 ft<sup>2</sup>) area requires 6 distributors, the 174.6 m<sup>2</sup> (1,880 ft<sup>2</sup>) area requires 1, the 408.7 m<sup>2</sup> (4,400 ft<sup>2</sup>) area requires 3, and the 432.5 m<sup>2</sup> (4,656 ft<sup>2</sup>) area requires 3. Refer to 3.1.5.2, which identifies design rules, and 3.1.6.1, which provides specific instructions.

## 3.2 Backbone (Riser) Wiring Subsystem.

3.2.1 Backbone Overview. – The backbone (riser) subsystem is the portion of the PDS that provides the central or main group of cables in a facility. The subsystem consists of all wire and fiber optic cabling and the associated support hardware for routing this cable to other locations.

The backbone wiring consists of the transmission media (cable), intermediate and main cross connect blocks, mechanical terminations, and interbuilding entrance facilities for interconnections of telecommunications closets, equipment rooms, and network interfaces.

The riser subsystem may also run laterally in buildings with large horizontal floor areas and multiple communications/equipment rooms per floor.

**3.2.2 Backbone Topology Arrangements.** – This standard defines a structured physical layout of the cabling system or wiring topology for a PDS. The three physical topologies most commonly used in buildings are the star, bus, and ring. The bus and ring are used for data applications such as the LAN, while the star is used for both voice applications and data. Depending on the size and user applications, a NASA facility could require more than one topology be implemented in order to satisfy the operational requirements.

**3.2.2.1 Backbone Star Topology.** – A star topology is illustrated in detail A in figure A-9. Most facilities will be wired in a physical star and star/tree arrangements. From these arrangements and through the proper hardware, a distribution system can be configured into a logical bus and ring LAN's or point-to-point links. A star topology is the simplest, and all the traffic in the network shall travel through the main cross-connect. An advantage is that it is easy to add or remove user drops at the telecommunications closet by simply rewiring the main cross connect, and it provides management flexibility. A disadvantage is that it is vulnerable to failure because the main cross connect is a potential performance bottleneck and represents a single point of failure.

**3.2.2.2 Bus Topology.** – Bus topology is illustrated in detail B in figure A-9. Along with the bus topology, equipment such as data terminals, storage devices, printers, and host computers are strung out along a single length of cable that can be extended on at least one end. The bus offers only one transmission path between any two devices. Some implementations may use coaxial cable for the transmission medium.

For most implementations, the wiring arrangement will be a physical star, and through the use of electronic hardware, a logical bus will be established. An advantage is the simplicity of adding and removing users and the high data transfer rates because there is no need to route data through intervening communications closets. A disadvantage is any discontinuity disrupts service to all downstream workstations.

**3.2.2.3 Ring Topology.** – Ring topology is illustrated in detail C in figure A-9. In a ring topology, the transmission path forms a circle, or loop, with devices connecting at various points on the ring so that signals pass through one device at a time before returning to the originating device. For most implementations, the wiring arrangement will be a physical star, and through the use of electronic hardware, a logical ring will be established. An advantage is that simple discontinuity does not disrupt service to stations. A disadvantage is adding or removing stations is slightly more complicated than backbone systems.

**3.2.3 Media Considerations.** – Backbone is applicable to a wide range of different user requirements. Depending on the characteristics of the individual application, choices with respect to transmission media have to be made. In making this choice, factors to be considered include:

- a. Flexibility in supported services

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- b. Required useful life of backbone wiring
- c. Facility size and user population

Facility occupant needs for telecommunications services vary over time and from occupant to occupant. Plans for future use of the backbone wiring may range from the predictable to uncertain. The different service requirements shall first be determined. It is convenient to group similar services together in a few categories such as voice, display terminals, LAN's, and other digital connections. Within each group, individual types shall be identified and required quantities should be projected.

Each of the recognized cable options has individual characteristics making it useful in various situations. A single cable type, in most cases, will not satisfy all user requirements in a given facility, and it is then necessary to use more than one medium in the backbone wiring. When more than one medium is required, the different media shall use, at a minimum, the same facility architecture with the same location for cross connects, mechanical terminations, and interbuilding entrance facilities.

**3.2.4 Backbone (Riser) Cable Distances.** – The maximum backbone distances between the main cross-connect and the mechanical termination in the telecommunication closet shall comply with figure A-10.

To minimize cable distances, it is often advantageous to locate the main cross connect near the center of a site. Installations that exceed these distance limits may be divided into areas that can be supported by backbone wiring satisfying the distances requirements.

**3.2.5 Design Considerations.** – The following list describes general items a designer shall consider in the design of a PDS. This list is not complete and items will be added, as required:

- a. Conform to the latest NFPA Codes for fire protection.
- b. Support all cable types required to implement the various LAN types and other communications services as stated in the user requirements specifications.
- c. Design for stacked communications closets/equipment rooms. Locate communications/equipment rooms at building core locations, if possible.
- d. Locate entry (main entrance) communications closets/equipment rooms on an outside wall or main hallway.
- e. Utilize the backbone to horizontal cable ratios as stated in 3.7.4.1, 3.8.1.5, and 3.8.2.4.

3.2.6 Backbone (Riser) Cable. – To determine backbone (riser) cable needs, the PDS designer needs to know the type of construction that will be used for the return air system and the type of construction used for enabling cables to be run in vertical shafts, as well as the air plenums of multifloor facilities. During the design phase, cost trades should be made to show the economics of implementing a given type of return air system. These trades will account for physical materials of the facility and also the type of cable required.

The NEC makes recommendations regarding acceptable wiring, with respect to fire resistant and low-smoke-producing characteristics and for cables installed in the air handling or plenum spaces above suspended ceilings.

The requirements for the backbone, Segment C cables described below provide physical descriptions for cables that could be used in a nonplenum environment and without the use of closed cable vaults between floors. The actual cables used will depend on the facility construction and the applicable NEC ratings.

### 3.3 Horizontal Wiring Subsystem.

3.3.1 Horizontal Overview. – Horizontal wiring is the portion of the wiring system that extends from the user work area communications outlet to the communications closet/equipment room. It differs from the riser subsystem in that it is usually located on one floor and always terminates in a communication outlet at the user or workstation end.

It consists of cables that support most combinations of modern devices connected to the communications outlet. Where remote distributors are employed, the horizontal wiring subsystem will normally terminate in one of two types of remote distributors: wall cabinets or ceiling distributors. In new construction, it is preferable for horizontal wiring to extend directly to a communications closet/equipment room.

The following services are normally provided in all NASA KSC facilities and are required in any horizontal wiring subsystem design unless otherwise specified by NASA.

- a. Voice Communications Services: Switching Systems (PBX, Key Systems, and Telephones)
- b. Data Telecommunications/Computer Networks
- c. Broadband (BCDS)/Community Antenna Television (CATV)

In addition to satisfying today's telecommunications requirements, the horizontal wiring system should enable ongoing maintenance, relocation, and accommodation of future equipment and service changes. The horizontal wiring system contains the greatest quantity of individual cables for a facility. After construction of a facility, the horizontal distribution wiring is often less ac-

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cessible than the backbone wiring. The time and effort required for changes can also be significant. The disruption to occupants makes the choice of horizontal cable types, layouts, and locations very important to a facility distribution design.

The pathway facility shall be designed to handle all types of telecommunications cable (telephone, data, video, LAN, etc).

Most networks that run on UTP cable use only two of the four pairs of wires available in the cable. To avoid crosstalk problems, one should never run more than one type of data in the same cable (i.e., Token Ring and 10Base-T; data and telephone).

UTP cable is relatively immune to outside sources of interference that can corrupt data, but it is always a good practice when running cables through walls and ceiling to keep them as far as possible from sources of electromagnetic interference and radio frequency interference (RFI).

Electrical noise is random voltage that is either induced or applied to transmission media. Electric noise has two distinct types: ambient and impulse noise. Noise measurements must be conducted actively or in a real-time fashion with an ac noise meter.

Ambient noise sources in the 40 hertz (Hz) to 150 kilohertz (kHz) range include ac lines, intercoms, telephones, and fluorescent lights. Noise in the 150-kHz to 20 MHz range includes light dimmers, computers, copiers, and printers. In the 20-MHz to 1 gigahertz (GHz) range, noise sources include radios, TV sets, and microwave ovens.

The most common sources of impulse noises are single and three-phase motors (for example, air compressors), welders, and switches.

Closed metal pathways (e.g., conduit, wireways) generally provide adequate protection from nearby capacitively coupled noise sources typically found in commercial buildings.

Open or nonmetal pathways (e.g., open tray or plastic wireway) shall be placed with sufficient separation from sources to eliminate any potential coupling problems. The minimum separation distances between open or nonmetal pathways and power wiring are:

- a. 125 mm (5 in) from a power line of 2 kilovoltampere (kVA) or less
- b. 305 mm (12 in) from fluorescent lighting and power lines between 2 kVA and 5 kVA
- c. 915 mm (36 in) from power lines more than 5 kVA
- d. 1.015 m (40 in) from transformers and motors

- e. 1.828 m (72 in) from lightning rods and wires

3.3.2 Horizontal Topology Arrangement. – The horizontal wiring shall be configured in a star topology, as illustrated in figure A-9. Each work area telecommunications outlet shall be connected to a telecommunications closet.

Horizontal wiring may contain no more than one transition point between different forms of the same cable type per TIA/EIA-568-A.

3.3.3 Media Requirements. – This standard recognizes the importance of data, video, and voice distribution in a commercial building. Unless otherwise specified, in an office environment, a minimum of two services shall be provided for each CFP; i.e., data and voice. The need for video (BCDS) at selected CFP's shall be confirmed with NASA.

As a minimum, each CFP in a workstation or office shall be provided with the following connectivity:

Voice (Telephone)	100 ohm, 4-pair, unshielded twisted pair, Cat. 5e copper cable. (See 3.6.3 for the required connector type.)
Data (LAN)	Copper cables shall serve the data requirements at each CFP. The Chief Information Officer (CIO) shall determine if fiber optic cables shall be required to the CFP.
	Cat. 5e – 100 ohm, 4-pair, unshielded twisted pair, Cat. 5e copper cable. (See 3.6.3 for the required connector type.)
	Fiber Optic – 50/125 micrometer, multimode dual strand fiber optic cable. (See 3.6.3 for the required connector type.)

All cabling shall be terminated at the workstation end and the telecommunications room end, properly labeled, and fully tested.

3.3.4 Horizontal Cable Distances. – Figure A-11 shows the lengths of all elements of the horizontal wiring subsystem. The maximum overall length of a horizontal wiring subsystem for twisted pair Ethernet (10BaseT) established by the IEEE 802.3 specification is 100 m (328 ft).

Given the established IEEE 802.3 criteria, the maximum horizontal cable length in this standard shall be 90 m (295 ft). This distance is measured from the communications outlet to the termination in the communications closet/equipment room. This includes the sum of the lengths for segments A and B wiring, the wiring required to connect the remote distributor, and the length of cable that extends the segment A wiring to the termination of the media in the communications

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closet/equipment room. Note that distances represent actual cable length, not physical distance between the wiring closet and the workstation's outlet.

If any single horizontal wiring run is greater than the 90-m (295-ft) limitation, there are products available that will allow one to exceed that distance; however, if one finds that a large number of workstations will be located beyond the 90-m (295-ft) limit, it may be wise to plan for more than one wiring closet. One can then connect the two wiring closets together with either a copper or fiber backbone cable.

The entire channel length shall not exceed 97 m (318.2 ft). The channel is composed of the 90-m (295-ft) length described above, along with 7 m (22.9 ft) for patch cables and cross connect jumpers in the closet. An additional 3 m (9.8 ft) is budgeted for equipment cables in the work area.

**3.3.5 Design Considerations.** – The following list describes general items a designer should consider in the design of a PDS. This list is not complete and items will be added as required:

- a. Conform to latest NEC for cable fire resistance ratings.
- b. Design for stacked communications closet/equipment rooms. Locate communications closets/equipment rooms at building core locations, if possible.
- c. Use circular conduit sleeves for wall penetrations.

**3.3.6 NEC Applications.** – The following list describes some applications and their relationship to the NEC ratings. Ratings may apply to all types of cables including copper UTP, copper shielded twisted pair (STP), fiber optic, and coaxial cables.

- a. The NEC ratings and cable structures previously referenced would require changes based on the designer's application. As an example, the Communications Riser (CMR) Cable referenced in 3.6 would require an upgraded rating to Communications Plenum Cable (CMP), if it were to be used in "above the ceiling" air plenum spaces. References to the PVC compound suitable for the riser (CMR) cable would require an upgrade to Teflon, or an equivalent compound, for a CMP rating.
- b. All cables are required to comply with an applicable part of the NEC as detailed in Articles 725, 760, 770, 800 or 820.
- c. Frequently used ratings include plenum CMP, vertical shaft CMR, and general purpose Communications Cable (CM).

- d. The CMP plenum rating is superior to the other cables and is used when it is necessary to route cables through air passages.
- e. The CMR riser-rated cable would be used in vertical shafts and is rated against fire spread.
- f. All general-purpose cables are rated as CM and are now required to be flame resistant.
- g. A CMP cable, having a superior rating, may be used in place of a CMR or CM cable. The CMR cable may be used in place of one rated CM.
- h. The latest NEC specification shall apply and supersede any references in this document.

### 3.4 Work Area.

3.4.1 Hardware/Installation Considerations. – The work area components extend from the telecommunication outlet of the horizontal wiring system to the station equipment in the work area.

The following types of work areas shall be supported: landscape furniture offices, fixed office spaces, off-line test labs, and temporary locations in the high-bay and low-bay test locations. A standard configured communications outlet was chosen and will be used in all locations where all services are made available. Refer to figure A-12 for a description of the device. Because of the diverse work areas, several mounting options may be required. Refer to figure A-12 for a wall outlet for Cat. 5e. It has 3 outlets: two RJ-45 and one for BCDS. Refer to figures A-13 and A-14 for a description of some of the possible options. Other options will be added to this standard as required.

Prior approval from NASA will be required for the type of communications outlet and mounting options to be used on a project.

3.4.2 Customer Faceplate. – The CFP outlet box will be located in specified user areas to house connectors required to interface the work location subsystem wiring to the user communications and data hardware devices. A 120-volt ac receptacle shall be provided within 914-mm (3-ft) of each CFP.

The CFP shall be capable of being mounted to fixed walls, demountable walls, and open system furniture environments and be available as an off-the-shelf item. The communications wallplate shall meet, at a minimum, the following requirements:

- a. Accommodate up to four individual connector panels for existing buildings.

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- b. Accommodate both fiber and copper cables and connectors.
- c. Allow connectors to be added, as needed (up to four).
- d. Ability to change connectors without disrupting other services (front loaded).
- e. Side entry for the connectors [This is the preferred method for minimizing connector damage; however, angled (45 degrees down) entry may be used as well. The designer may also propose other methods to NASA.]
- f. Area for a service loop to store excess cable lengths, specifically fiber optic cable (1 meter of 2 fiber cable).
- g. Plastic construction.
- h. Physical dimensions: no greater than 165.1 mm (6.5 in) wide by 139.7 mm (5.5 in) high by 44.4 mm (1.75 in) deep, not including connectors.

3.4.2.1 CFP Configurations. – The following CFP configurations (see figures A-15, A-16, and A-17) shall be used in most situations; however, additional configurations may be required for unique situations.

- a. Type A provides one Cat. 5e telephone connector, one Cat. 5e copper LAN connector, and one fiber optic LAN connector (if required).
- b. Type B provides one Cat. 5e telephone connector, two Cat. 5e copper LAN connectors, and one fiber optic LAN connector.
- c. Type C provides one BCDS connector only.
- d. Type D provides one telephone connector only (capable of carrying both digital and analog signals).
- e. Type E provides four Cat. 5e copper LAN connections.
- f. Type F provides one COAX connector and one Cat. 5e copper LAN connector.
- g. Director and manager work areas shall be equipped with one Type A CFP at each desk and one Type C CFP across the room from the desk.
- h. Conference rooms shall be equipped with Type B CFP's at appropriate intervals around the interior walls and at planned conference table, projector, and podium locations. Type C CFP's shall be placed at appropriate locations within the room

for wall-mounted, column-mounted, or hanging television receivers. Type D CFP's shall be installed for wall-mounted telephones as required.

- i. For open office areas, Type C CFP's shall be placed at appropriate locations within the room for wall-mounted, column-mounted, or hanging television receivers. Locations shall be chosen that ensure receiver visibility for all personnel within the bullpen area.
- j. Classrooms and laboratories shall be equipped with Type B CFP's at approximately 1.2-m (4-ft) intervals around the interior walls and at planned conference table, projector, and podium locations. Type C CFP's shall be placed at appropriate locations within the room for wall-mounted, column-mounted, or hanging television receivers. Locations shall be chosen that ensure receiver visibility for all personnel within the classroom or laboratory area. Type D CFP's shall be installed for wall-mounted room telephones as required.
- k. Type C CFP's shall be placed at appropriate locations within lobbies for wall-mounted, column-mounted, or hanging television receivers. Locations shall be chosen that ensure receiver visibility for all personnel within the lobby area. A minimum of 2 Type D CFP's shall be installed in a lobby area for general use telephones. Type B CFP's shall be installed every 3.7 m (12 linear feet) of lobby wall space for use by kiosks, demos, and trade fair booths.
- l. For Mission Conference Centers, the required number of Type B CFP's required by NASA shall be verified, along with locations of any Type C CFP's.
- m. Each standard workstation shall be equipped with a Type A CFP. Each high-use workstation (workstation requiring several printers and/or computers) shall be equipped with a Type B CFP.
- n. For mechanical and electrical rooms, one Type E CFP shall be provided. Mount in a location to minimize physical damage.
- o. For rooms with external doors, a Type E CFP shall be considered for the interior wall adjacent to the door striker for Card Reader, for remote control striker, for door open sensor, and for a spare.
- p. The Type F CFP shall be used for Timing and Countdown.

### 3.5 Communications Rooms.

3.5.1 Overview. – A communications room is defined as an area within a facility where telecommunications systems are housed, along with the electrical termination of one or more por-

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tions of the PDS. Equipment rooms are distinct from telecommunications closets because of the nature and complexity of the equipment they contain. Any or all of the functions of a telecommunications closet should be provided in a communications/equipment room. Every facility shall contain at least one communications room, and in many cases, multiple communications rooms will be required.

Unlike traditional commercial installations, most NASA communications room installations will house hardware other than that dedicated to administrative communications use. The following sections provide guidance for design of these facilities. A typical room layout is shown in figure A-18.

3.5.2 General Provisions. – The following general provisions could apply to some or all installations:

- a. Provisions shall be made for a main cable entry.
- b. A separate telephone equipment room or a separate partitioned section of a communication room may be provided for the telephone switching equipment. This room would contain the switch hardware, interfacing connections, and backup power. Pathways in the form of conduits or cable tray shall provide for connectivity between the telephone equipment room and the other communications room.
- c. Some facilities will require that communications rooms support operational functions as well as administrative communications. NASA shall provide direction in these cases.
- d. Floor space for backup power (batteries) may be required to support hardware. Specific requirements shall be confirmed with NASA.
- e. At a minimum, systems to be addressed in the design and layout of a communications room include:
  - (1) Telephone
  - (2) Data/LAN (multiple)
  - (3) Paging and Area Warning
  - (4) OIS-D
  - (5) BCDS
  - (6) KCCS
  - (7) Timing and Countdown
  - (8) OTV
  - (9) Fire alarm

3.5.3 Specific Provisions. – The following provisions should apply to the design of all communications rooms. Deviations must be approved by NASA.

3.5.3.1 Floor Space.

- a. Minimum clearance between front or rear of rack and walls with wall-mount capabilities: 1067 mm (42 in).
- b. Minimum clearance between racks: 914.4 mm (36 in).
- c. Avoid conflicts with wall-mounted items.
- d. Avoid door opening conflicts.
- e. Avoid support columns.
- f. NASA shall provide the quantity and type of rack (see figures A-19 and A-20) [the most common rack used is a 584 x 914 mm (23 x 36 in) Optima rack] to be installed in the communication's room.
- g. Provide for managed growth/expansion. A minimum of 50 percent expansion capability shall be allocated for installation of future racks and wall space.
- h. Place riser penetrations close to a wall. Secure riser cables and trays to wall and support weight on floor.
- i. Provisions shall be made to accommodate different rack-type footprints.
- j. Confirm required floor space for backup power (batteries/UPS) if required to support hardware in addition to the telephone switching hardware (e.g., T-1 carrier).

3.5.3.2 Wall Space.

- a. Where practical, make maximum use of wall space for wall-mounted terminal fields.
- b. Provide cable ladders for access from cable trays to wall boards.
- c. Line all walls behind terminal fields with 19 mm (0.75 in) thick by 2.43 m (8 ft) high plywood and painted with fire-resistant paint.
- d. Provide a minimum of 914.4 mm (3 ft) of unobstructed work space in front of wall-mounted terminal fields.

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- e. Communications rooms shall not have dropped ceilings. Walls should extend to the deck above to allow for environmental control of the space.

### 3.5.3.3 AC Power.

- a. Provide a 120/208V, 3-phase, 4-wire, 42 pole panelboard in the building main communications equipment room. Amperage rating of the panel will be dictated by the load. Details of the exact requirements for outlets served from the panels will be supplied by NASA. However, as a general rule, provide one 20-A, 120-V circuit for each equipment rack in the room.
- b. Mounting details, preferred locations, and other pertinent data shall be determined in the design reviews.

### 3.5.3.4 Air Conditioning/Heating.

- a. Conditioning shall be provided on a 24 hour/7 day a week basis. Design room cooling for approximately 4,000 British thermal unit (Btu) per hour per rack. Temperature must be maintained from +15 degrees Celsius [60 degrees Fahrenheit (°F)] °C (60 °F) to +27 °C (80 °F), with extremes of +10 °C (52 °F) to +40 °C (105 °F) allowed for a maximum of 1 hour. Humidity should be maintained at a nominal 55 percent, with a range of 45 to 70 percent within the defined temperature range. Heat load shall be calculated during the design process based on equipment to be installed, to size the heating, ventilating, and air conditioning (HVAC) equipment to maintain the above-stated environmental conditions.
- b. If battery backup power is required, provisions shall be included for ventilation of corrosive fumes and separation from electronic equipment.

### 3.5.3.5 Bonding/Grounding.

- a. Provide a 102 x 305 x 6 mm (4 x 12 x 1/4 in) copper ground bus on stand-off insulators in each communications closet/equipment room. Bond to building main electrical ground with No. 4 AWG copper conductor.
- b. Bond all metallic frames, racks, cabinets, cable trays, etc., to ground bus in room with No. 6 AWG copper conductor. (Adjacent racks may be bonded together.)
- c. Green equipment grounding conductors of all power distribution shall be grounded in accordance with the NEC.
- d. Refer to KSC-STD-E-0012 and NFPA 70 for other grounding requirements.

#### 3.5.3.6 Secondary Cable Trays (In Communication Room).

- a. Ladder-type cable trays shall be used in the design.
- b. Describe the tray interface to the facility primary cable trays.
- c. Provide cable tray sizing to accommodate all cables plus 50 percent growth.
- d. Locate tray a maximum of 610 mm (24 in) above the top of the equipment cabinets.

#### 3.5.3.7 Lighting.

- a. Must have a uniform light intensity of 807 lux (lx) [75 foot candle (fc)] or greater, when measured at floor level. Provide emergency standby lighting to allow safe egress from the room in the event of a power outage.
- b. Do not place light fixtures directly over equipment cabinets, termination frames, or other freestanding equipment.
- c. Complete lighting layout will be determined in the design reviews.

#### 3.5.3.8 Fire Protection.

- a. In buildings that are fully sprinkled for fire protection, provide protection in the communications closet/equipment room. Coordinate number and locations of heads during the design process.
- b. Provide fire detection per the NFPA codes and KSC-STD-E-0004 in communications rooms in buildings not protected by fire sprinklers.
- c. Provide fire stopping materials for wall and slab penetrations.

#### 3.5.3.9 Floor Loading.

- a. Distributed load rating of the floor shall be 4.8 kilopascal (kPa) [100 pound-force per square foot (lbf/ft<sup>2</sup>)].
- b. Concentrated load rating of the floor shall be 8.8 kilonewton (kN) (2,000 lbf).

3.6 Connecting Hardware Specifications. – The backbone and horizontal wiring termination hardware is used to provide a means of terminating and cross connecting wiring systems. It is also used to provide a means of connecting a facility wiring system to equipment and to tele-

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communications networks. The following paragraphs describe the technical characteristics of some of the hardware used in NASA installations. Equivalent hardware shall be used in all designs, and prior NASA approval shall be required for any deviations.

3.6.1 Cross Connect Hardware. – The transition from the backbone (riser) subsystem to the horizontal wiring subsystem for the telephone and Cat. 5e systems will be made in the communications closets/equipment rooms, using cross connect hardware. Paragraphs 3.7.2, 3.8.2, and 3.8.2.1 describe the requirements for the cross connect hardware. A cross connect is the physical and orderly connection between patch panels or punchdown blocks in the distribution frame that facilitates connection from the workstation to the host or network. See figure A-21 for a typical cross connect system.

3.6.2 Remote Distribution Panels. – Remote distribution panels are one of the options available to connect segment A to segment B wiring. For this option, panels as described in 3.8.2.3 should be employed.

3.6.3 Connectors. – Connectors are required for the user communications outlets, remote distribution panels, the high-speed data distribution racks, and patch panels located in the communications closets/equipment rooms. The connectors are the devices that provide the essential connecting points between cables and equipment.

3.6.3.1 Communications Outlet Connectors. – The CFP currently utilized is typically equipped with the following connectors required to provide the services described in 3.4.

- a. Telephone Connector: 4 pair, RJ-45 Cat. 5e rated (minimum), using TIA/EIA-T568B wiring
- b. BCDS Connector: Self-terminating type "F" connector
- c. Cat. 5e Data Connector: 8 pin modular jack, Cat. 5e rated using TIA/EIA-T568B wiring
- d. Fiber Optic: Small form factor duplex type MT-RJ

3.6.3.2 Remote Distribution Connectors. – Several pin/pair assignments for RJ-45 connectors are currently used today. Most designs use the AT&T Premises Distribution System 568A or 568B Standard, rather than the Universal System Ordering Code (USOC). Within the 568 standard, there is an optional pin/pair assignment that complies with the Integrated Services Digital Network (ISDN) Standard. The Optional 568B Standard must be used in all terminations of 4 pair copper UTP cable, unless otherwise directed by NASA. Figure A-22 provides details of this connector.

The following provides the physical characteristic of the ceiling distributors connectors:

- a. Telephone Connector: RJ-45 CAT 5e rated nonkeyed using 4 pair TIA/EIA-T568B wiring
- b. BCDS Connector: Self-terminating type "F" connector
- c. Cat. 5e Connector: RJ-45, Cat. 5e rated modular jack, 8 positions, 4-pair using EIA/TIA T568B wiring
- d. Fiber Optic: Small form factor duplex type MT-RJ.

See figures A-22 through A-30.

### 3.7 Voice.

3.7.1 Telephone Distribution Concept. – Figure A-3 shows a typical telephone distribution concept. A typical system is made up of backbone (segment C) and horizontal (segments A and B) wiring, vertical frame sections with punchdown wiring blocks, remote distribution panels, and user communication outlets. In addition to segment A and C wiring, vertical frames are used to connect other items such as a private branch exchange (PBX) and racks housing operational hardware. Punchdown blocks are used for terminating both backbone and horizontal cables, each having its own set of vertical blocks. Horizontal cabling is routed through remote distribution panels (when used), located in the facility walls, ceilings, and then to the communications outlet.

The telephone interfaces to external facilities by two means: analog and digital. A given number of twisted pairs for analog use, specified by NASA, shall be routed to the main distribution frame (MDF).

3.7.2 Telephone Cross Connect Hardware. – The telephone cross connect hardware is installed using a telephone intermediate distribution frame located in communications closets/equipment rooms and shall contain wiring blocks, connecting blocks and designation strips. It shall include the following unless specified by NASA :

- a. Each vertical section shall terminate up to 900 pairs. (MDF should accommodate up to minimum 4 verticals for a major facility.)
- b. Each vertical section shall support up to multiple blocks, at 100 pairs each.
- c. Each block of 100 pairs shall have 4 horizontal rows of 25 pairs.
- d. Cables shall be terminated in horizontal strips of 6 each, 4 pair cables.

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- e. The 4-pair quick connect blocks pluggable into the horizontal strip shall be recommended.
- f. Terminations shall be made using insulation displacement and gastight connections between the cable conductor and cross connect wire.
- g. Mounting assembly shall be supplemented with vertical cable ducts between each group of 2700 pair (3 verticals) to accommodate cable routing. Cable management hardware shall be provided in all cable ducts/pathways.
- h. System shall have a horizontal duct at the bottom of each vertical.
- i. Horizontal cross connect troughs shall be supplied and mounted adjacent to each block.
- j. Grounding kit shall be supplied.
- k. A compatible vertical cable tray (wire minder) shall be available for use between each vertical section. Designation strips shall be used to identify cable pairs. Wire wrap technology and the use of 66 blocks are not acceptable.

Refer to figure A-21 for a graphical description of a typical cross connection system.

3.7.3 Telephone Remote Distribution Panel. – EIA-310-D standards and the 24-port distribution panel shall meet the following requirements:

- a. 24 Ports: 24 Across
- b. Panel Dimensions:
  - Height: 88.7 mm (3.5 in) (2 rack units)
  - Width: (482.6 mm) (19 in)
- c. Connector Interface: Compatible with RJ-45, or equal, connectors

3.7.4 Backbone (Riser) Cable Types. – Because of the wide range of services and installations in which the backbone wiring will be used, more than one transmission medium will be recognized. This document specifies the use of media that can be used individually or in any combination in the backbone wiring. The medium is a 100-ohm multiple overall shielded twisted pair.

3.7.4.1 Cable Ratio. – Backbone (riser)/horizontal cable ratio costs and operational requirements dictate that there is not a one-to-one ratio of backbone and horizontal cabling. Vertical to horizontal ratios shall be defined early in the design and configured to support the types of opera-

tions referenced in the NASA requirements. The ratios that the designer should use for telephone wiring, unless otherwise directed by NASA, are described as a ratio of two backbone (riser) pairs for each four horizontal pairs.

3.7.5 Horizontal Cable Types. – The cable recognized for use in the horizontal wiring subsystem is a 100-ohm UTP Cat. 5e rated cable.

### 3.8 Data.

3.8.1 Fiber Optic Distribution Concept. – Figure A-5 shows a conceptual design for a fiber optic communications system. This system is primarily a backbone system used for data rates of 100 MBs and higher and will be required to support higher bandwidth solutions such as Gigabyte Ethernet with data transfer rates of 1 GBPS, and bandwidths up to 250 MHz. See figures A-27 through A-33.

3.8.1.1 Fiber Optic Connector. – The multimode fiber optic backbone subsystem shall use industry standard tip (ST) connectors. See figures A-29 and A-30. The Fiber Distributed Data Interface (FDDI) standard dual fiber connector is not part of the backbone configuration.

3.8.1.2 Patch Rack. – The fiber optic patch rack that encloses the optic patching bulkhead panels shall accommodate standard 482.6-mm (19-in) wide panels. The rack shall be 762-mm (30-in) deep, no more than 685.8-mm (27-in) wide, and have a rear door enclosure and front door see-through door closure. Overall panel height shall be more than 2 m (78.75-in) high and shall comply with EIA 310-D.

3.8.1.3 Patch Panel. – The patch panel, like the cable, requires prior NASA approval. Optical patch panels shall comply with EIA 310-D.

3.8.1.4 Wall Distributor. – The fiber optic wall distributors are a part of the fiber optic distribution system and shall be located in each communications/equipment room.

3.8.1.5 Backbone (Riser) Fiber Optic Cable Type. – The riser cable shall be plenum-rated multi-fiber cables sized to provide 12 or more 50/125 micrometer ( $\mu\text{m}$ ) multimode fibers per cable to the communications room for each 300 users supported. The cable shall comply with ANSI/TIA/EIA-472COOO-A-1993.

For each 12-fiber multimode riser cable, a 6-count single-mode fiber cable shall be installed for future use. Hybrid cable incorporating both multimode and single mode within the same sheathing is acceptable.

3.8.1.6 Horizontal Fiber Optic Cable Type. – The horizontal cables consist of a minimum of two optical fibers enclosed by a protective sheath. The fibers shall be 50/125  $\mu\text{m}$  multimode fi-

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bers and comply with ANSI/TIA/EIA-472COOO-A-1993. Use plenum-rated cable where installed in return-air spaces.

Patch cords shall be of the same manufacture as the horizontal link cable. Patch cords shall not be fabricated in the field but shall be connectorized by the manufacturer, with the same type connector/termination as used on the horizontal distribution system. Patch cords shall be certified for the required performance level of the structured cable system.

#### NOTE

NASA must approve the contractors choice of fiber optic cable even if it meets the stated criteria.

Single mode fiber shall have a maximum attenuation of 0.5 decibel (dB) kilometer (km) at 1300 nanometers (nm).

3.8.2 Cat. 5e UTP Distribution Concept. – This PDS is defined for use up to and beyond 100 MHz. It is intended for emerging applications with transmission rates up to and possibly beyond 100 MHz, e.g., 100BaseT.

The cable medium recognized for horizontal cabling is 4-pair 100-ohm UTP cable (No. 24 AWG solid conductors) Cat. 5e rated, and certified for transmission of signals up to and beyond 100 MBPS.

TIA/EIA-568-A provides specifications for patch cords (see figure A-34) with modular connectors at both ends and specifies that the stranded-type cable be used to fabricate Cat. 5e patch cords. Connecting hardware shall be constructed using Cat. 5e compliant components with RJ-45 jacks mounted on the front and AT&T 110 or equivalent type contacts mounted on the rear.

3.8.2.1 Cross Connecting Hardware. – Components (data-blocks, plugs, jacks, ports, etc.) for Cat. 5e per requirements of ANSI/TIA/EIA-568-A are readily available COTS items. Cross connects shall be made using Cat. 5e rated cable pairs. The cross connect system frames and mounting hardware otherwise shall meet the Cat. 5e rating.

3.8.2.2 Data Distribution Patch Panel. – Patch panels shall employ 24, 48, or 96 modular jacks. Terminations on the rear shall be 110-type punch-down, and on the front shall be RJ-45 jacks. The modular jacks for high-speed networking applications are designed to snap into any modular faceplate, patch panel, or surface-mount box. This mounting and removal system allows for easy installation and modification. Access shall be from the front of the faceplate or patch panel, known as “front-loaded.” All connectors, jacks, and patch cords shall be rated Cat. 5e.

3.8.2.3 Remote Data Distribution or Patch Panel. – In new installations, home run wiring shall run from the desk to the data IDF without the use of ceiling distributor panels. Remote wall or

ceiling distribution panels are one of the options available to connect Segment A to Segment B wiring. Such panels, if used, shall have 48 ports (minimum) and consist of 110-type blocks on the rear and RJ-45 jacks wired according to TIA/EIAT568B on the front. All connectors, jacks, and patch cords shall be Cat. 5e rated. The panel shall follow EIA-310-D standards.

The preferred remote distribution to be employed shall consist of an aluminum enclosure designed to mount into a grid drop ceiling. Access to the terminations shall be via a drop-down latching door that is flush in the ceiling plane and is integrated into the ceiling with the application of ceiling tile onto the surface of the door.

The enclosure shall house an equipment rack that supports mounting of standard 48 port patch panels and 110 blocks, along with 483-mm (19-in) wide rack-mounted switching hardware (hubs, routers, concentrators, etc.). The entire enclosure, including cable entry provisions, shall be rated for use in a plenum rated environment.

Remote distributors shall be employed in large open office areas with a high-density population that cannot accommodate the establishment of a communications closet. Remote distributors shall be centrally located within the area of the maximum number of workstations its population capacity will allow it to serve, with 20 percent spare capacity for future growth. Distributors shall be located in ceilings of corridors or aisle ways, to maximize accessibility. They shall not be located within offices or cubicles.

**3.8.2.4 Backbone (Riser) Cable Types.** – The backbone wiring shall use 100-ohm UTP cable. Backbone (riser) to horizontal ratios shall be defined early in the design and configured to support the types of operations referenced in the Request for Proposal (RFP) or NASA requirements. The ratio that the designer should use, unless otherwise directed by NASA, is 2 pair in the riser cabling for each 4 pair in the horizontal cabling.

**3.8.2.5 Horizontal Cat. 5e Cable.** – Cable shall be 100 ohm, 4-pair, UTP, and shall be certified for Cat. 5e performance. Cable manufacturer must be ISO 9002 certified.

**3.8.2.6 Cable Installation.** – The reliability and performance of UTP cable is critically dependent on maintenance of the physical integrity of the cable. The attenuation and NEXT characteristics of the cable are inversely affected by twisting, stretching, or sharp bending of multipair cables. The installer shall closely adhere to the manufacturers installation criteria for the respective system. System installation and commissioning shall not be considered complete, prior to the final acceptance of test criteria by the manufacturers representative providing the system certification.

### 3.9 Video.

**3.9.1 BCDS Distribution Concept.** – BCDS is based on CATV design principles. The CATV system, commonly referred to as cable television, is a network of cables, headend, electronic, and

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passive components that process and amplify television (TV) signals for distribution from the headend equipment to the individual television outlets.

The Premises Distribution Designer shall provide a detailed design for BCDS. The system shall interface and shall be compatible with the KSC BCDS currently in use at the Kennedy Space Center. The NASA Support Contractor typically makes the final interfacing connection to the outside cable plant in the Vehicle Assembly Building Repeater (VABR). However, this should be confirmed in the design. A 120-volt AC receptacle shall also be provided within 914-mm (3-ft) of each BCDS outlet. Figure A-4 shows a BCDS conceptual design that could support approximately 2,000 personnel in a three-story facility. This type of system is vastly different from the others previously discussed.

To ensure a proper design and implementation of a BCDS, the following information shall be provided to NASA by the PDS designer, prior to the 30 percent design review:

- a. Scaled drawings showing the floor plan of each facility floor, including any fire-walls.
- b. Scaled drawings showing the cable tray routing for each floor within a facility.
- c. Scaled drawings showing the locations of the premises wiring communications outlet locations.
- d. Requirements for plenum-rated user drop cable in all areas of the facility.

Major system components to be addressed in the design include the following:

- a. Bi-directional broadband amplifiers with active fail-safe backup
- b. Status monitoring transponders
- c. Standby power supplies
- d. Eight-port broadband taps
- e. Main line passives (i.e., splitters directional couplers)
- f. RG-6 drop cable
- g. Distribution cable
- h. In-type connectors

- i. Housing-to-housing connectors
- j. Self-terminating F-type terminators
- k. Miscellaneous mounting hardware
- l. Underground cable, Times Fiber T10 or equal.

3.9.2 BCDS Cable. – There are two types of BCDS cables normally used in a facility - branch cables and user drop cables. Branch cables perform a similar function to backbone cables used to interconnect communications closets/equipment rooms through the use of amplifiers located in these rooms. Drop cables are used to connect the user locations to the taps located in the ceiling close to user locations.

3.9.2.1 BCDS User Drop Cables. – Three types of drop cables shall be considered when designing a BCDS system. The type of cable selected will be subject to NASA approval:

- a. This cable shall be used for shorter runs where landscape furniture is used and where plenum rated cable is not required.
  - (1) Center Conductor: Solid copper covered steel, No. 20 AWG
  - (2) Dielectric: Cellular polyethylene
  - (3) Shield: Duobond II plus 67 percent aluminum braid
  - (4) Jacket: PVC
  - (5) NEC Rating: CATV
- b. This cable shall be used when landscape furniture and plenum-rated cable are not required.
  - (1) Center Conductor: Solid copper covered steel, No. 18 AWG
  - (2) Dielectric: Cellular polyethylene
  - (3) Shield: Duobond II plus 61 percent aluminum braid
  - (4) Jacket: PVC
  - (5) NEC Rating: CATV CL2

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- c. This cable shall be used when plenum-rated cable and landscape furniture are required.
  - (1) Center Conductor: Solid copper covered steel, No. 18 AWG
  - (2) Dielectric: Foamed Teflon
  - (3) Shield: Duofoil plus 95 percent tinned copper braid
  - (4) Jacket: Natural Flamarrest
  - (5) NEC Rating: CATVP CMP

### 3.10 Paging and Area Warning System (PAWS).

- a. Power Amplifiers / Mixers / Audio Processing Equipment.

Power amplifiers shall be housed in a mainframe. The mainframe must be capable of 8 power amplifier cards, each with a 70V, 200-watt output with an efficiency of at least 80 percent. The mainframe shall fit into a standard 19-inch rack with a maximum height of seven (7) inches. The Innovative Electronic Designs (IED) 6000 series equipment or equal is recommended. If the IED 6000 is utilized, it is recommended that audio processing be accomplished with the IED 5000 equipment. The 5251CS card is recommended for microphone amplifier applications and the 5201CS card is recommended for line-level inputs. The 5401 can be used as a line-level mixer and the 5104 can be used as a line-level distribution amplifier.

- b. Back-up power will be required if the facility is classified as critical. Back-up power may be two separate ac power sources with an automatic transfer switch (ATS) or an UPS unit on one of the nets and must be capable of supporting the system at full load for a period of not less than 10 minutes.

3.10.1 PAWS Distribution Concept. – The Paging and Area Warning System distributes audio signals throughout given facilities for area warning, emergency operational and administrative paging, and alert capability. The Premises Distribution Designer shall provide detailed design for a complete Paging and Area Warning System, including cable terminations, amplifiers, and audio processing equipment. A Paging and Area Warning System shall be provided for all new facilities. A redundant paging system will be determined by the NASA Communications Office (TA-B2) with the input of the facility manager (if applicable) and the NASA Safety Office based on the criticality of the facilities within the quantity distance of hazardous systems. Speaker locations and areas to be provided with attenuators shall also be confirmed with NASA Communications Office (TA-B2).

The following components are provided for the Paging and Area Warning System:

- a. Power amplifier mainframe with compatibility of 8 power amplifier cards.
- b. Audio processing mainframe with the capability of 12 audio processing cards. Adjacent cards can be interfaced with input/output option jumpers.
- c. Attenuators: 35 watt and 75 watt
- d. Microphone: Dynamic type with push-to-talk thumb switch
- e. Ceiling and Wall-Mounted Speakers: Baffle – speaker – transformer assembly with wire volume control and enclosure
- f. Equipment Area and Exterior Wall-Mounted Horns: Weatherproof fiberglass construction with an adjustable U-bracket for mounting
- g. Equipment Cabinet: Constructed of 14-gauge CRS with 11-gauge CRS corner caster gussets, and two pairs of 14-gauge CRS adjustable mounting rails, zinc plated and punched on EIA spacing. Cabinets shall be suitable for 483-mm (19 in) wide rack-mounted equipment. Plexiglass front and steel rear door shall be provided with locking capability.
- h. Rotating beacons

KSC system interface signals shall be processed through a control tray assembly provided by the NASA Support Contractor. Tray assembly shall be rack mounted in the equipment cabinet and provide a minus 10 decibel unit (dBU) input to the local power amplifier in the facility (if required).

3.10.2 Interbuilding Distribution. – Paging and Area Warning System signals are distributed between buildings on communication pairs within the multipair copper telephone cable comprised in the outside cable plant. Upon entry to the facility, dedicated PAWS pairs are separated through the cross connect and into the input to the local PAWS at the control tray assembly located in the equipment cabinet.

### 3.11 Operational Intercommunication System – Digital (OIS-D).

3.11.1 OIS-D Distribution Concept. – The OIS-D distribution system varies from other systems described herein, in that the Premises Distribution Designer typically provides for the design of an empty raceway system only. Conductors, terminations, equipment, and hardware are provided and installed by the NASA Support Contractor. However, on occasion, it may be necessary to include cable installation and termination as part of the construction contract.

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Building entry for the OIS-D system is typically located in the facilities communications equipment room. For a separate OIS-D service to a building, a 102-mm (4-in) conduit shall be provided from the outside cable plant connection point (manhole) into the building communications equipment room. Where interbuilding OIS-D signals are carried on dedicated comm pairs in the outside plant multipair copper cable, the dedicated pairs shall be separated from the cable through the cross connect to the OIS-D terminal distributor to be located in the communication room.

The terminal distributor shall be a National Electrical Manufacturers Association (NEMA) Type 12 wall-mounted enclosure, with a fully hinged door and locking handle. A removable flame-retardant plywood back panel, painted with non-flammable paint, shall be provided in the cabinet for mounting terminal strips. Cabinet sizes will vary depending on the number and location of end users. A typical size box used is 914 x 914 x 203 mm (36 x 36 x 8 in). From the OIS-D terminal distributor in the communications room, 50-mm (2-in) conduits shall be routed to each OIS-D station location and OIS-D speaker monitor location that is inaccessible (i.e., in walls, under floors, and where no dropped ceilings are provided). Pull strings shall be provided in all empty conduits. Where a system of cable tray is routed through a facility for the distribution of communications cabling, the tray shall be utilized for the distribution of OIS-D cabling as well. The 50-mm (2-in.) empty conduits with pull lines shall be utilized to transition from terminal points and devices to the tray and one 100-mm (4 in.) conduit with pull strings shall be stubbed up from the OIS-D terminal distributor in the communications room to the cable tray. In finished locations, a two-gang plaster ring located at each identified End Instrument (EI) location shall be used. Over the opening, a two-gang blank trim plate that matches the wiring device trim plates in the space shall be provided.

Locations of OIS-D End Instruments and speaker monitors shall be obtained from NASA at the early stages of the design. The maximum distance from Group Processor Assemblies (GPA's) to the EI's is 762 meters (2500 feet) when phantom powered or 1830 meters (6000 feet) when remotely powered. When remotely powered, additional floor space and/or wall space will be required. Consequently, it is important for the Premises Distribution Designer to coordinate with the NASA Support Contractors regarding locations of terminal distributors and GPA's in relation to the EI's.

### 3.12 Timing and Countdown System.

3.12.1 Timing and Countdown Distribution Concept. – Timing and countdown system signals are originated by a central GPS timing system computer and are distributed throughout the station. Each signal shall be formatted and amplitude modulated on 1 KHz carrier in accordance with Interrange Instrumentation Group B (IRIG-B) 123 for timing and MILA format for countdown to output devices at selected locations within various buildings. Signals pass through a series of distribution amplifiers and drive timing output devices, which provide a synchronized base of reference for time throughout the station.

Interbuilding distribution is supported on comm pairs and multipair communication cables routed throughout KSC. At the building entrance facility, dedicated Timing and Countdown pairs will be separated from the cable at the cross connect and routed to a Timing and Countdown terminal distributor cabinet, also to be located in the main communications equipment room.

The Timing and Countdown terminal cabinet is traditionally a NEMA 12 rated, formed aluminum cabinet sized 914 x 914 x 203 mm (3 ft x 3 ft x 8 in), with a fully hinged door and removable flame-retardant plywood back panel. Terminal strips should be provided for transitioning from communication pairs to a coax cable for distribution within the building. The coax cable is a nominal 50-ohm impedance cable with a No. 20-AWG core conductor, foam fluorinated ethylene propylene (FEP) insulation, 95 percent tin copper braid shield, and black flexible plenum-rated jacket. Coax cable should be distributed on cable tray, with other communication cabling in the building or in dedicated 25-mm (1-in) conduit. Transition from cable tray down to timing output devices should also be in 25-mm (1-in) conduits. Timing and Countdown cable should maintain a minimum 300-mm (12-in) separation from all other audio and power system cabling. All raceways should be routed concealed above drop ceilings and within partitions in finished areas.

Locations of timing output devices shall be obtained from NASA at the early stages of the design. Outlet boxes for rough-in at the timing output device locations shall be a 119 x 54-mm (4-11/16-in square x 2-1/8-in deep), formed, hot-dipped galvanized steel electrical rough-in box. A single gang trim ring-mounted vertically should be provided on the outlet box and closed with a blank cover plate, matching other outlet device plates within the immediate area. A 120-volt ac receptacle shall be provided within 914-mm (3-feet) of each timing display. The Premises Distribution Designer's design shall require the Contractor to provide and install the terminal cabinet raceways and cable for the Timing and Countdown system. The provision and installation of all hardware, along with the termination of all cabling, is typically provided by the Government and its respective Support Contractor for this system.

**3.13 Administration Subsystem.** – There are two parts to the administration of a Premises Distribution System: the hardware portion including all the material on which the cross connects and the patch panels are connected and the documentation used to validate the design and to manage and maintain end-to-end connectivity after a system has been installed.

**3.13.1 Administration Hardware.** – Administration hardware provides for the interconnection of two or more elements of a distribution system. Some of these elements include backbone (riser) to the horizontal cabling system, horizontal cabling to the remote distribution panels, and panels to the user wall outlets.

Logical arrangement of the hardware in a communications room and other required facility areas is also an important part of hardware administration. A floor plan showing the hardware and its locations is required. Floor plans and other facility drawings shall contain the locations of all elements of the PDS.

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Patch panels, equipment racks, and punch down blocks shall be arranged to allow for natural wiring progression, minimize crossing of the wires, and allow for easy access to each component for the purpose of testing, facilitating moves, additions, and changes to the system.

3.13.1.1 Telephone Hardware. – Telephone administration hardware enables the end-to-end connectivity between communications closets/equipment rooms and user locations. All telephone wiring shall comply with the Cat. 5e standard and shall terminate on Cat. 5e rated hardware as shown in figures A-21 through A-24, A-26, A-33, and A-35 through A-38 per figure A-3.

Cross connections to other blocks are not part of the premises distribution contract. These cross connects will be done by the NASA Support Contractor. If multiple connections are a requirement, separate blocks shall be reserved for this purpose. NASA shall be consulted prior to designing multiple connections in a system.

3.13.1.2 Cat. 5e Hardware. – Cat. 5e hardware refers to the administration hardware in the communication room that supports the cabling dedicated to computer networking (LAN). It consists of patch panels, patch cords, and jumpers. The hardware is designed to support high-bit rate digital data transmission circuits over UTP cabling. The major components of a typical system are shown in figure A-6 and shall terminate in Cat. 5e rated hardware as shown in figures A-21 through A-24, A-33, through A-35 through A-37 per figure A-3.

3.13.1.3 Marking/Labeling. – All hardware components of a PDS shall be labeled as described in TIA/EIA-606. This information will be used to properly install the system and provide record keeping to ensure correct end-to-end connectivity. Connecting hardware may be color-coded for easy tracking of the origins and termination points of a group of wire pairs. The following color codes are preferred:

- a. Green: From central office.
- b. White: Between main or intermediate cross connect and telecommunications closets.
- c. Blue: From horizontal wiring.
- d. Gray: From main cross connect to intermediate cross connect.

3.13.1.3.1 Cable Labeling. – Cable labels shall be prepared for all segment A, B, and C cables in accordance with the instructions shown in figure A-39 through A-42. A list of the labels for segment A and B cables must be provided and contain the information in tabular form.

3.13.1.3.2 Distribution Panels. – All remote distribution panels for the telephone and Cat. 5e systems must be labeled.

3.13.1.3.3 Data Patch Panels. – Data patch panels for Cat. 5e systems will be located in the data racks in each of the communications rooms.

3.13.1.3.4 User Outlets. – All user outlets shall be labeled for services provided in the design. NASA will provide direction for the services that will be required at each user outlet in the design. Refer to figure A-12 for required labeling and marking information.

3.13.2 Administration Documentation. – The documentation portion of wiring administration consists of label and pin numbering, as well as the maintenance of records and documents. Initial administration documentation shall be provided by both the Premises Distribution Designer and the installation contractor. The following types of documentation must be provided when any of these systems are included in a facility design:

- a. Telephone Cable Schedules
- b. Cat. 5e Cable Schedule
- c. BCDS Cable Schedule
- d. Fiber Optic Cable Schedule
- e. Telephone Cable Labeling
- f. Data Cat. 5e Cable Labeling
- g. BCDS Cable Labeling
- h. Fiber Optic Cable Labeling
- j. User Number Assignments

Documentation creation for a large PDS is complex, takes considerable effort to develop, and must be updated once the documentation is put into use. Some examples from previous designs have been included in abbreviated form, and are included in the figures A-39 through A-51. Note the numbers in these examples are for specific facilities and will change for other designs.

3.13.2.1 Cable Schedules. – The cable schedules are an accounting of all premises distribution cables on an individual basis within a given facility. The schedules are related to a communications or data path. It is a trace of the cables and the connection points involved between the communications room and the user communications outlet.

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Cable schedules must be developed as a part of the point-to-point design process performed at the shop drawing development stage by the installing contractor and must be used to demonstrate a complete design and provide instructions for installation. This section provides examples of the telephone, and Data Cat. 5e, fiber, and BCDS cable schedules.

Cable schedule documentation will be prepared in a tabular form for all services provided for in the premises design and will normally include telephone, Data Cat. 5e, fiber, and BCDS. Typical examples of the cable schedules for these services are shown in figures A-45 through A-51. In most cases, the meaning of the data in the cable schedule heading blocks is self-explanatory. Some additional information, however, is provided below. Note some of the data is related to specific facilities (e.g., room numbers, etc.). Data that is prefaced by T or D indicates that information is related to telephone or Data Cat. 5e respectively.

The cable schedule for the BCDS is considerably different than that for the telephone and Cat 5e data services. In the cable schedule shown in figure A-51, the first, second, and third level headings represent the floors within the facility. Under the branch cables (BCDS) heading, the from/to column indicates amplifier number (TA), tap number (TP), equalizer number (EH), and splitter number (SP). The length column shows the cable length between the from/to hardware elements. The two-digit number that precedes the TA, TP, EH, and SP letter designation indicates the amplifier associated with the hardware. These numbers will be assigned by NASA when the BCDS design for a given facility is done. This information will also be provided to the Premises Design Contractor.

The following indicates how the BCDS numbering scheme functions: from 44TP1 to 44TP2, the amplifier TA44 feeds tap 44TP1, which in turn feeds tap 44TP2. Each of the taps has 8 output ports, of which only 7 are used for user locations. The 8th port is reserved for test purposes. Each of the tap ports will be assigned a room/communications outlet number as defined for all services and described in 3.13.2.1. Refer to figure A-4. This drawing shows the relationship of the hardware system components referred to in the above example.

**3.13.2.2 Cable Labeling.** – It is the intent that all cable labeling follow the recommendations of TIA/EIA 606, Chapter 6, Wiring Subsystem Administration. The cable labeling information data sheets represent an accounting of all premises distribution cable labels, on an individual cable basis, for all cables within a given facility. The information is related to a communications or data path (i.e., it is a trace of the labels of all cables within a given facility). This information is used as a companion to the cable schedules for a given service, in a given facility (i.e., for every line item in a cable schedule, there will be an associated line item in the cable labeling information data table). Cable labeling information data tables shall be developed as a part of the shop drawing submittal process and shall be used to demonstrate that all cable label information is correct and to provide instructions for the labeling process.

The cable labeling documentation shall be prepared in a tabular form for all services except for the BCDS. Typical examples of cable labeling documentation are shown in figures A-39 through A-42.

Unlike the telephone and Data Cat. 5e services, the BCDS uses semi-rigid trunk cables to connect trunk amplifiers together throughout a facility. These cables are never changed unless they are involved in a facility redesign. As a result, there is no labeling information table required for the trunk cables. The trunk cables, as well as associated BCDS hardware, shall be labeled.

**3.13.2.3 User Number Assignments.** - All communications outlets within a facility shall be provided with a unique identifier number for all users located on a given floor. The user identification number assignments will be arranged in groups of 24 users, up to the maximum number of users for each floor (base design plus 50 percent growth). An example of user assignment documentation is shown in figure A-43. The information in the figure shows the relationship of the users, in blocks of 24, to a specific remote distributor, and then to a specific communications/equipment room. A remote distributor with a 12 designation indicates that the distributor is configured for only 12 users and is capable of being upgraded to support 24 users.

The BCDS system uses a tap arrangement rather than remote distribution panels, which is typically used for the telephone, low-speed, high-speed, and Cat. 5e data services. For the BCDS system, tap ports are assigned/connected to user locations, and these interfaces will be assigned user numbers as shown in figure A-44. This shows the BCDS user number assignments documentation concept. Line items in the table relate to an amplifier, taps, and a specific communications outlet. The contractor shall be required to provide a database in tabular form that indicates the labels along each length of cable, showing the relationship of the label at the outlet end, with that at the amplifier.

**3.13.2.4 Distribution Location Marking.** - The construction contractor shall apply adhesive sticker markers to the false ceiling supports to indicate that distributors are located above the ceiling tiles.

Two distinguishable types of markers shall be used: one marker will indicate that telephone and Cat. 5e data are located above the marker, while the other type will indicate that BCDS taps are located above the marker.

### **3.14 Documentation.**

**3.14.1 Design Documentation.** - A design documentation package shall be provided for each premises distribution design. The package shall consist of, at a minimum, a set of drawings with specification information. Specification information must be included in addition to the design.

**3.14.1.1 Construction Documents.** - The PDS design for respective systems shall meet the operational requirements for the facility. At the onset of a project, NASA shall coordinate with the

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various user activities to verify the communication systems required for the project. It is important that this be established at the programming phase of the project so that budgeting can be allocated, and required systems can be included in the Statement of Work (SOW) describing the Premises Distribution Designer's scope of services.

A typical design process at KSC involves an initial predesign or kick-off meeting with NASA, the selected Premises Distribution Designer, NASA Support Contractor personnel, and user groups. At this meeting, NASA shall verify with contractor support personnel which individuals shall be included on the distribution list for review of progress documents throughout the design process. At this time, the Premises Distribution Designer shall query the users and support personnel for any ambiguities regarding different communication systems described in the Statement of Work. It is the objective at the conclusion of the predesign meeting that adequate information for the communication systems has been disseminated to develop the conceptual design that will be due at the next submittal.

Given the complexity of a project, the design process shall entail anywhere from two to three intermediate submittals, prior to reaching the 100 percent submittal (typically, 30%, 60%, 90%, or 45%, 90%). At the initial intermediate submittal, design documents shall include a building floor plan, with the locations of all telecommunications outlets shown in every space on every floor. The symbol legend shall clearly indicate the different services provided at each telecommunications outlet. In addition, spaces such as communications equipment rooms and communications closets shall be delineated, along with intended pathways for connectivity throughout the various systems. Specifications at the initial intermediate submittal shall include sections for the various systems included on the project.

It is imperative that NASA distributes the review documents to the activities responsible for the respective communications systems on the project. It is the responsibility of the NASA Support Contractor personnel and user groups to provide feedback in the form of review comments making any corrections or adjustments in the system layout thus far. Attendance at the review meeting by all parties on the distribution list is highly encouraged for this information exchange with the design team.

Subsequent intermediate submittals shall be iterations of the above. The designer shall coordinate with the architect and other disciplines on the design team, for the location and characteristics of spaces and routing of pathways. Careful attention shall be paid to fire-rated partitions within the structure. Adequate working clearance shall be provided around all equipment in communications equipment rooms and closets, as well as accessibility to cable tray runs above drop ceilings. In office areas, furniture plans shall be obtained from the architect to clearly indicate exact locations of telecommunication outlets. For modular furniture systems, connection points shall be planned and any communications/power poles required should be located.

By the 100 percent submittal, the PDS design should be complete. Documents as a minimum shall include the following:

- a. Symbol legend indicating types of communications system outlets and a brief description of each.
- b. Building floor plans indicating locations of all communications system outlets.
- c. An enlarged-scale floor plan of all spaces, including building entrance room, telephone equipment rooms, telecommunication equipment rooms, and communications closets. Plans shall indicate entrance ducts, backboards along perimeter walls, equipment rack layout, cable tray layout above, ground bus locations, terminal cabinet locations, and power panel locations. Lighting fixture layout, fire protection features, and general convenience power located within the room shall be indicated on the respective electrical documents.
- d. Riser diagrams for each communications system included in the design. Diagrams shall include originating spaces such as equipment rooms and communications closets, as well as each communications system outlet shown on the floor plans. Riser diagrams shall clearly indicate the schematic distribution of the system, including service entrance, backbone, and horizontal segments.
- e. Elevations for each typical equipment cabinet layout per system. Elevations shall indicate equipment spaces and patch panels for each typical cabinet.
- f. Elevations of each typical customer faceplate used at telecommunication system outlet locations. Faceplate elevations shall indicate number and types of ports for each typical CFP, indicating labeling information for each port.
- g. Rough-in detail for each type of typical communications system outlet rough-in.
- h. Miscellaneous details for equipment mounting, cable support mounting hardware, etc.
- i. Complete specifications for all components in the structured cabling system utilizing the KSC SPECSINTACT standard format.

3.14.1.2 **Submittals.** - Submittal data includes information that should be provided by the contractor for review and approval prior to the purchase of any components and their installation. In addition, submittal data also includes test reports, certifications, and statements following the system installation, indicating that work has been done in compliance with the intent of the contract documents.

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Items that should be submitted by the contractor for review and approval, prior to beginning work, shall include the following:

- a. Communications/equipment room layout plan indicating locations and exact sizes of all components to be installed within the room. The drawings shall be scaled indicating working clearance between all equipment/components installed within the room.
- b. Coordination plan of the installation with other trades.
- c. Front rack elevations of all equipment cabinets to be installed on the project.
- d. Floor plans indicating intended locations of all remote distributors.
- e. Wiring details of patch panels and punchdown fields, indicating intended sequencing of cable terminations.
- f. Wiring schematics of all typical terminations (e.g., T568-B wiring of 8 pin data terminal).
- g. Preliminary cable schedules (final schedules to be delivered at completion of work).

At the completion of the project following testing and commissioning of the system, the following items shall be submitted as record information for the closeout and final acceptance of the work:

- a. As-built drawings consisting of building floor plans, with the locations of all communications system outlets with identifier numbers corresponding to cable schedules on each outlet.
- b. Finalized cable schedules.
- c. Complete test reports indicating all required test data.
- d. Manufacturers system certifications and warranties.
- e. Manufacturers maintenance and operation data for all components required in the installation.

#### 4. QUALITY ASSURANCE PROVISIONS

##### 4.1 Testing.

4.1.1 Test Plans. - The contractor shall submit a test plan describing the test methodology used to ensure all items will be correctly installed and ready for use. The test plan shall include, at a minimum, a description of the type of test that will be run, the equipment that will be used to perform the tests, and a sample of the type of test documentation records that will be submitted to show the test results. The test plan shall be submitted to the NASA lead design engineer for approval prior to performing tests.

4.1.2 Acceptance Testing. - Testing will be required for all cables, including copper pairs, coax, fiber optic and Cat. 5e UTP cables. Sections 4.1.2.1 through 4.1.2.5 describe the minimum testing that will be required.

4.1.2.1 Copper Pair Testing (Telephone). - Testing shall be in accordance with the latest edition of the BICSI TDM Manual (Chapter 13), and ANSI/TIA/EIA-TSB67. Testing configuration shall encompass the entire channel, including cable, patch cord, and connectors. As a minimum, the following testing will be performed on the telephone, cable pairs:

- a. Continuity (open)
- b. Polarity (transposition and crossed)
- c. Near End Crosstalk (NEXT) Loss (Pair-to-Pair)
- d. Attenuation (Loss)
- e. Equal Level Far End Crosstalk (ELFEXT) Loss – (Pair-to-Pair)
- f. Length

4.1.2.2 BCDS Trunk Cable. - The following tests shall be performed on the 75-ohm BCDS trunk cables and equipment:

- a. Wavetek Model 1855 Sweep Generator
  - b. Wavetek Model 1865 Sweep Recovery Unit or equal
  - c. Wavetek Model C1 Oscilloscope Camera or equal
  - d. Miscellaneous test cables, connectors, and adapters
- (1) Trunk Cable Test. Connect a sweep generator to either end of the cable through appropriate adapters and test cable (the test cable must be as short as possible). Connect the sweep recovery unit to the other end of the trunk cable through the appropriate adapters and test cable (minimum length).

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Set the sweep generator to sweep from 5 to 400 MHz with an output level of plus +50 decibel referenced to 1 millivolt (dBmV). The sweep display should have a smooth slope free of ripples (no more than 1-dB peak-to-valley change within a 6-MHz bandwidth) or other distortions with the highest level at 5 MHz and the lowest level at 400 MHz. The lowest level must exceed +30 dBmV for proper system operation. The actual level is dependent on the length of the trunk cable.

If the cable run contains directional couplers and/or splitters, these devices shall be included in the sweep tests. All unused cable lengths connected to the directional couplers and/or splitters shall be terminated with a 75-ohm terminator when each segment is swept.

Set the sweep recovery unit markers to display the maximum and minimum levels on the sweep. Photograph the sweep presentation using the oscilloscope camera. Label the photograph with scale, date, and cable nomenclature.

- (2) BCDS Branch Cable Test – Forward. Connect a sweep generator to the amplifier end of the branch cable through the appropriate adapters and test cable (the test cable must be as short as possible). Connect the sweep recovery unit to the tap end of the cable at the output of the last tap (remove the 75-ohm end of the branch terminator and install the test cable) using a minimum length test cable. Set the sweep generator to sweep from 150 to 400 MHz with an output level of +50 dBmV. The sweep display should have a smooth slope free of ripples (no more than 1-dB peak-to-valley change within a 6-MHz bandwidth) or other distortions with the highest level at 150 MHz and the lowest level at 450 MHz. The lowest level must exceed +22 dBmV for proper system operation. The actual level is dependent on the branch length and the number of taps.

Set the sweep recovery unit markers to display the maximum and minimum levels of the sweep. Photograph the sweep presentation using the oscilloscope camera. Label the photograph with scale, date, and cable nomenclature.

- (3) BCDS Branch Cable Test - Reverse. Connect a sweep generator to the tap end of the cable through appropriate adapters and test cable (the test cable must be as short as possible). Connect the sweep recovery unit to the amplifier end of the branch cable through the same test cable used for the forward sweep. Set the sweep generator to sweep from 5 to 112 MHz with an output level of +50 dBmV. The sweep display should have a smooth slope free of ripples (no more than 1-dB peak-to-valley change within a 6-

MHz bandwidth) or other distortions with the highest level at 5 and the lowest level at 112 MHz. The lowest level must exceed +29.5 dBmV for proper system operation. The actual level is dependent on the branch length and the number of taps.

Set the sweep recovery unit markers to display the maximum and minimum levels of the sweep. Photograph the sweep presentation using the oscilloscope camera. Label the photograph with scale, date, and cable nomenclature.

#### NOTE

Equalizer modules, both high frequency and low frequency, must be installed in the equalizer housings prior to testing. Note that equalizers are only in the branch distribution cable system.

4.1.2.3 Fiber Optic Cable. - The following tests shall be performed on the multimode fiber optic cables:

- a. Attenuation no greater than 1.0 dB/Km at  $1300 \pm \text{nm}$  in accordance with EIA Standard RS-455 FOTP-46 or FOTP-53.
- b. Multimode bandwidth in accordance EIA Standard RS-455 FOTP-30 or FOTP-51.
- c. Numerical aperture in accordance with EIA Standard RS-455 FOTP-47.

The following tests shall be performed on the single mode fiber optic cables:

- a. Attenuation in accordance with EIA Standard RS-455 FOTP-78.
- b. Chromatic Dispersion in accordance with EIA Standard RS-455 FOTP-168 or 169 test method.

4.1.2.4 Cat. 5e UTP Cable. - In addition to the tests listed in 4.1.2.1, the following tests shall be performed for Cat. 5e cabling. A four-connector model and worst-case value of testing parameters shall be used.

- a. Return loss
- b. ELFEXT – Power Sum

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- c. Propagation Delay/Delay Skew
- d. Attenuation to Crosstalk Ratio (ACR)
- e. NEXT Loss – Power Sum

4.1.2.5 Paging and Area Warning System. - As the Paging and Area Warning System differs from other PDS Systems described within this standard, the following separate testing procedures specific to the Paging and Area Warning system only shall be performed. Testing shall address the following:

- a. Operational Test. - Perform an operational system test to verify conformance of the system to the project specifications. Perform tests that include originating program and page material at microphone outlets, all preamplifier program inputs, and all other inputs. Observe sound reproduction for proper volume levels and free them from noise.
- b. Acoustic Coverage Test. Feed pink noise into the system using octaves centered at 4,500 hertz. Use a sound level meter with octave band filters to measure the level at five locations in each zone. For spaces with seated audiences, the maximum permissible variation in level is +/- 2 dB, and the levels between locations in the same zone and between locations in adjacent zones must not vary more than +/- 1 dB.

## 4.2 Qualifications.

4.2.1 Designer Qualifications. - PDS system designers shall be certified by the BICSI as a Registered Communications Distribution Designer (RCDD).

4.2.2 Contractor Qualifications. - All work shall be performed by and all equipment shall be furnished and installed by a certified telecommunications contractor. The Contractor shall have the following qualifications in telecommunications systems installation:

- a. Supervisors and installers shall have completed the BICSI Cabling Installation Workshop and be BICSI certified installers, or equal.
- b. Supervisors shall have attained the minimum BICSI rating of "Technician," and installers shall have attained the minimum rating of "Installer."
- c. Documentation confirming said credentials shall be submitted as part of the submittal data for a project.

- d. General electrical trade staff (electricians) shall not be used for the installation of the Premises Distribution System cables and associated hardware, unless they have attained the aforementioned BICSI certifications.

4.2.3 Manufacturer Qualifications. - The materials, equipment, and hardware provided for a contract shall be from manufacturers that have a minimum of 5 years experience in producing the types of systems and equipment specified for the project.

#### 4.3 System Certification and Warranty.

4.3.1 System Warranty. - Performance-based structured cabling systems such as Cat. 5e rated systems and structured fiber optic cable solutions shall be provided with a manufacturer-backed warranty for both performance characteristics, as well as product reliability. Systems shall be based on a channel-type solution design that consists of an integrated assembly of components from a manufacturer or manufacturers that have partnered to warranty the system when assembled using their products. In no case shall any channel be provided that contains a component that is not approved for use in the channel by the other components' manufacturers.

The system warranty shall be based on a single point of contact. The entire warranty, including cable, connecting hardware, installation, and performance, shall be held by one manufacturer. Other manufacturers of components within the system shall be warranty program partners of the manufacturer holding the warranty.

Warranty shall be industry-standards-based, with requirements for designers and installers to be certified/accepted by the manufacturer holding the warranty.

Written documentation of the certification of system performance, along with a guarantee provided under the warranty, shall be provided by the Contractor at the closeout of the project. Said documentation shall be submitted as part of the submittal data described under the respective section of this standard.

4.3.2 Training. - The Contractor shall be required to provide, at system closeout, a minimum of 8 hours training for up to five Government personnel (contract support personnel or users). The Contracting Officer shall be responsible for coordinating the scheduling of the training and specifying which individuals shall attend. Manufacturer's product literature on all components used in the system shall be available for attendees during the training session.

## 5. PREPARATION FOR DELIVERY

None.

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## 6. NOTES

NOTICE. The Government drawings, specifications, and/or data are prepared for the official use by, or on the behalf of, the United States Government. The Government neither warrants these Government drawings, specifications, or other data, nor assumes any responsibility or obligations, for their use for purposes other than the Government project for which they were prepared and/or provided by the Government, or an activity directly related thereto. The fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded, by implication or otherwise, as licensing in any manner the holder or any other person or corporation, nor conveying the right or permission, to manufacture, use, or sell any patented invention that may relate thereto.

### Custodian:

NASA – John F. Kennedy Space Center  
Kennedy Space Center, Florida 32899

### Preparing Activity:

John F. Kennedy Space Center  
Facilities Electrical/Mechanical  
Division  
Spaceport Services Directorate

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APPENDIX A  
ILLUSTRATIONS

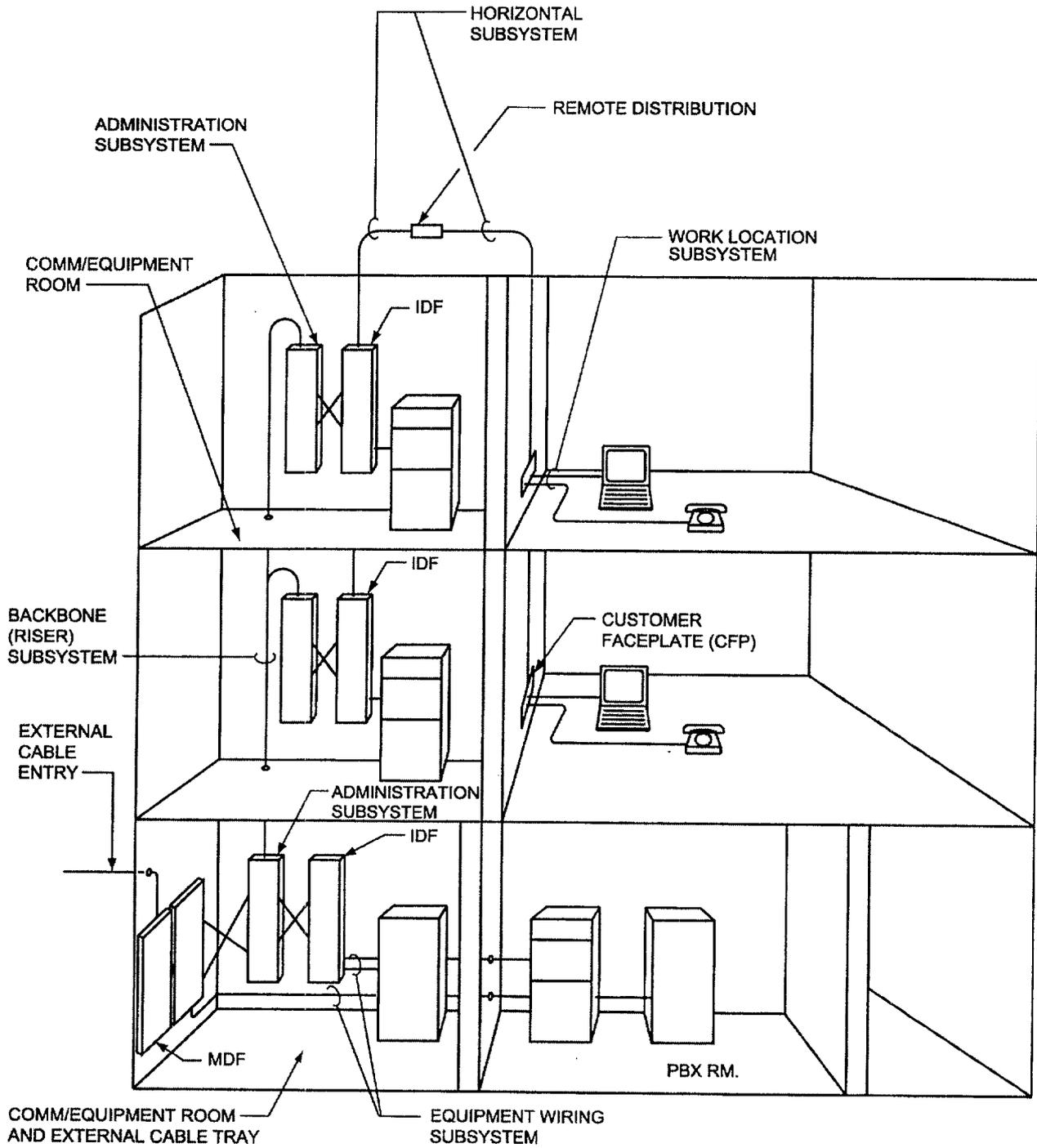


Figure A-1. Distribution Subsystem

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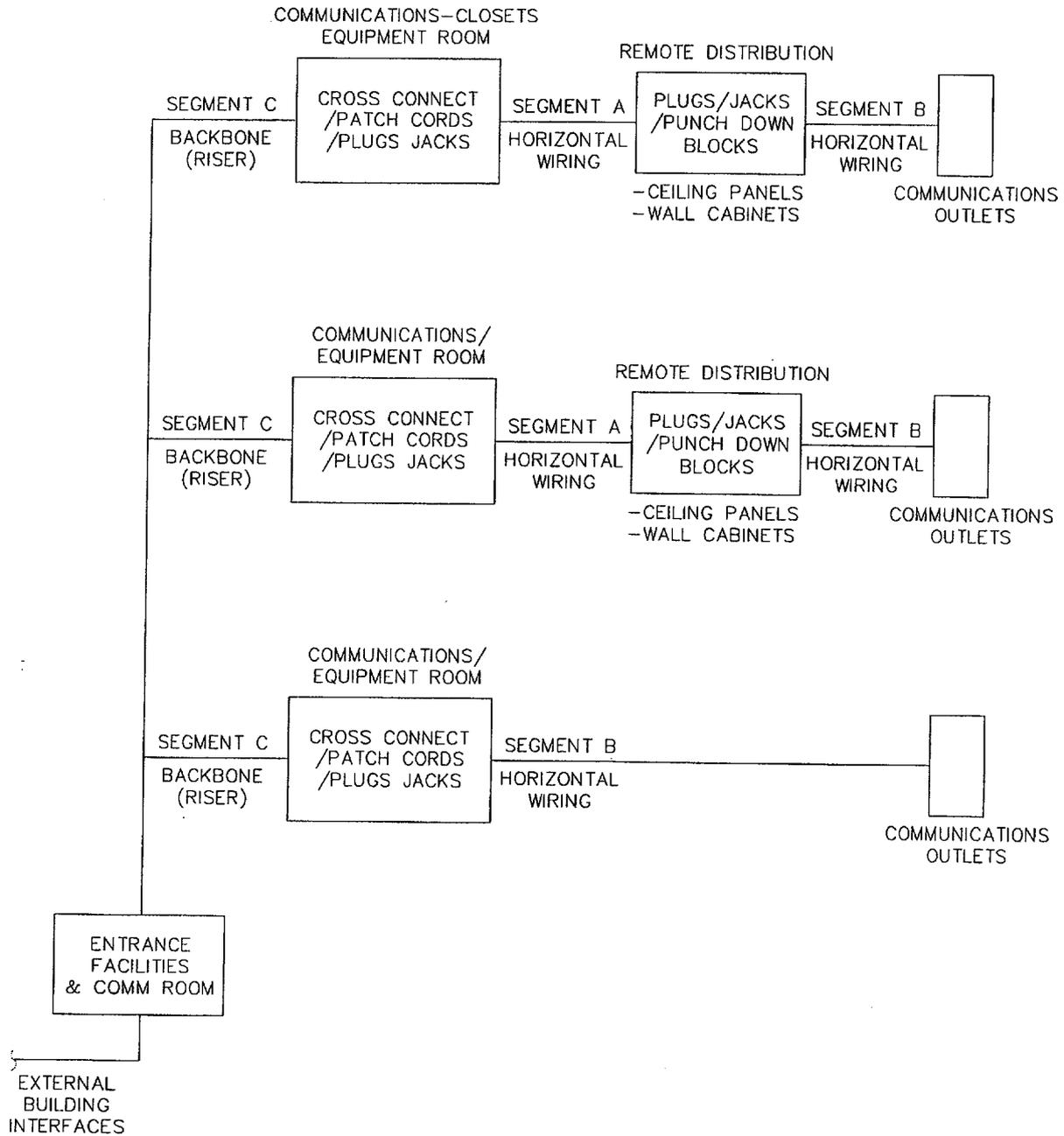


Figure A-2. Typical Premises Distribution Concept

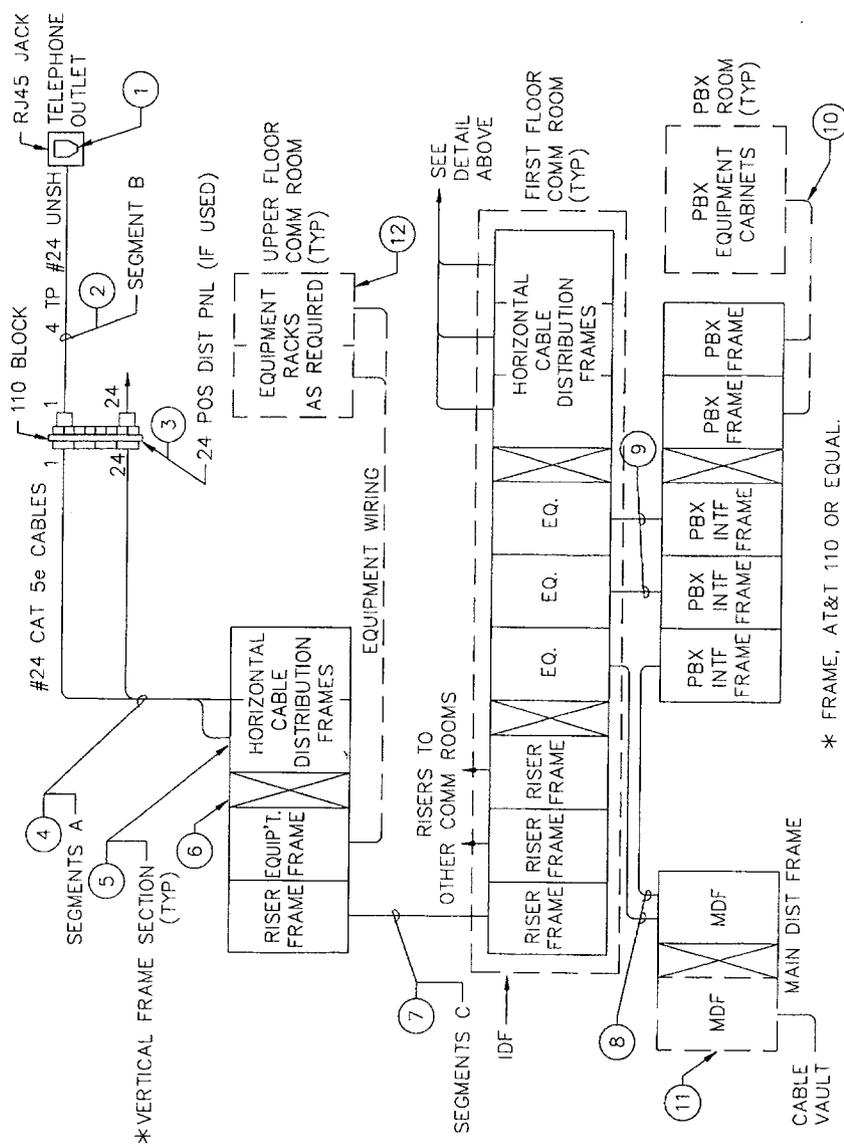


Figure A-3. Telephone Distribution Concept

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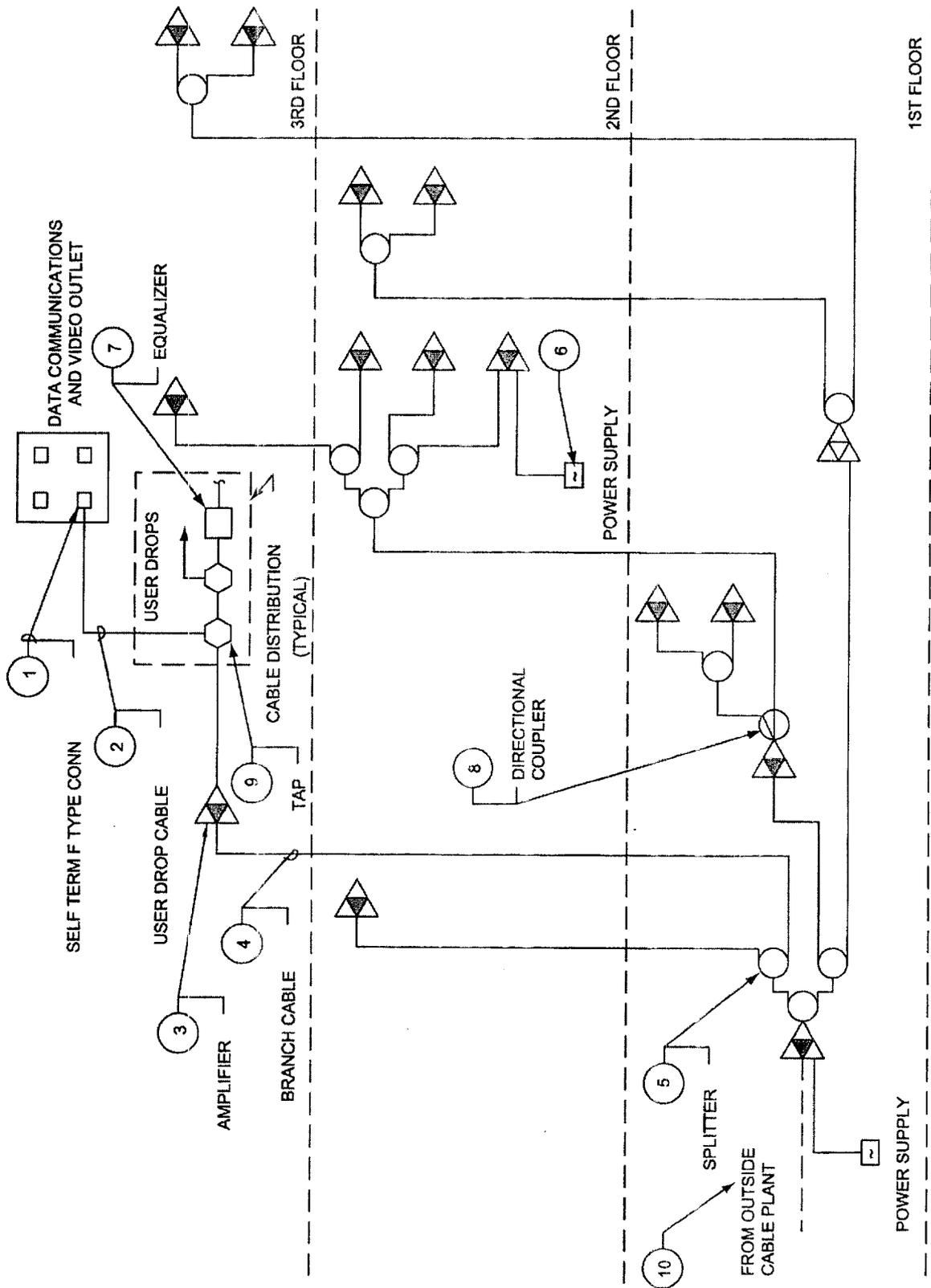


Figure A-4. Broadband Communications Distribution Concept

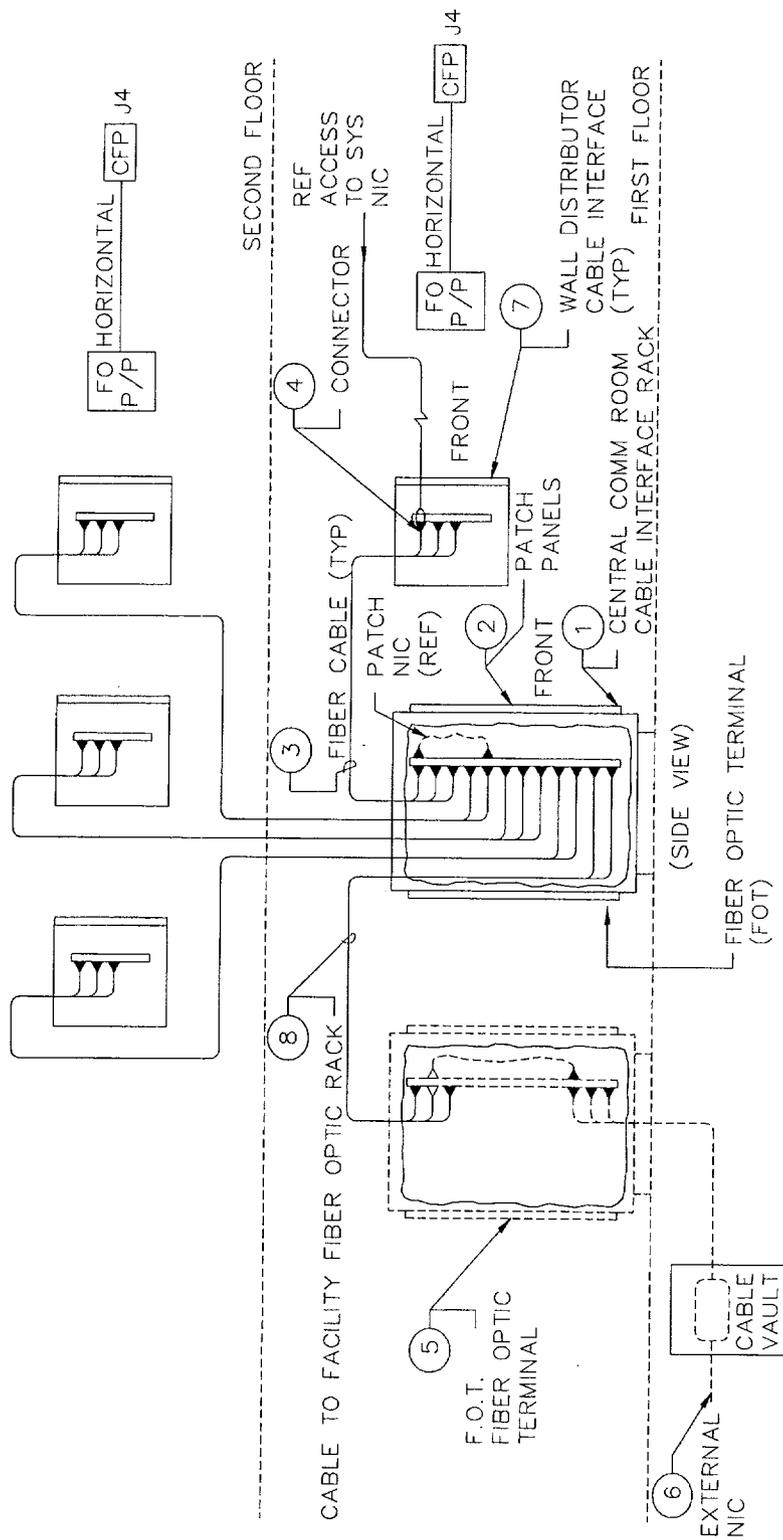


Figure A-5. Fiber Optic Distribution Concept

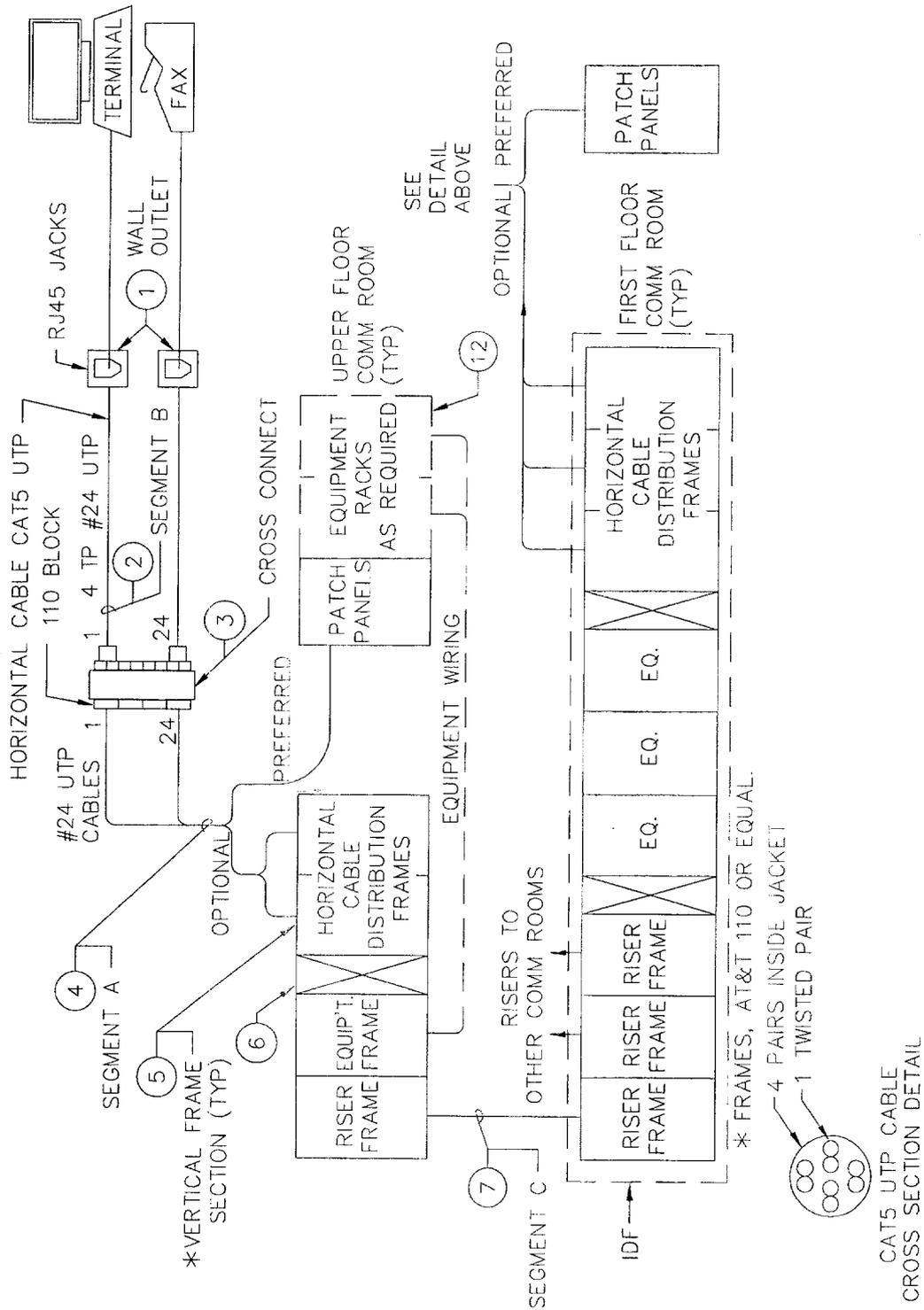


Figure A-6. Cat. 5 UTP Distribution Concept

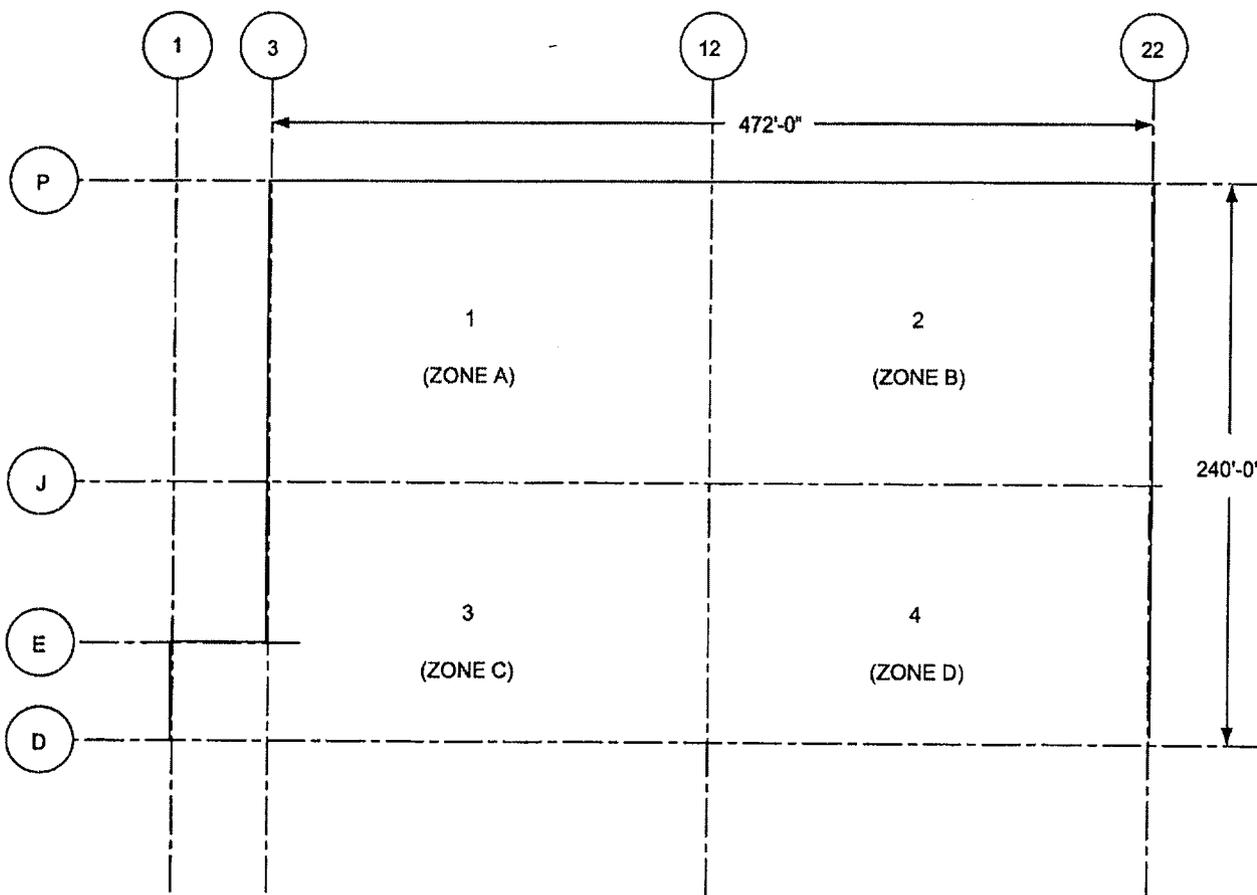


Figure A-7. Key and Zone Plan

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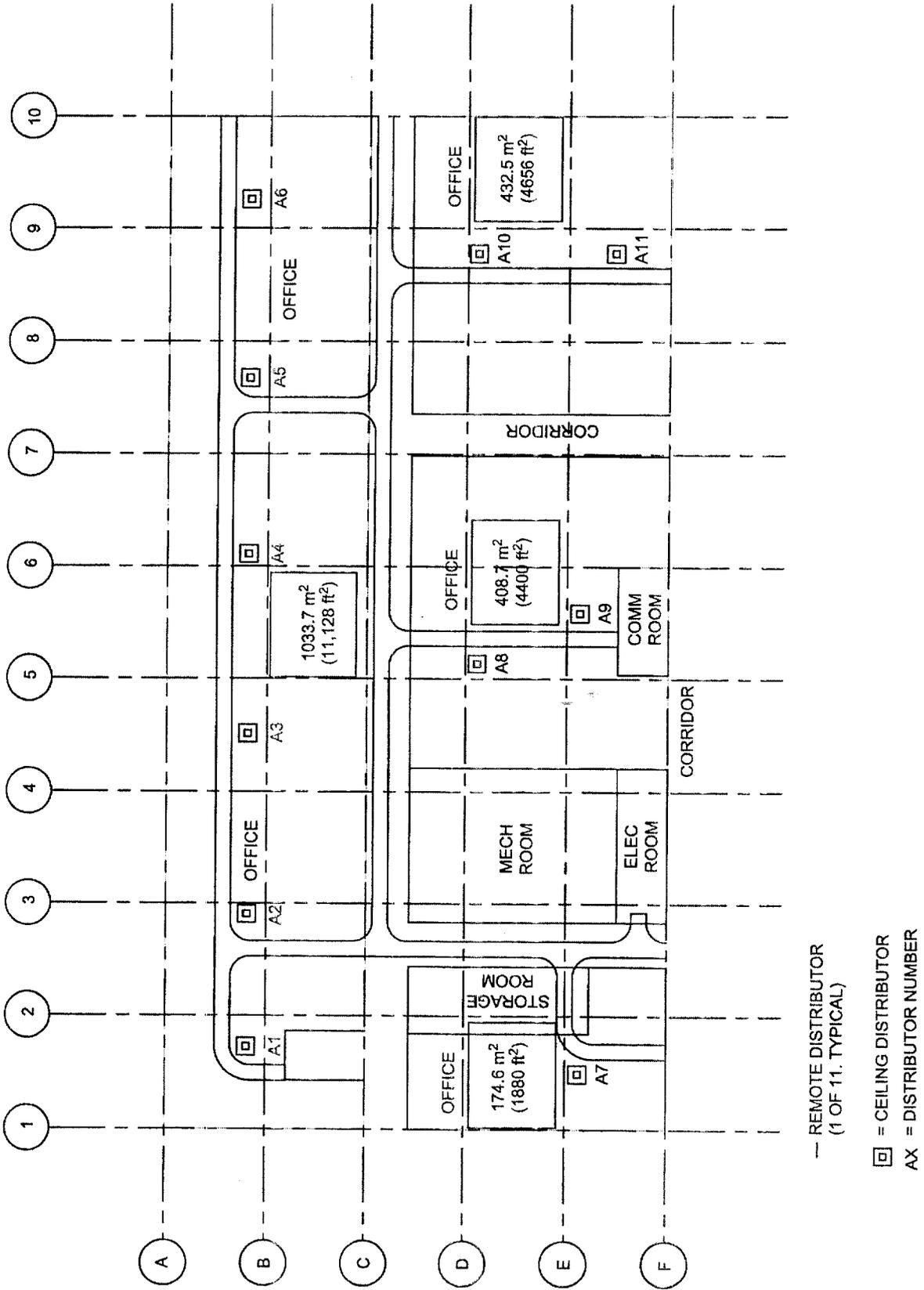
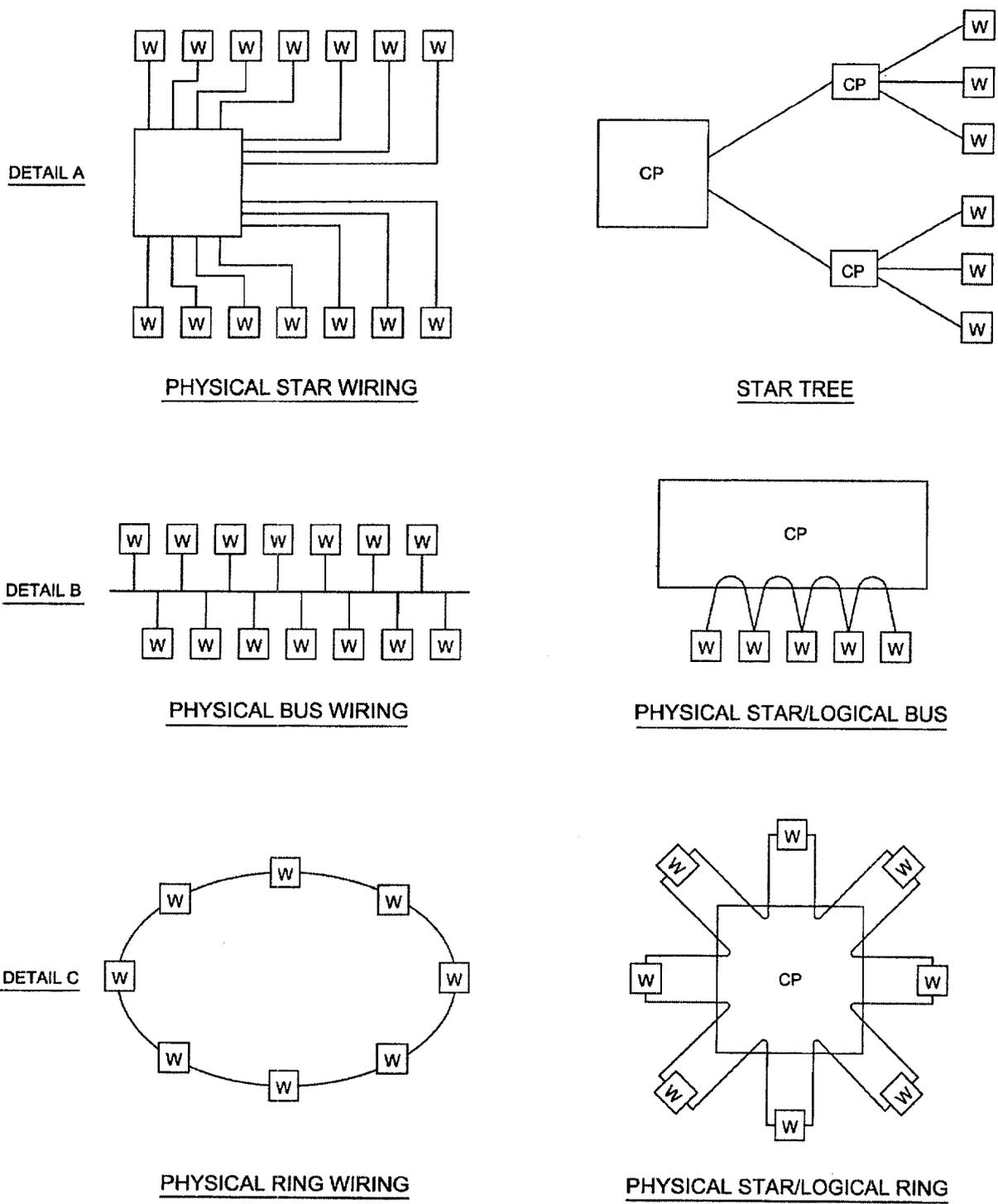


Figure A-8. Zone Distribution Plan



CP - CONTROL POINT (MAIN FRAME, CONTROLLER, CONCENTRATOR, ETC.)  
W - WORKSTATION

Figure A-9. Topology Arrangements

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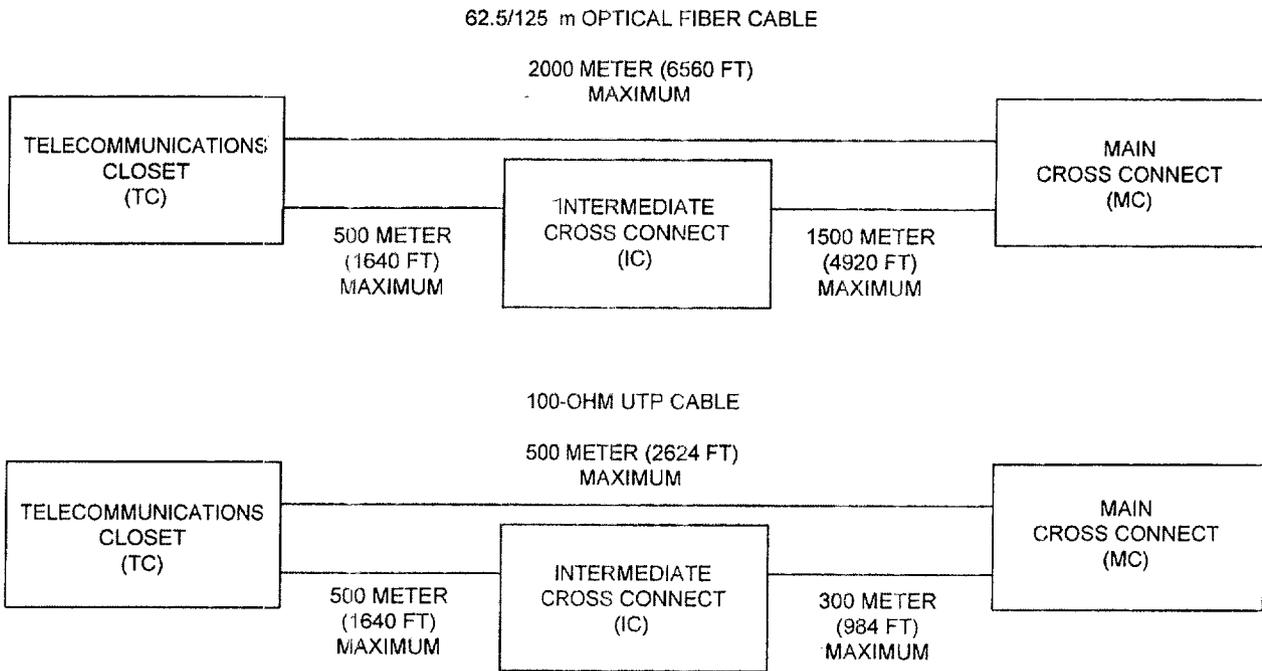


Figure A-10. Distances for Backbone Wiring

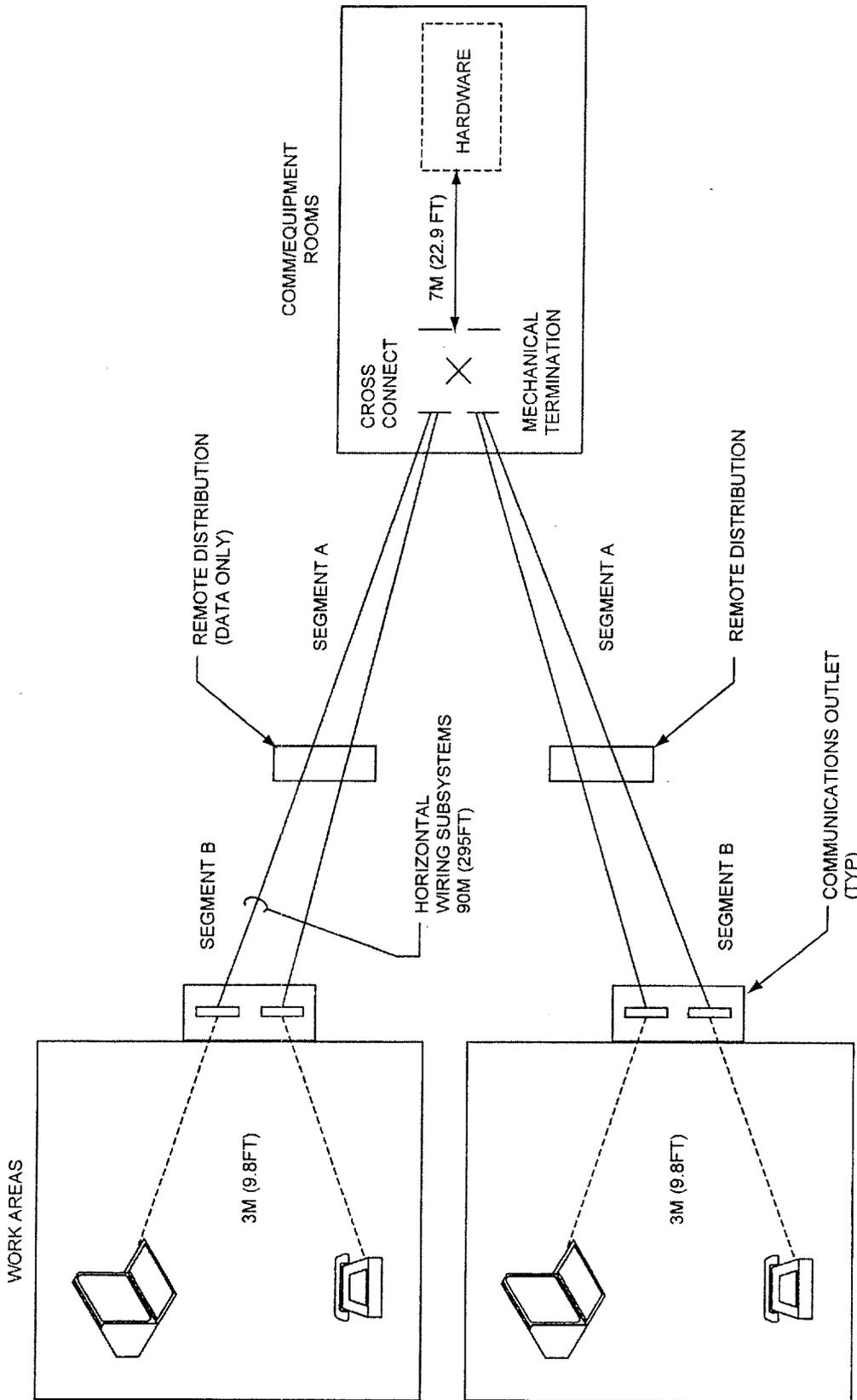


Figure A-11. Distances for Horizontal Wiring

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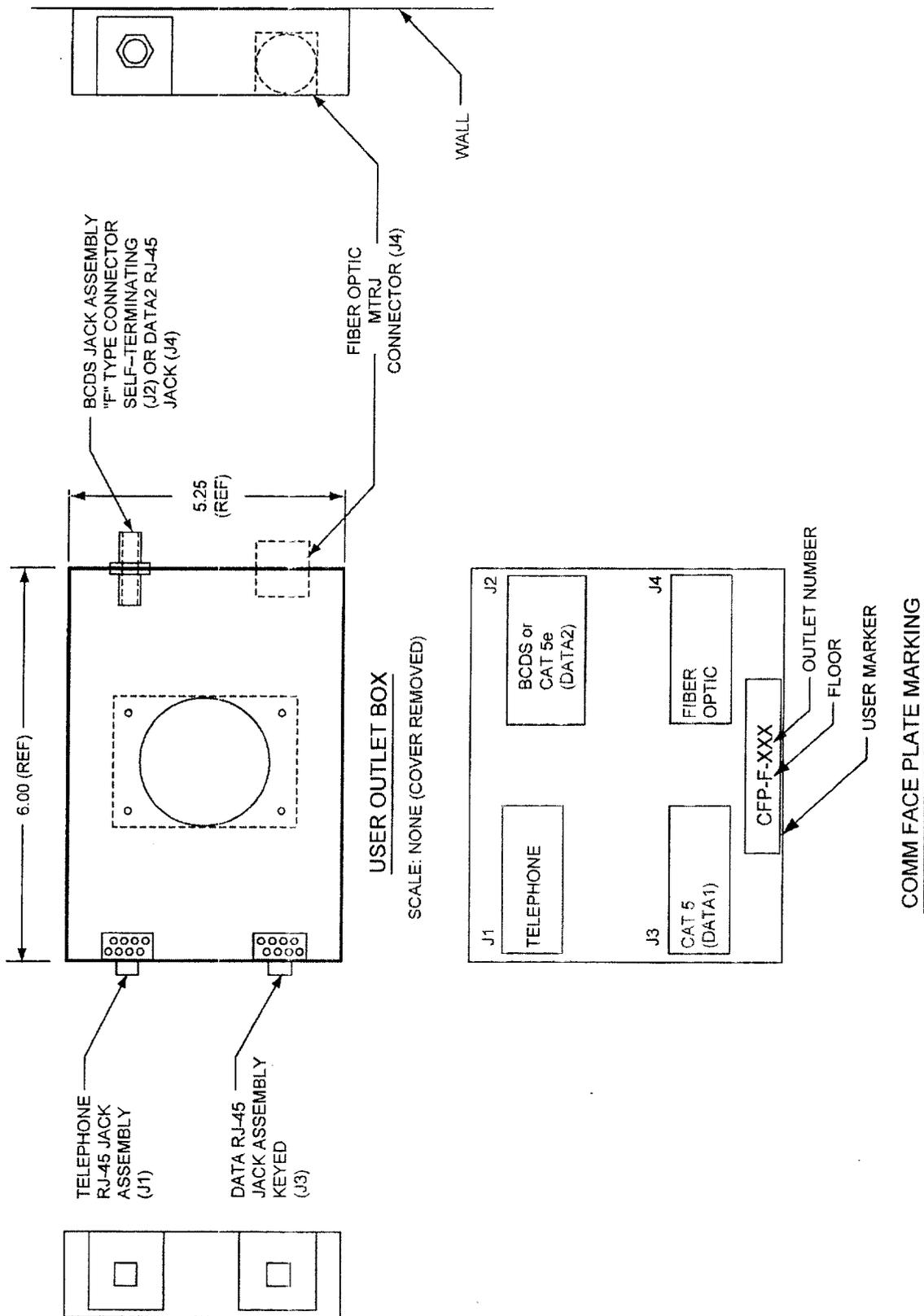
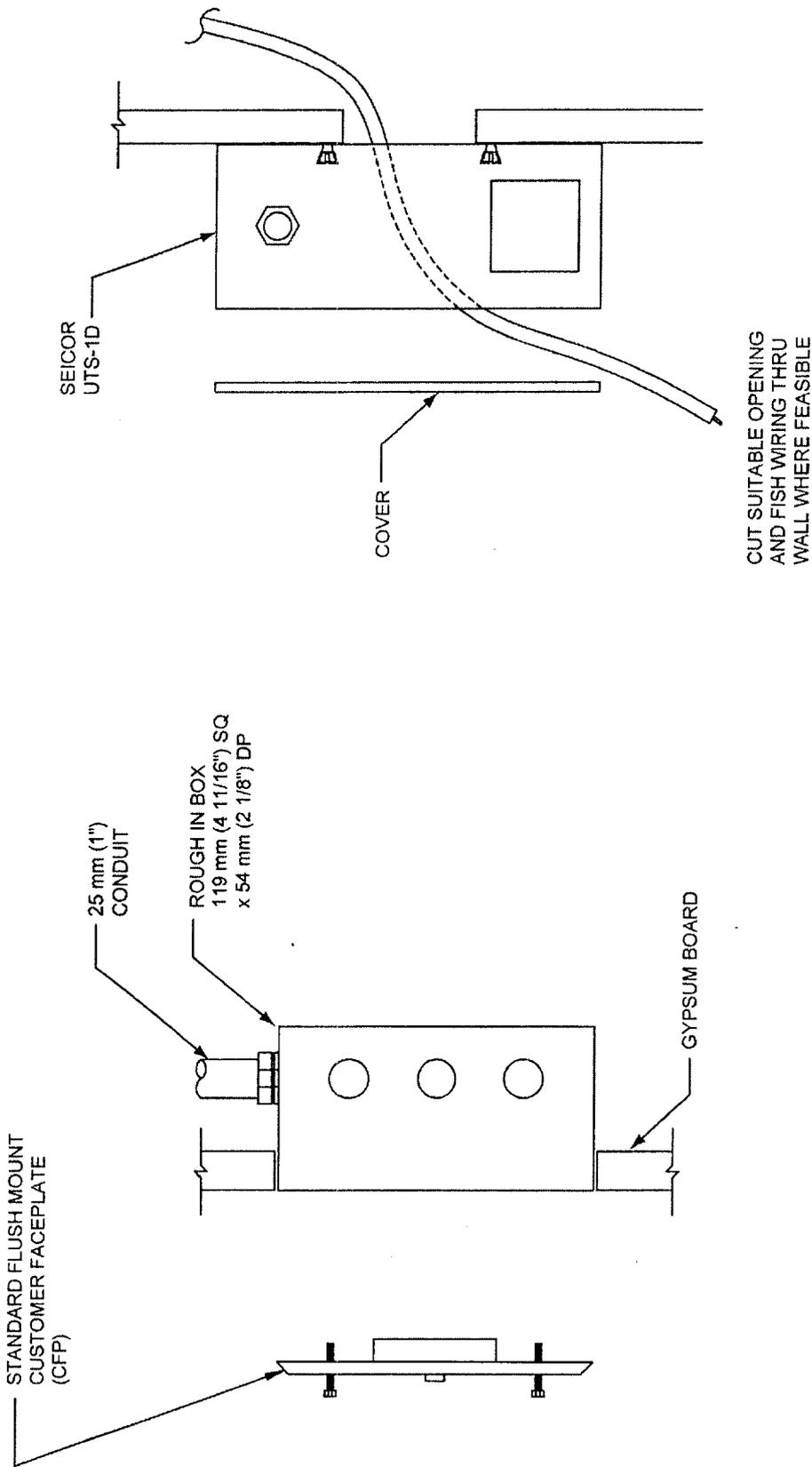


Figure A-12. Communications Wall Outlet (Typical)



FLUSH MOUNT OUTLET

SURFACE MOUNT ON DEMOUNTABLE WALL

Figure A-13. Communications Outlet Mounting Option-1

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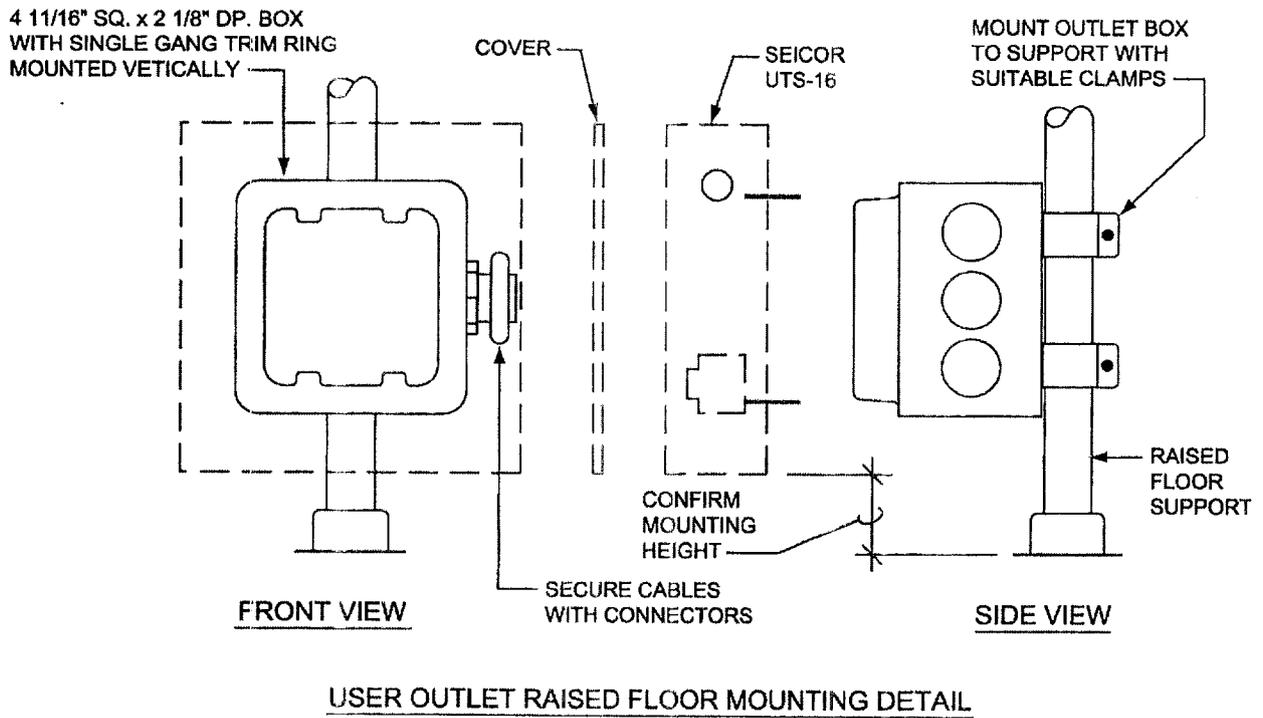
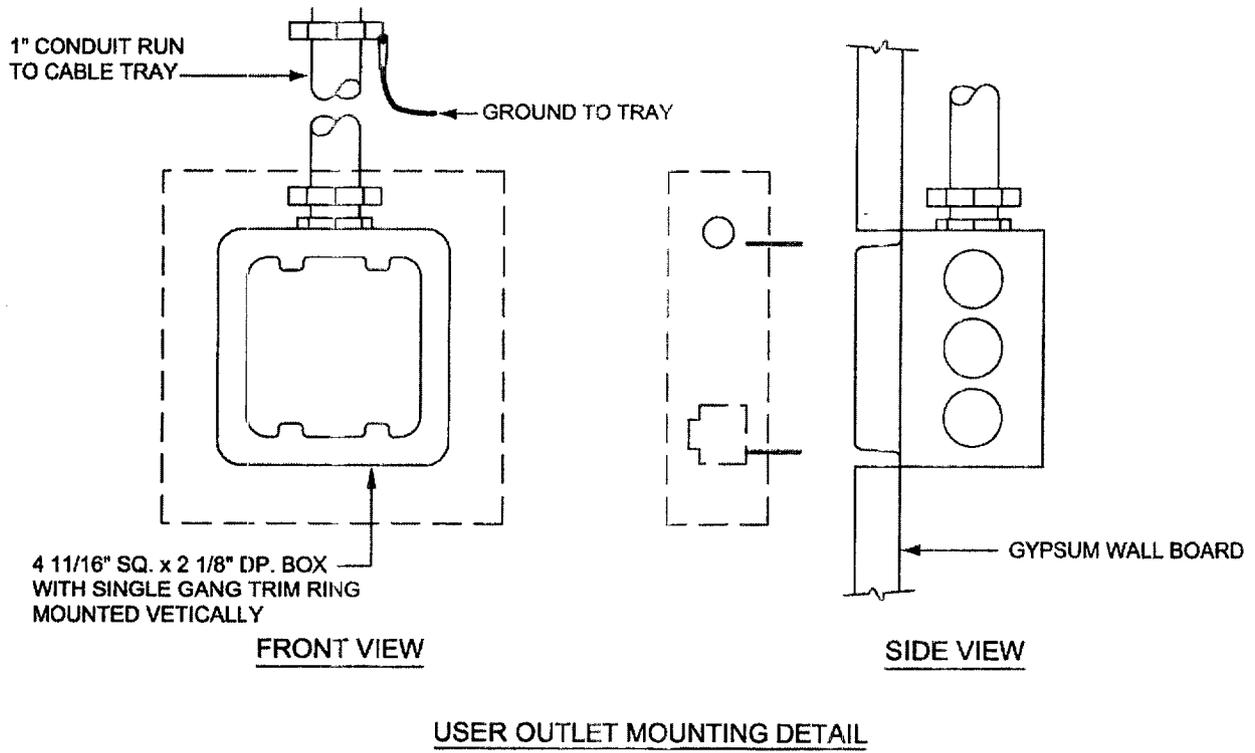


Figure A-14. Communications Outlet Mounting Option-2

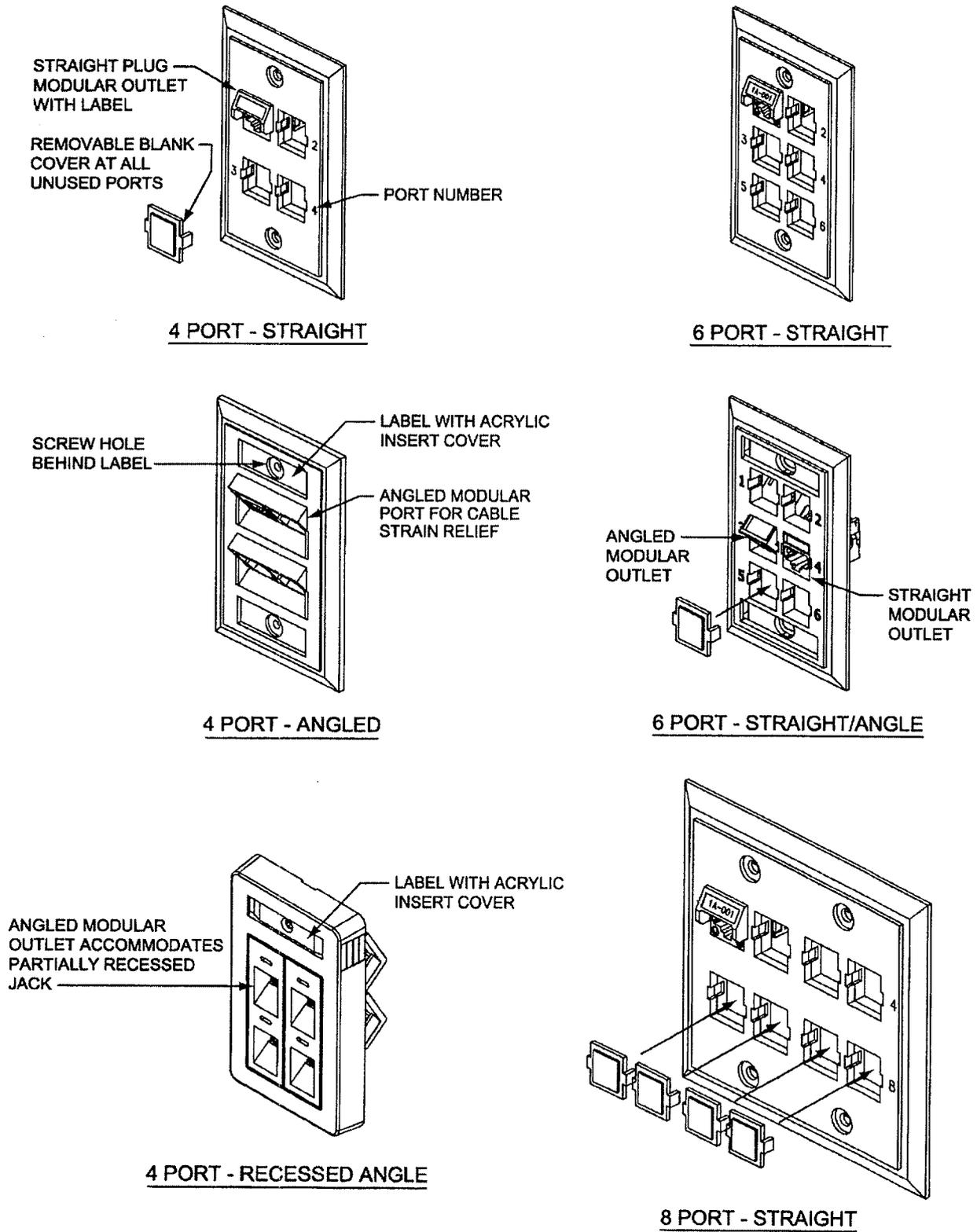


Figure A-15. Typical Modular Jack Coverplate Configurations

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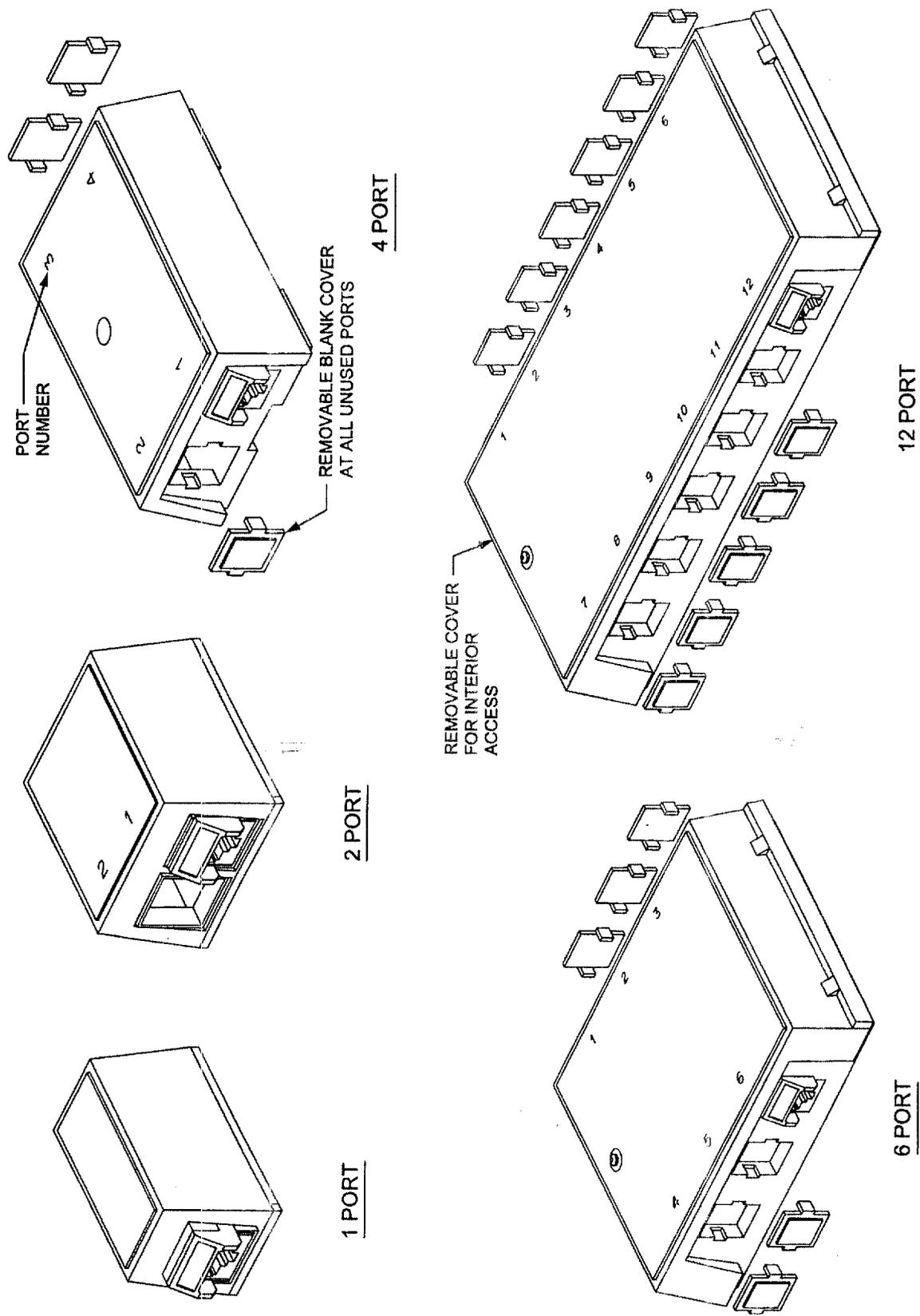


Figure A-16. Typical Surface-Mounted, Modular Port, Station Outlet Boxes

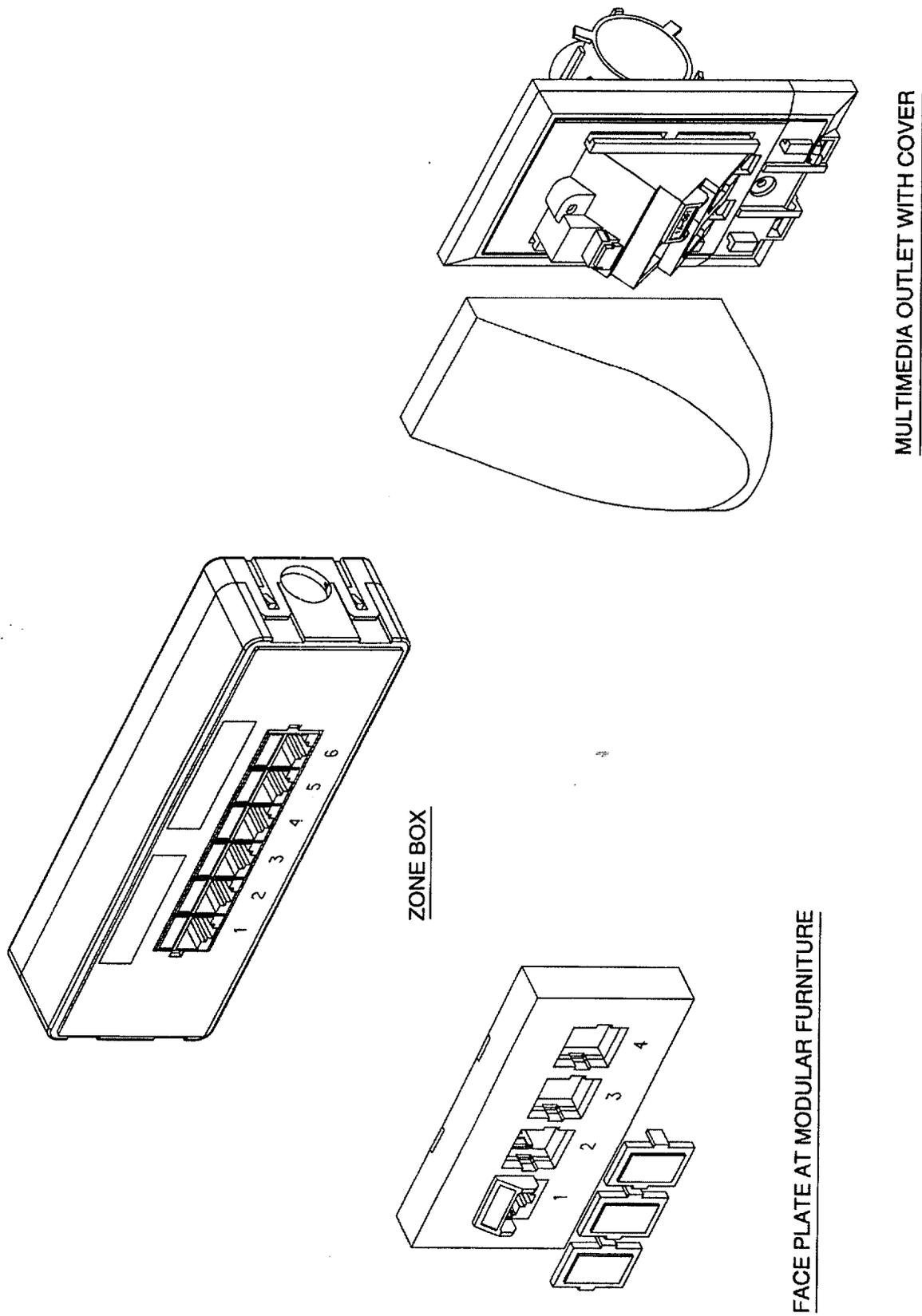


Figure A-17. Specialty Surface-Mounted, Modular Port, Station Outlet Box

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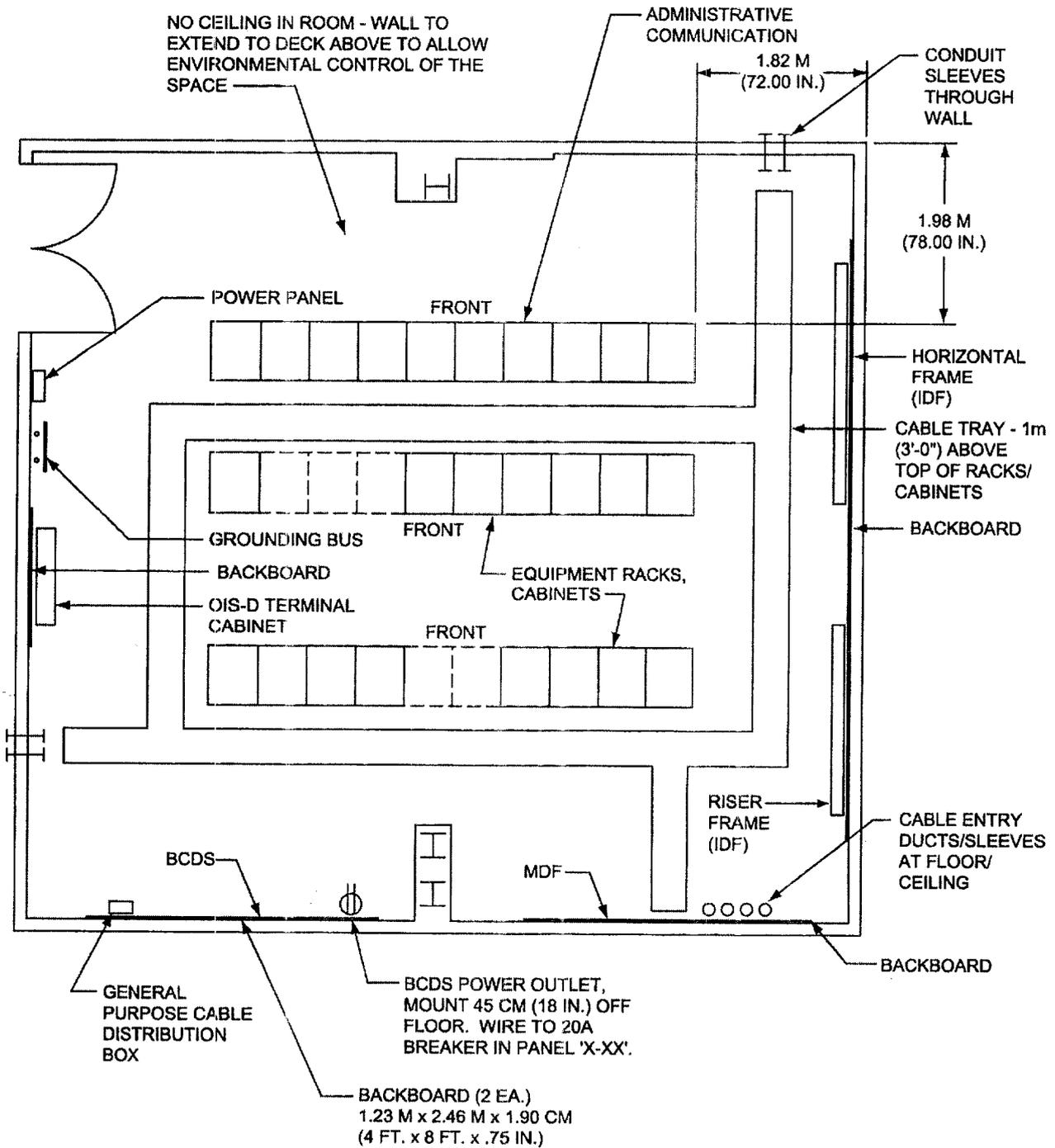


Figure A-18. Typical Communications Room Layout

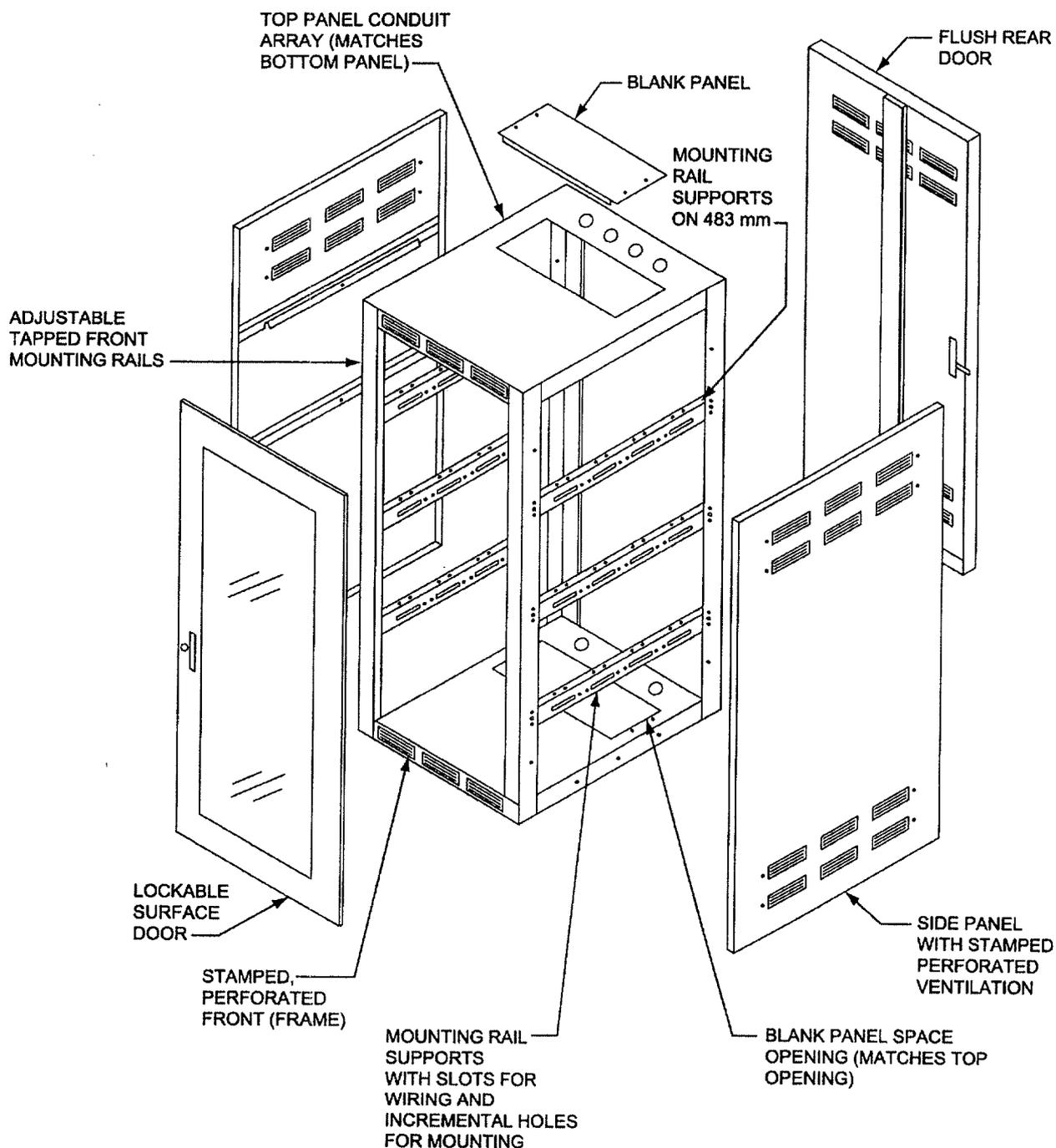


Figure A-19. Enclosed Vertical Cabinet

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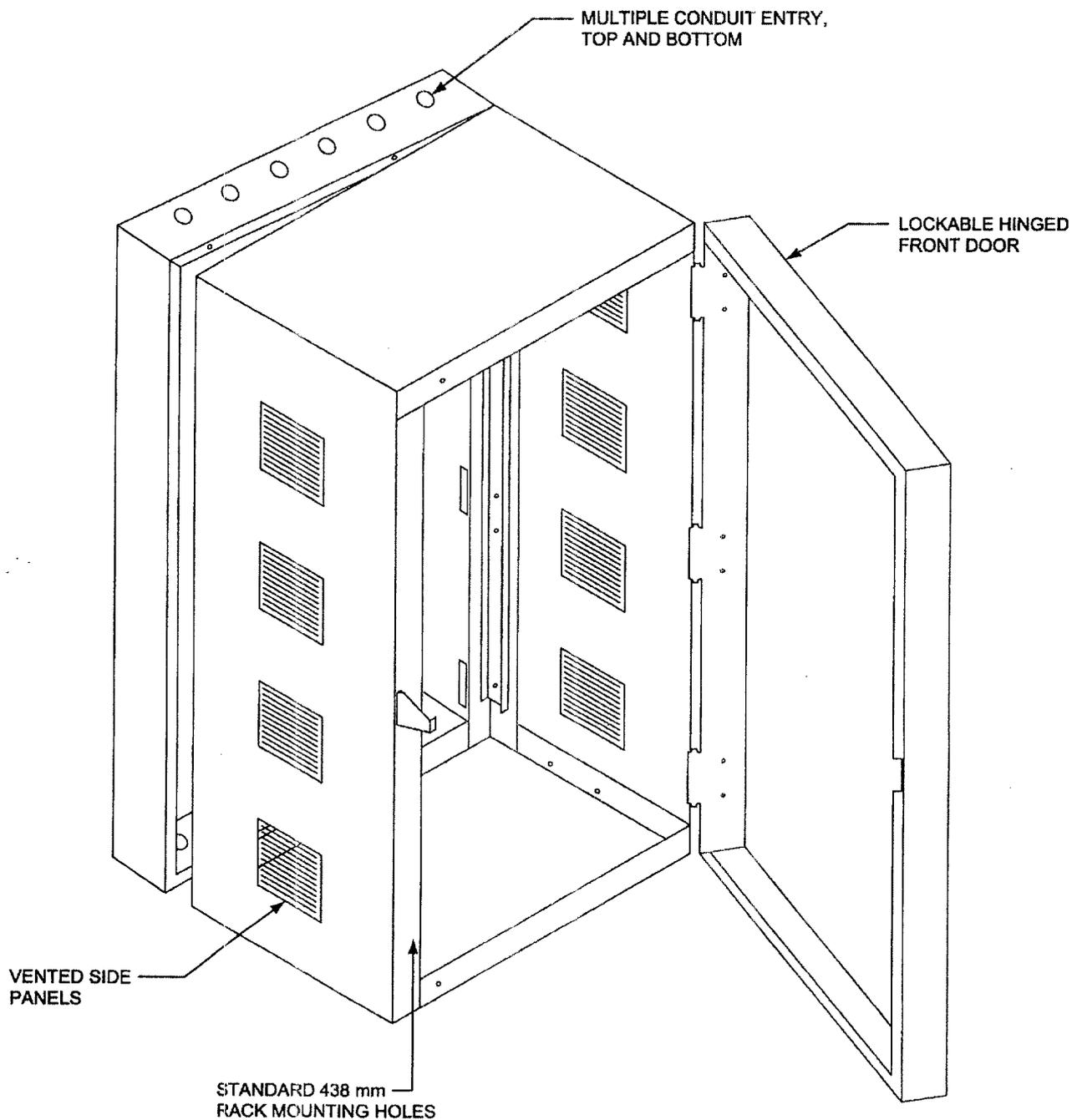


Figure A-20. Wall-Mounted, Double-Hinged Cabinet

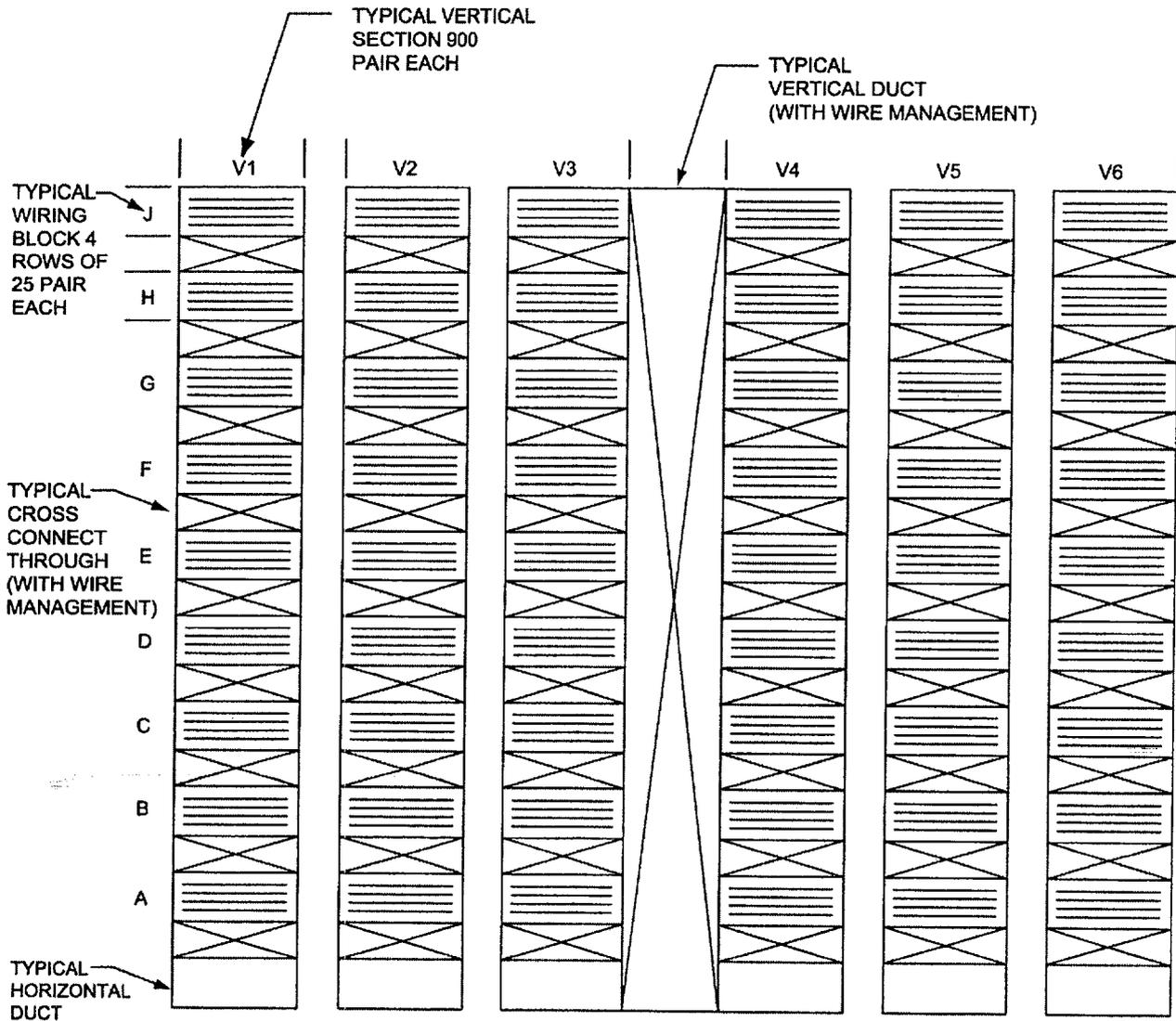
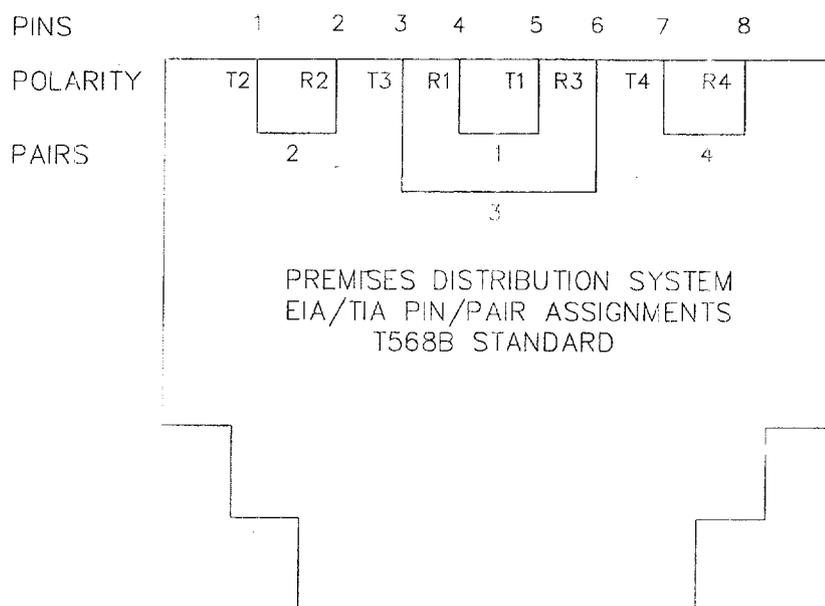


Figure A-21. Cross Connect System

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PIN	WIRE COLOR
1	WHITE/ORANGE STRIPE
2	ORANGE/WHITE STRIPE
3	WHITE/GREEN STRIPE
4	BLUE/WHITE STRIPE
5	WHITE/BLUE STRIPE
6	GREEN/WHITE STRIPE
7	WHITE/BROWN STRIPE
8	BROWN/WHITE STRIPE

Figure A-22. RJ-45 Connector Details

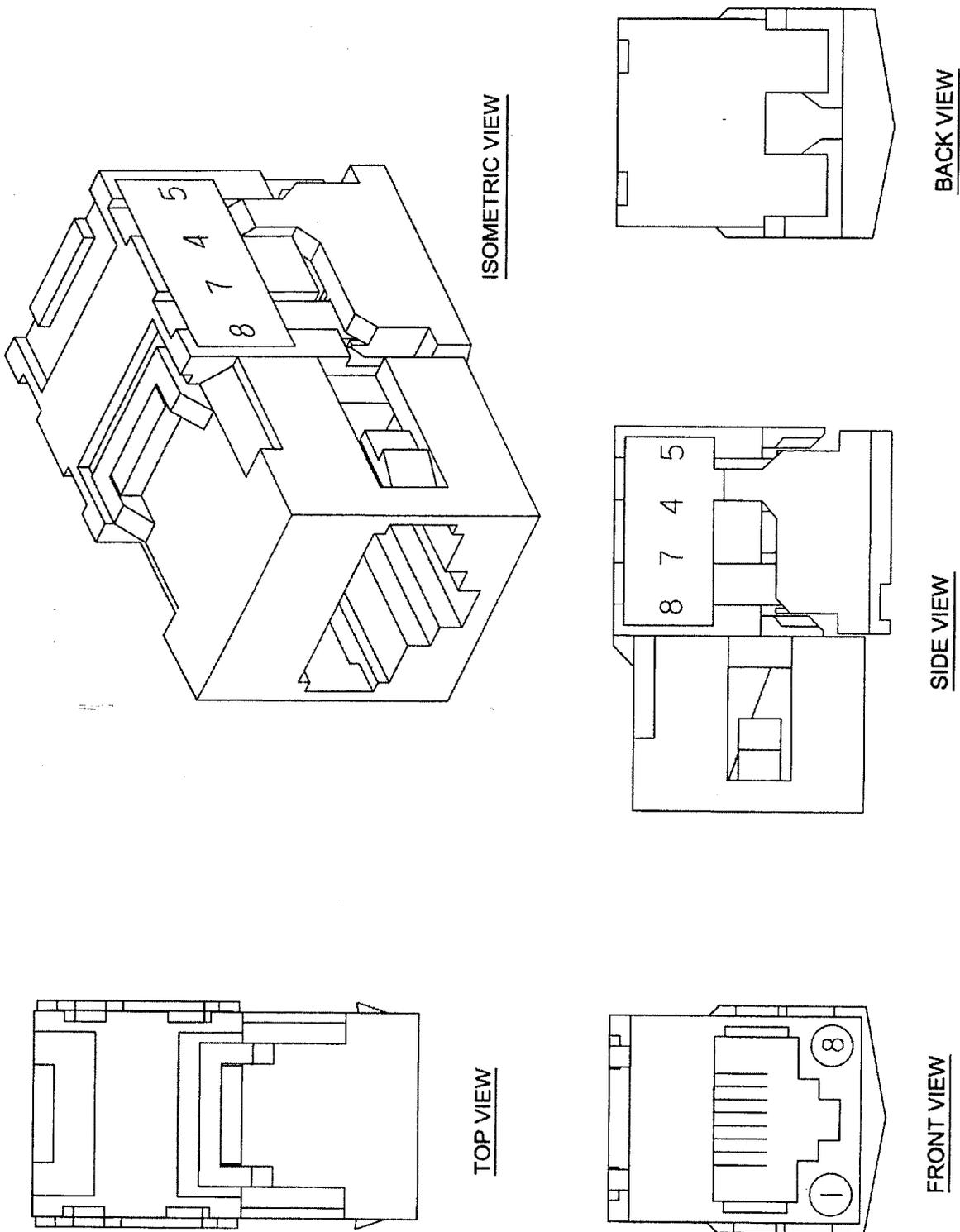


Figure A-23. RJ-45 Nonkeyed, Eight-Position, 110 Connect, Modular Jack

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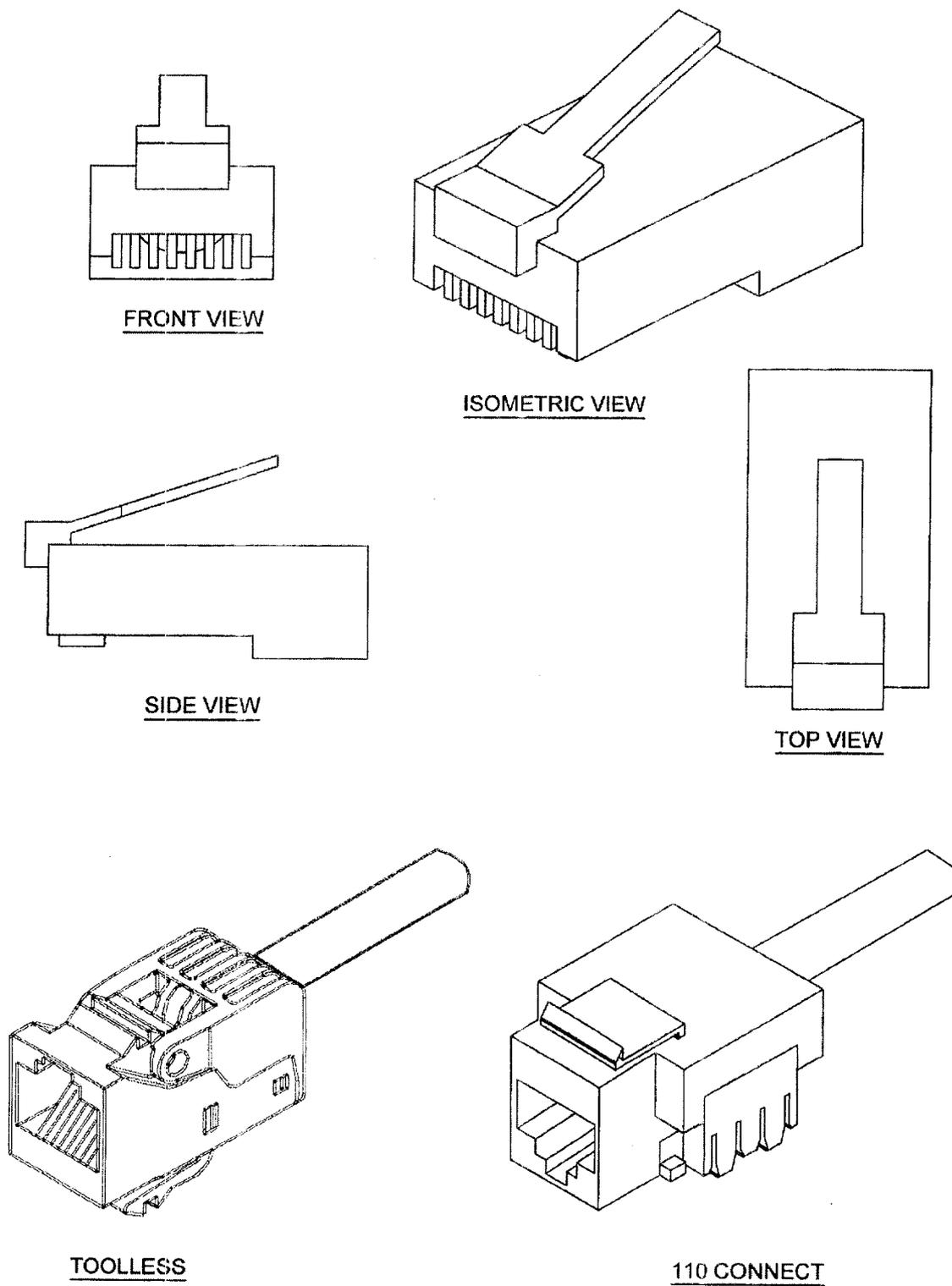
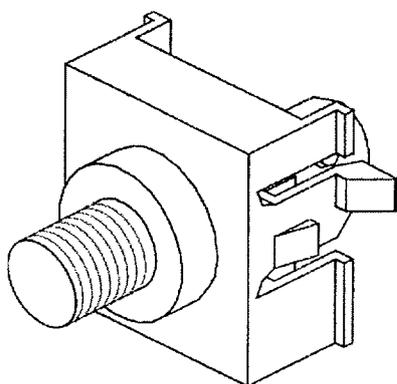
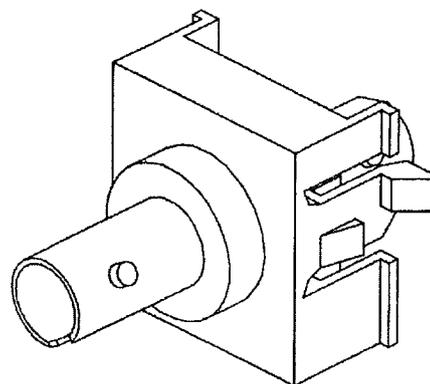


Figure A-24. Typical RJ-45 Modular Jack Configurations



F-TYPE MODULAR JACK



BNC MODULAR JACK

Figure A-25. COAX Modular Jacks for the CFP

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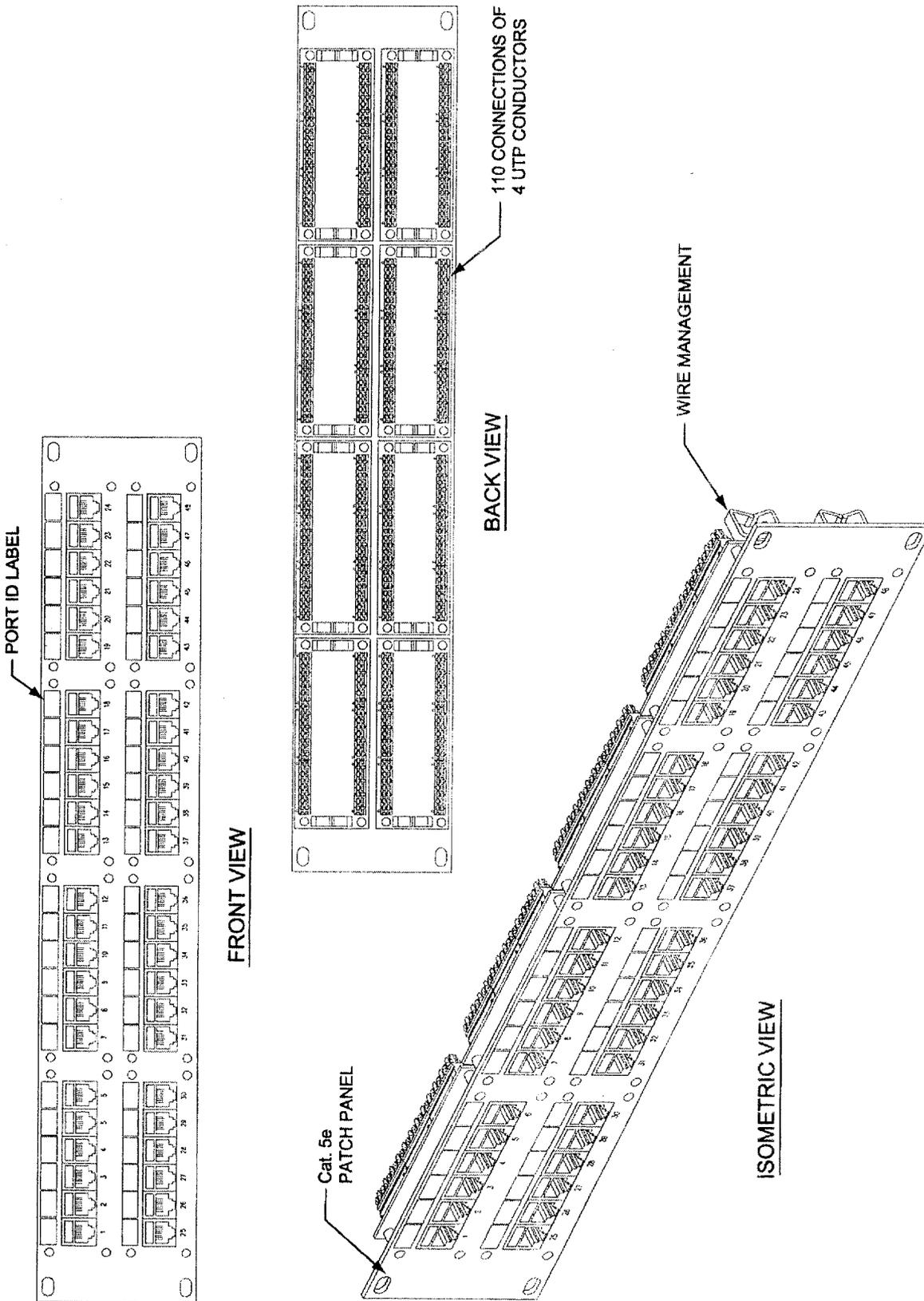
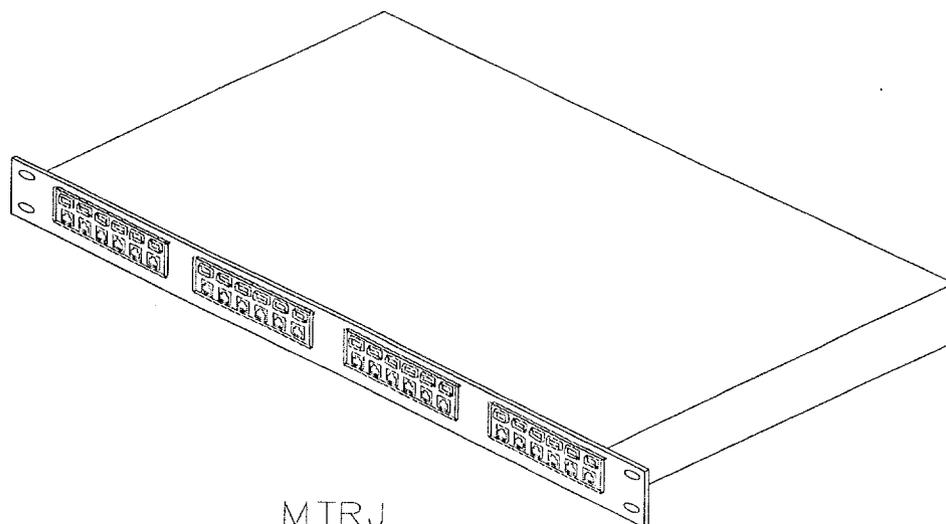
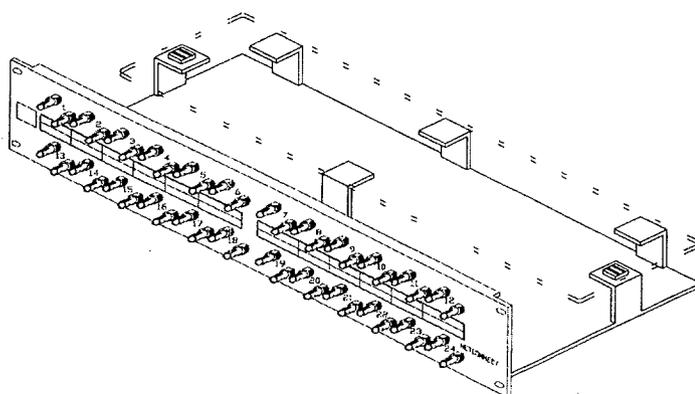


Figure A-26. 48 Port Patch Panel – 110 Wiring Premise Connection



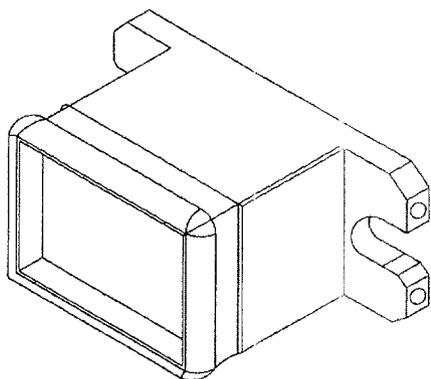
MTRJ  
FOR HORIZONTAL DISTRIBUTION



ST  
FOR RISER DISTRIBUTION

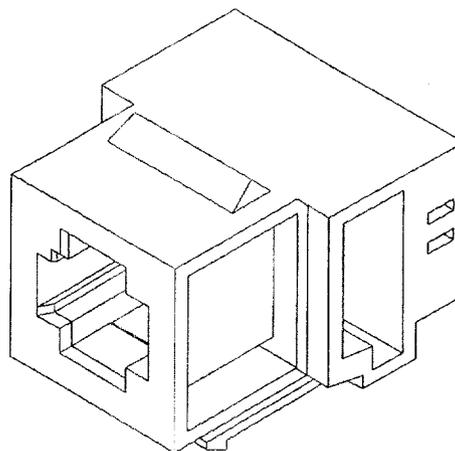
Figure A-27. Typical Fiber Termination Shelves

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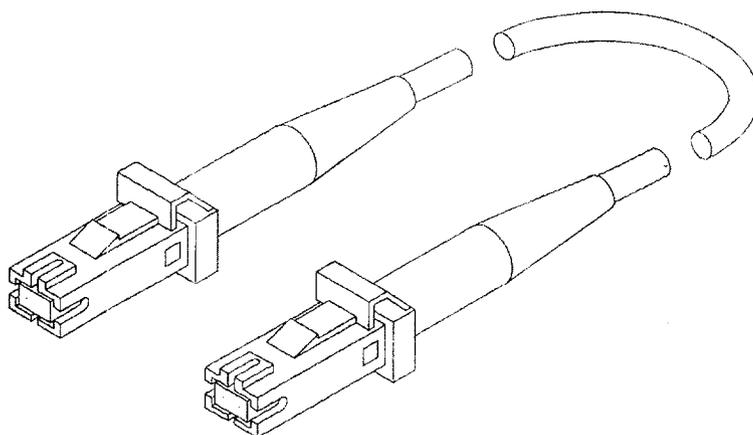
ISOMETRIC VIEW

MT-RJ ADAPTER



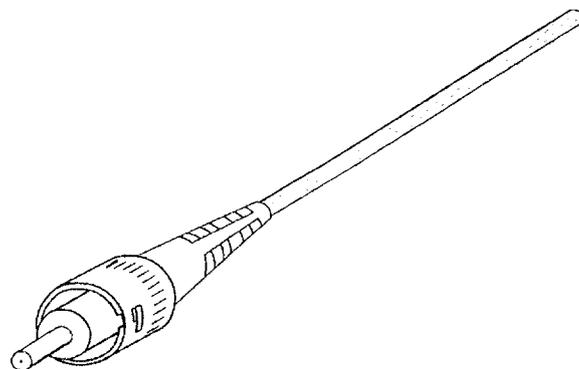
ISOMETRIC VIEW

MT-RJ FIBER TERMINATION MODULAR OUTLET

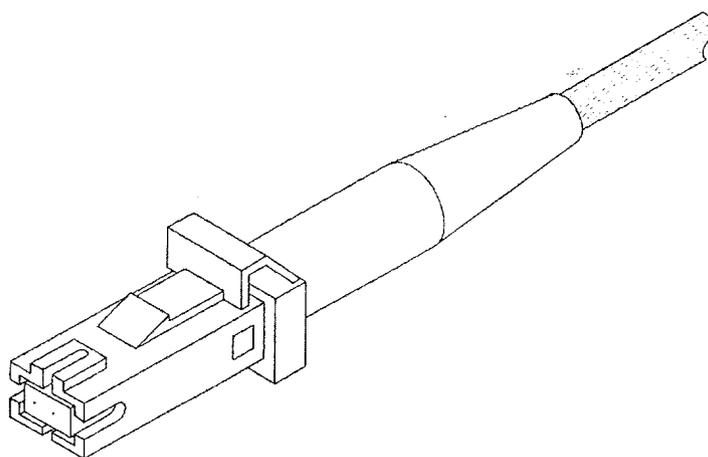


MT-RJ PATCH CORD

Figure A-28. Typical MT-RJ Fiber Fittings



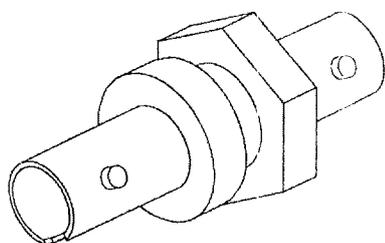
ST FIBER TERMINATION



MT-RJ FIBER TERMINATION

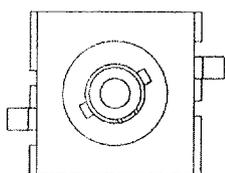
Figure A-29. Typical Fiber Terminations

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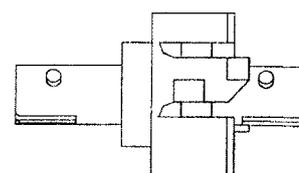


ISOMETRIC VIEW

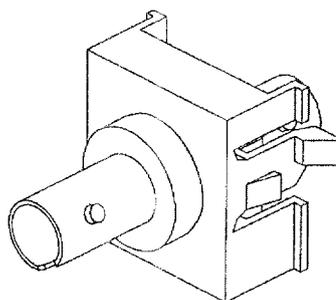
ST COUPLING



FRONT VIEW

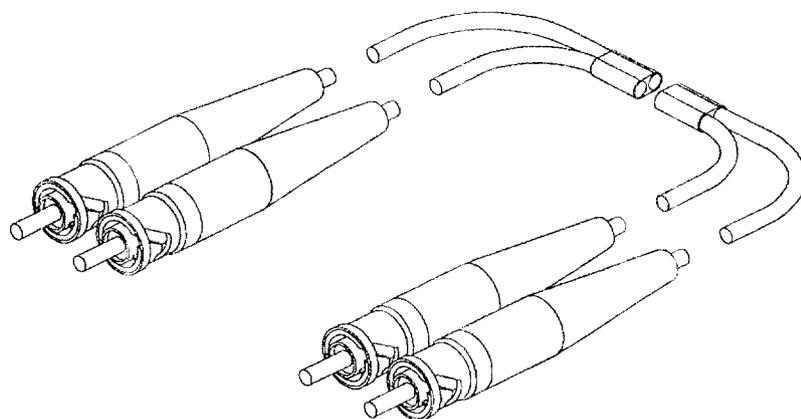


SIDE VIEW



ISOMETRIC VIEW

ST FIBER TERMINATION MODULAR OUTLET



DUAL ST FIBER PATCH CORD

Figure A-30. Typical ST Fiber Fittings

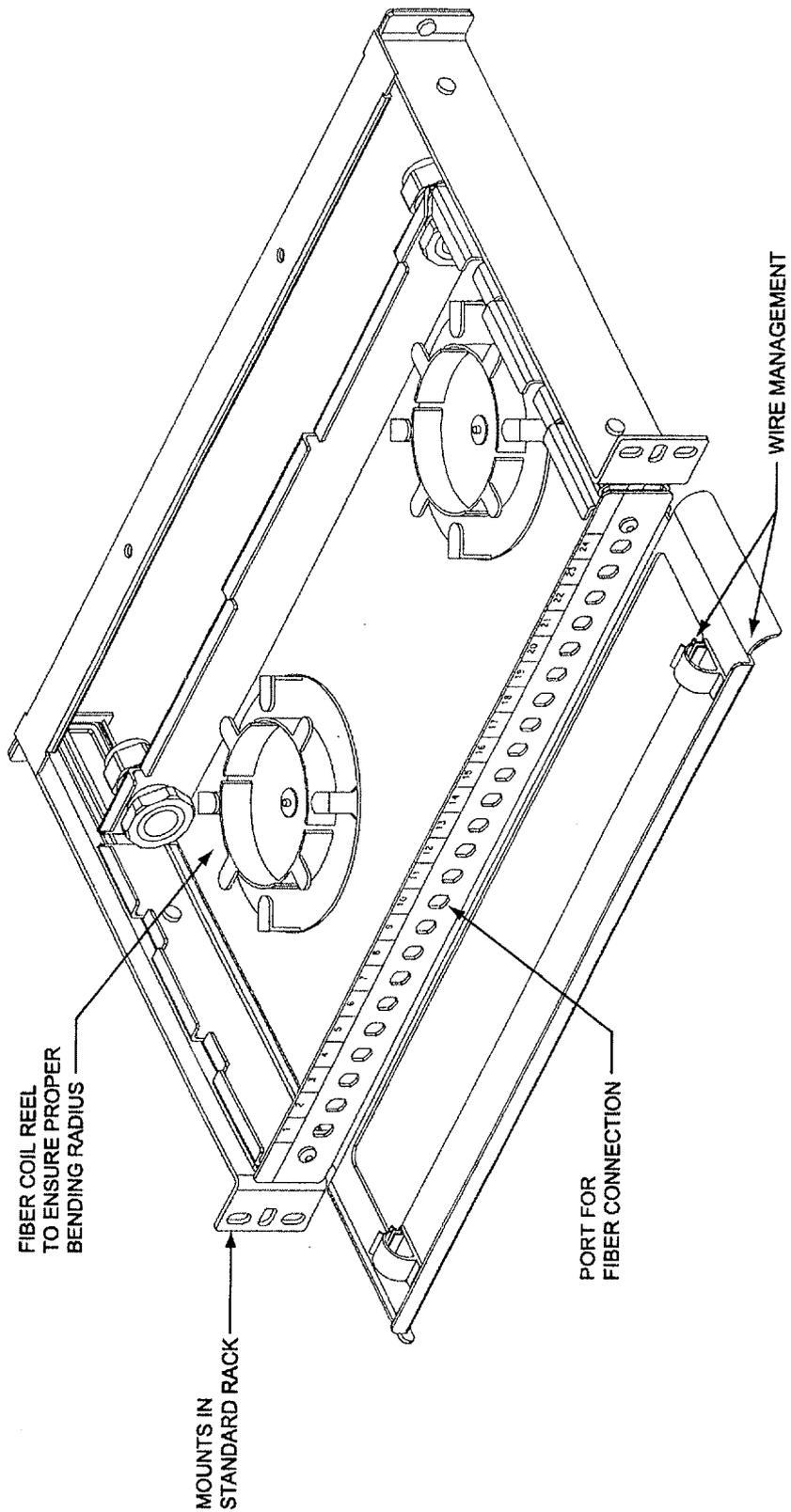


Figure A-31. Small Fiber Termination Shelf

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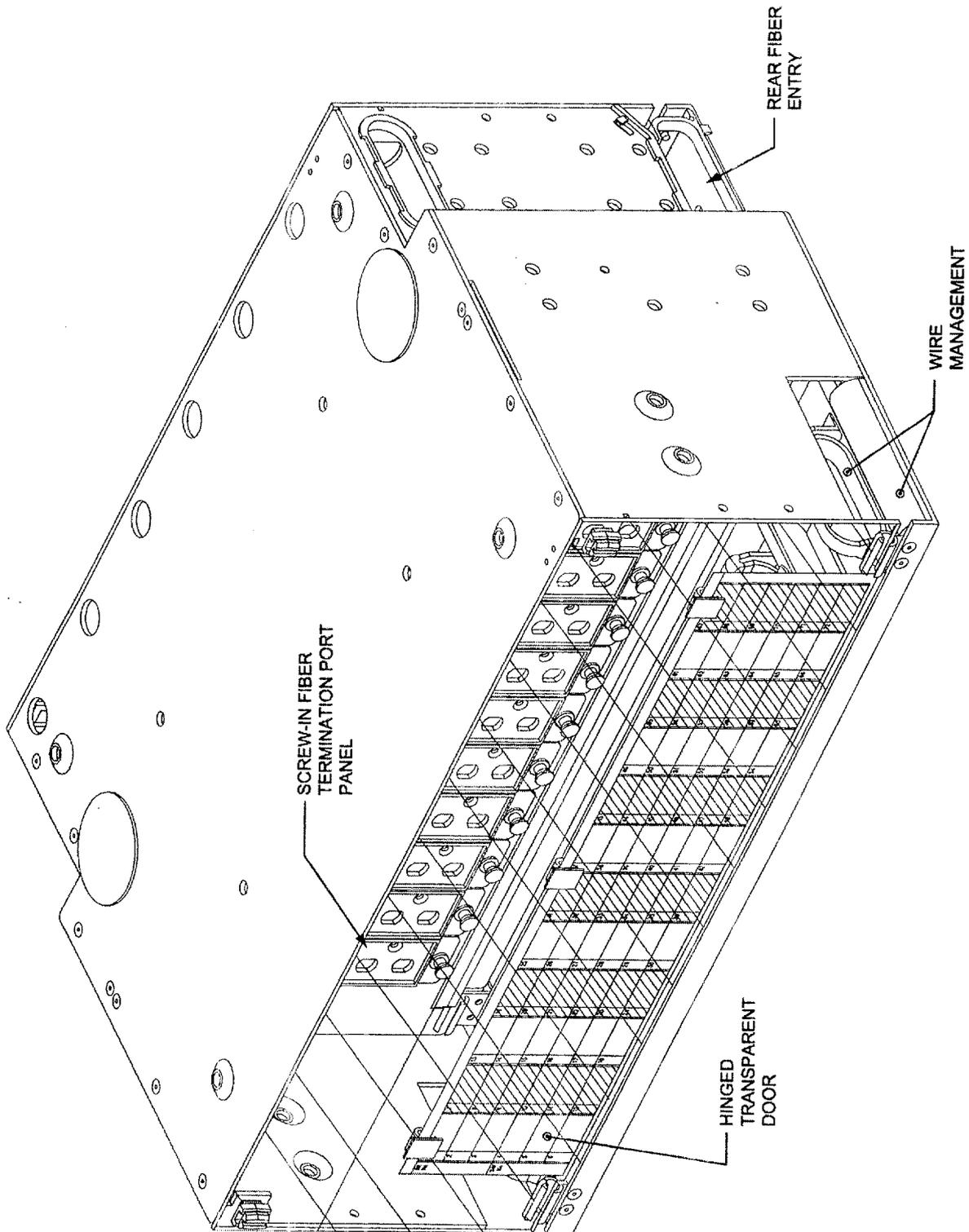


Figure A-32. Large Fiber Termination Shelf

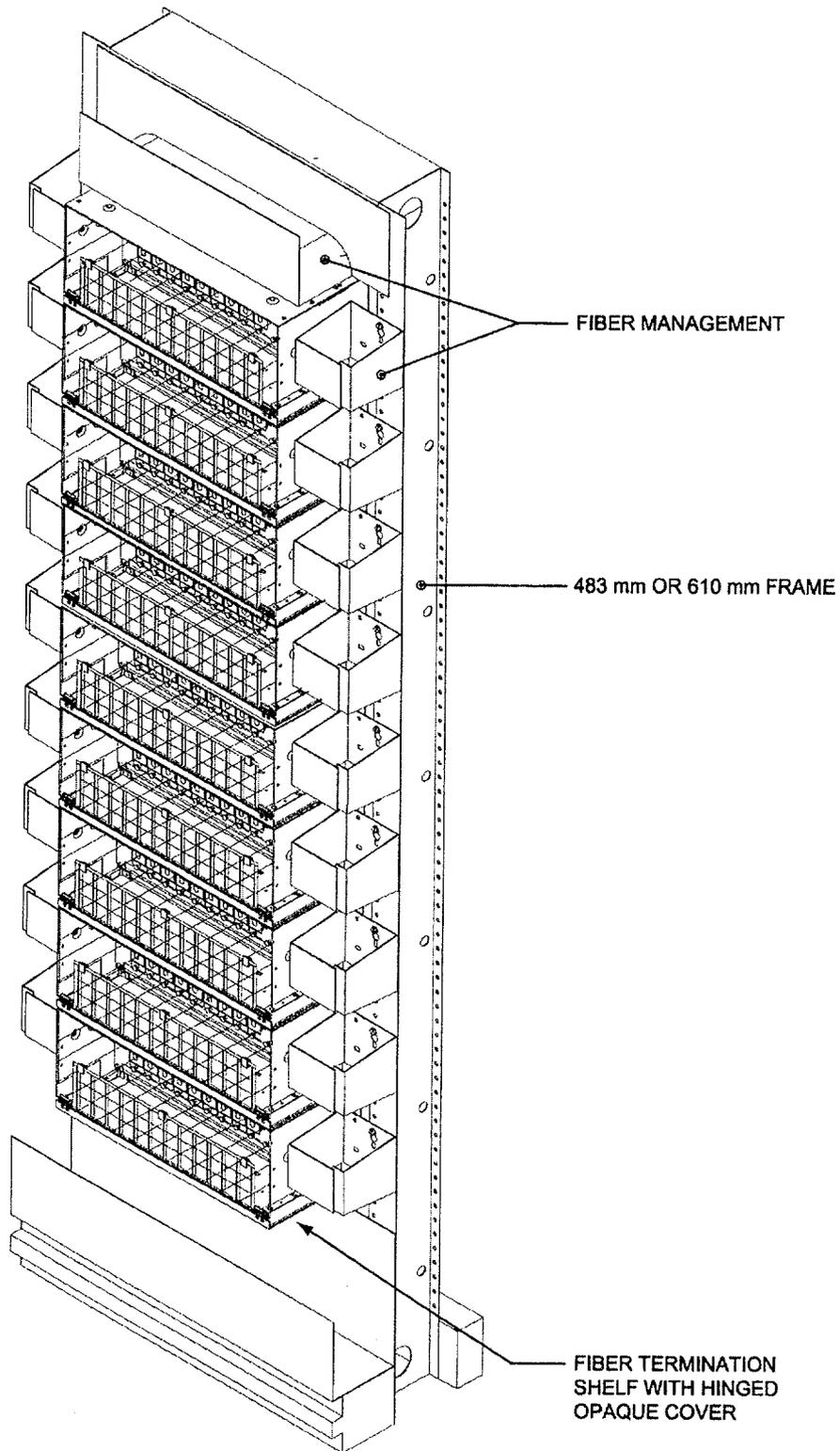
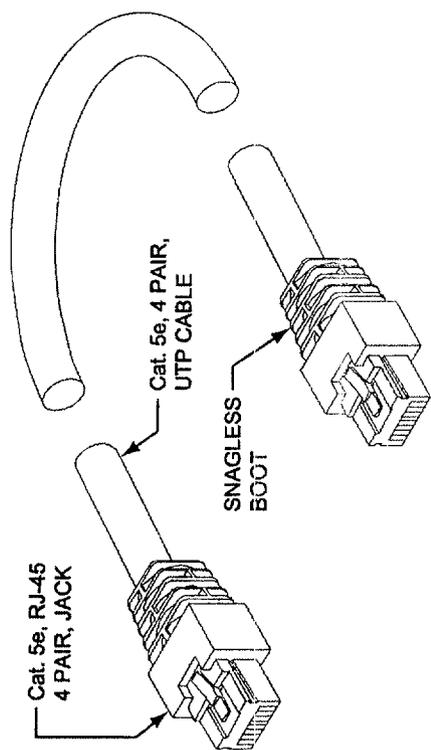
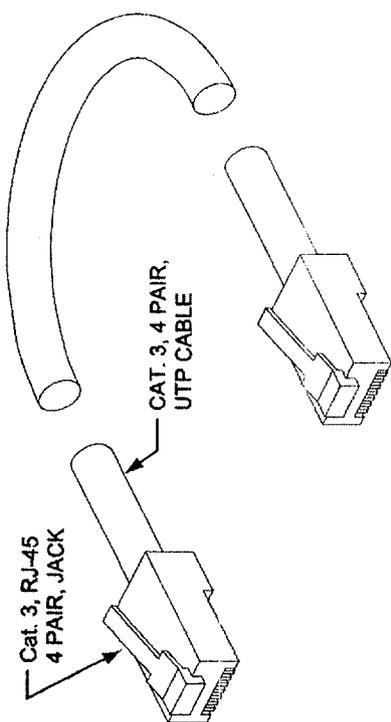


Figure A-33. Typical Fiber Termination Rack

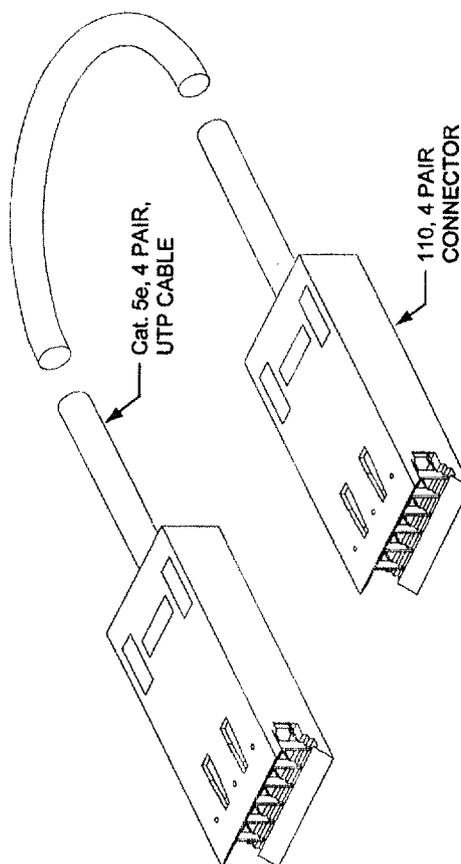
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Cat. 5e, RJ-45 PATCH CORD



Cat. 3, RJ-45 PATCH CORD



110 PATCH CORD

Figure A-34. Typical Copper Patch Conductor Cords

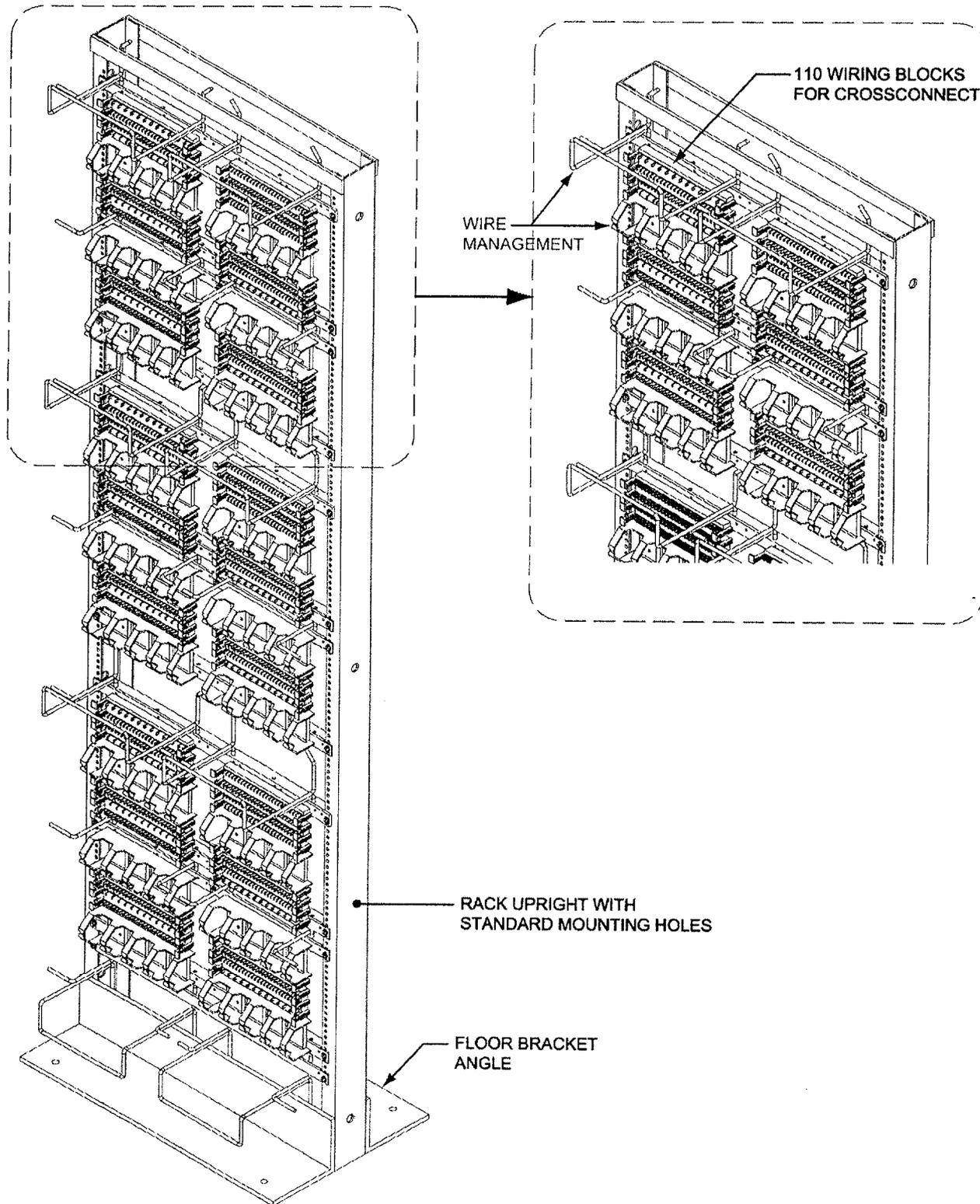


Figure A-35. Typical 110 Wiring Block Rack

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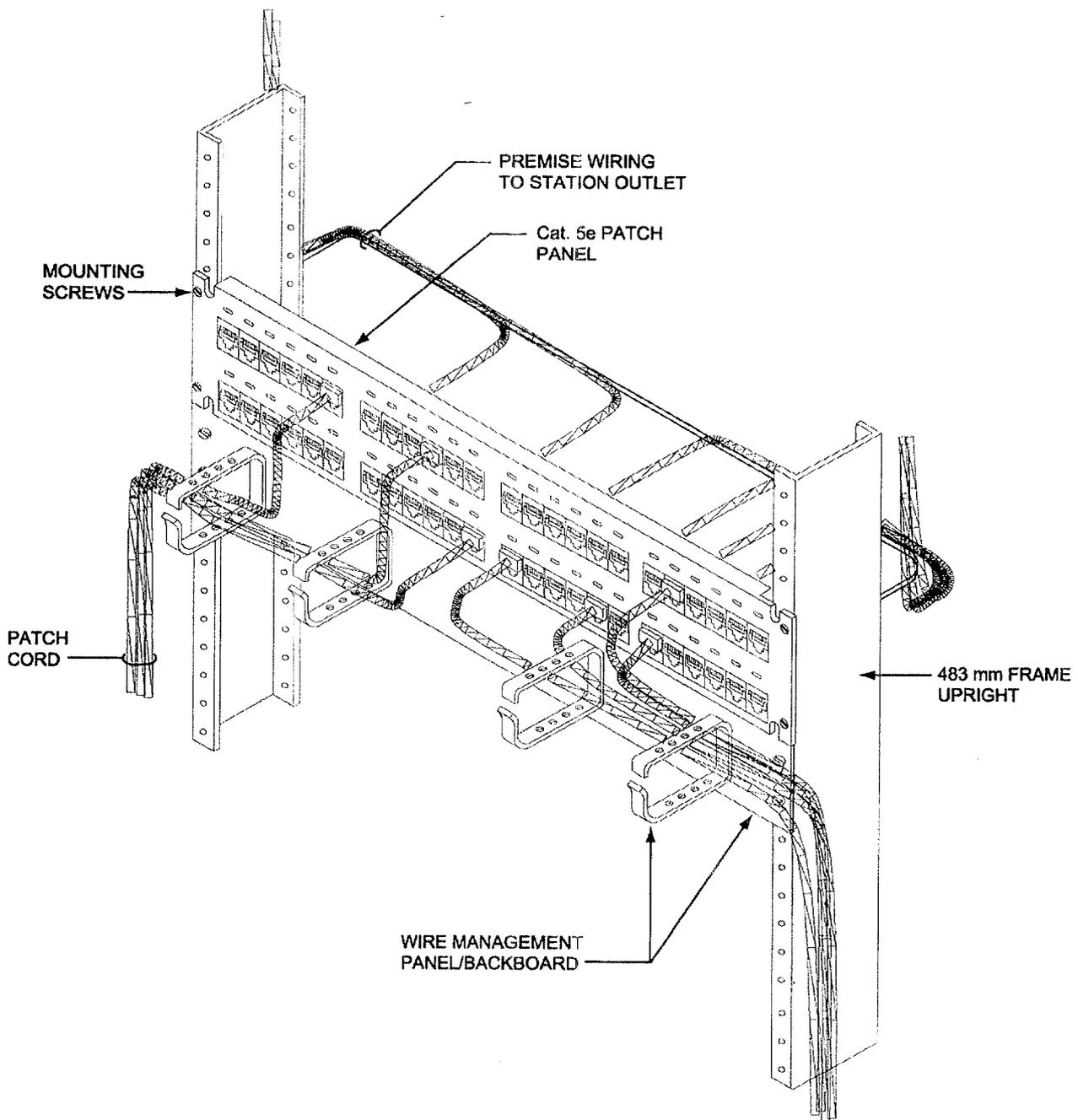


Figure A-36. Typical Patch Panel Mounting Detail

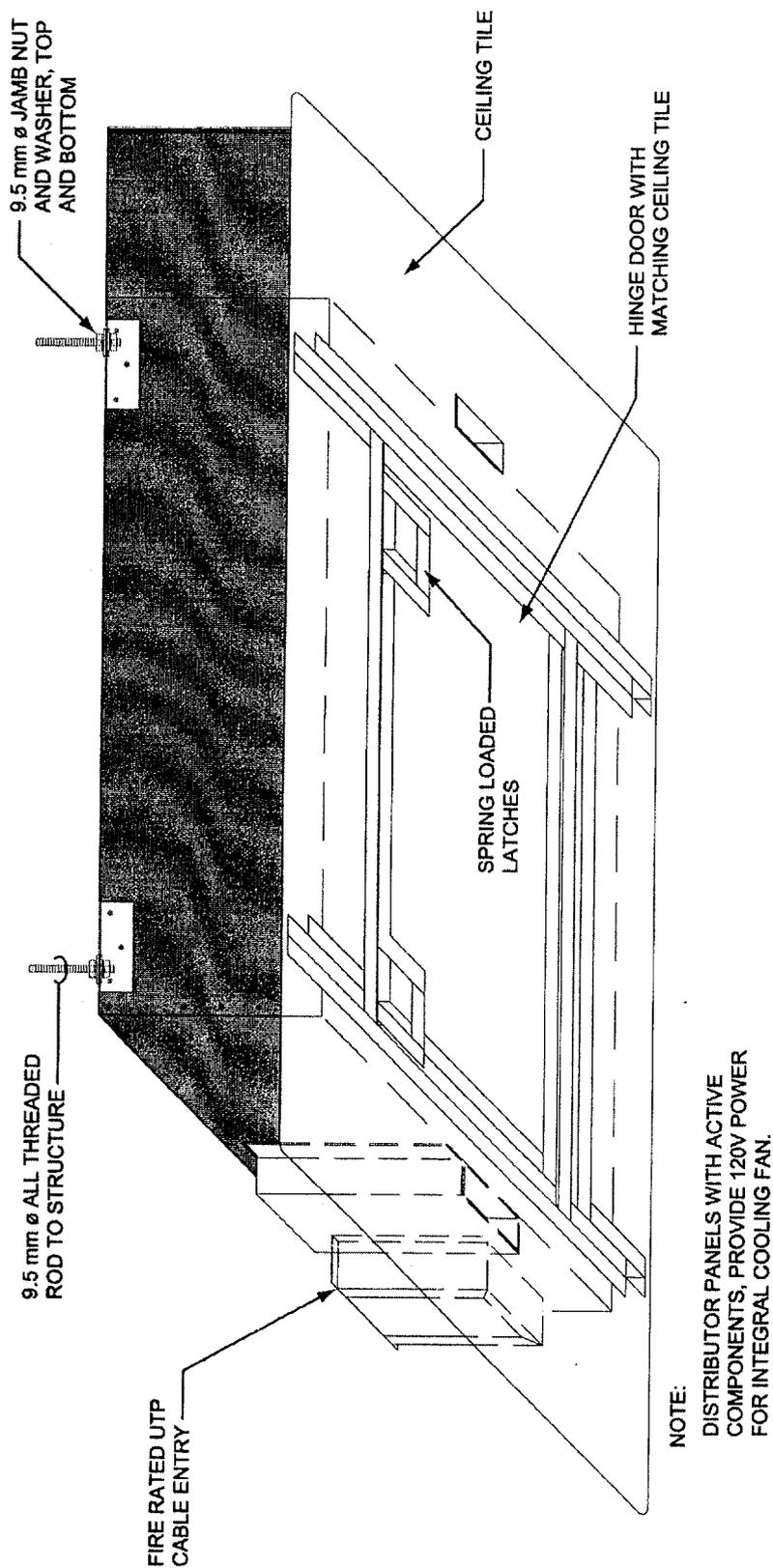


Figure A-37. Remote Distributor Panel – Ceiling Mounted

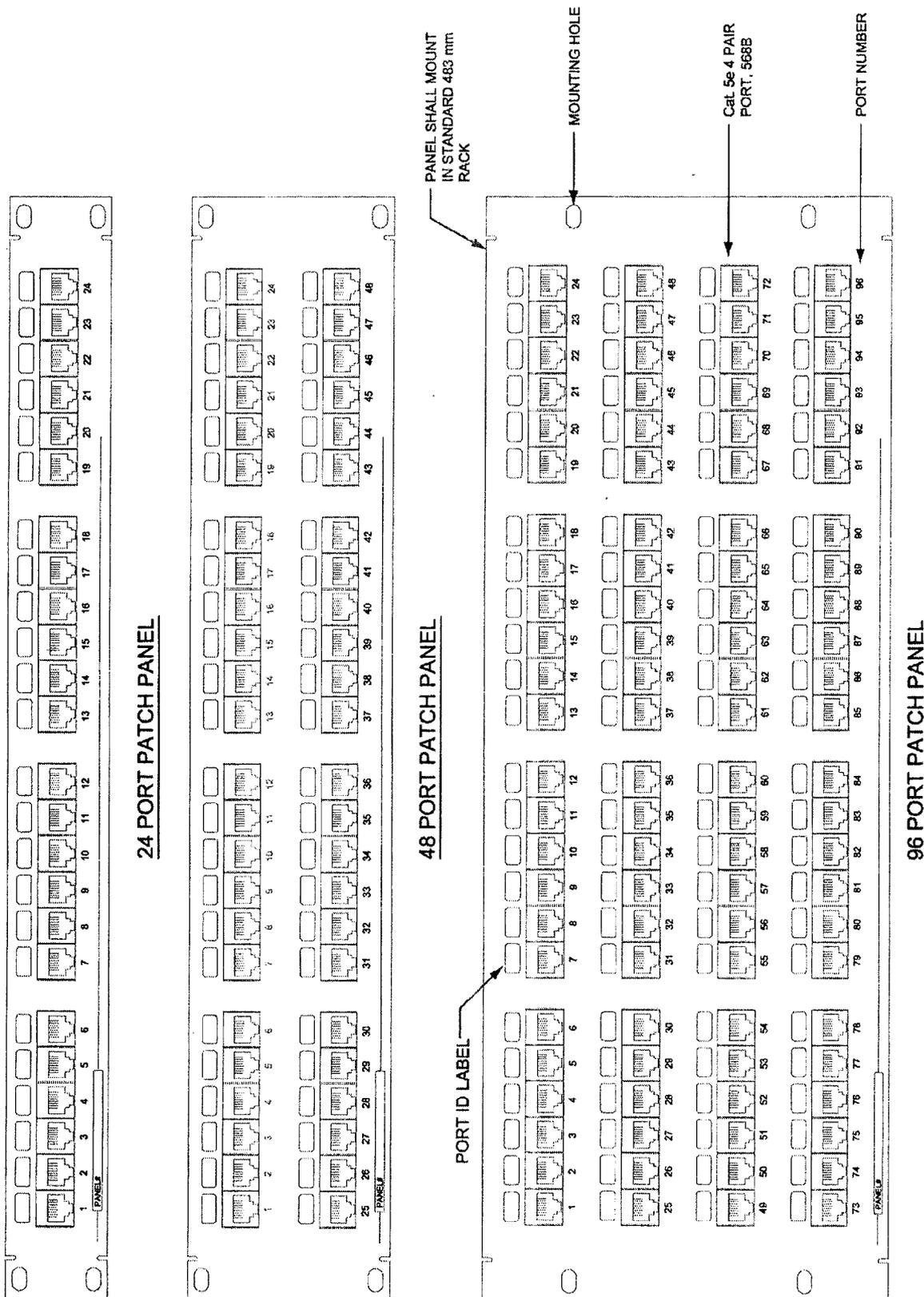
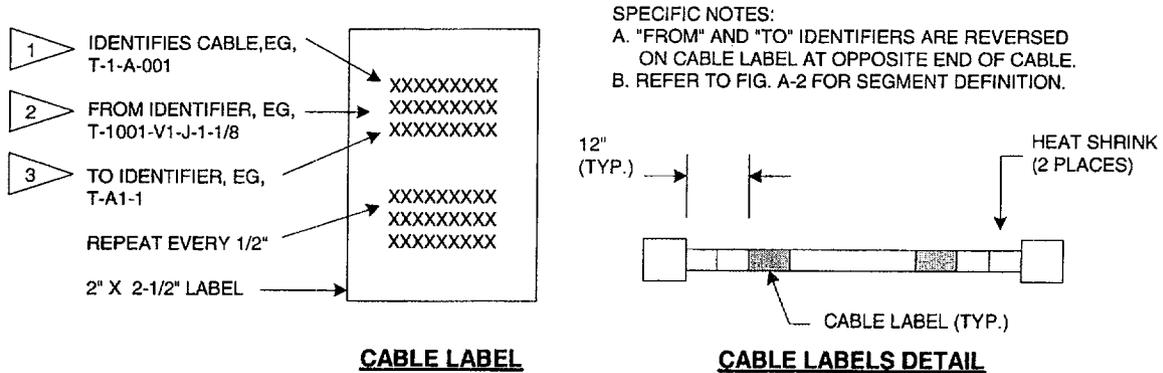


Figure A-38. Typical Cat. 5e Patch Panel Configurations for UTP Cabling



SEGMENT A CABLES		
1 LABEL	2 FROM COMM ROOM	3 TO DISTRIBUTOR
<b>TELEPHONE OR DATA SYSTEM USING 110 BLOCKS</b>		
<b>T-1-A-001</b>  CABLE NO. (001-XXX) SEGMENT FLOOR (1-10) SYSTEM (T OR D)	<b>T-1001-V1-J-1-1/8</b>  PINS ROW BLOCK (A-J) FRAME VERTICAL COMM ROOM NO. SYSTEM (T OR D)	<b>T-A1-1</b>  CONNECTOR DISTRIBUTOR NO. BUILDING ZONE SYSTEM (T OR D)
<b>TELEPHONE OR DATA SYSTEM USING RACK PATCH PANELS</b>		
<b>T-1-A-001</b>  CABLE NO. (001-XXX) SEGMENT FLOOR (1-10) SYSTEM (T OR D)	<b>T-1001-1.01-1-1</b>  CONNECTOR PANEL NUMBER RACK NUMBER COMM ROOM NO. SYSTEM (T OR D)	<b>T-A1-1</b>  CONNECTOR DISTRIBUTOR NO. BUILDING ZONE SYSTEM (T OR D)
<b>FIBER OPTIC SYSTEM</b>		
<b>F-1-A-001</b>  CABLE NO. (001-XXX) SEGMENT FLOOR (1-10) SYSTEM (F)	<b>F-1001-2.01-1-1</b>  CONNECTOR PANEL NUMBER RACK NUMBER COMM ROOM NO. SYSTEM (F)	<b>F-A1-1</b>  CONNECTOR DISTRIBUTOR NO. BUILDING ZONE SYSTEM (F)

Figure A-39. Typical Cable Labeling Instructions, Segment A Cables

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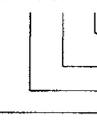
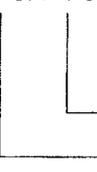
SEGMENT B CABLES USING REMOTE DISTRIBUTORS		
LABEL	FROM DISTRIBUTOR	TO CUSTOMER OUTLET (CFP)
<b>TELEPHONE OR DATA SYSTEM</b>		
<b>T-1-B-001</b>  CABLE NO. (001-XXX) SEGMENT FLOOR (1-10) SYSTEM (T OR D)	<b>T-A1-1</b>  CONNECTOR DISTRIBUTOR NO. BUILDING ZONE SYSTEM (T OR D)	<b>T-CFP-1-001-J1</b>  JACK (J1-J3) CABLE (001-XXX) FLOOR (1-10) SYSTEM (T OR D)
<b>FIBER OPTIC SYSTEM</b>		
<b>F-1-B-001</b>  CABLE NO. (001-XXX) SEGMENT FLOOR (1-10) SYSTEM (F)	<b>F-A1-1</b>  CONNECTOR DISTRIBUTOR NO. BUILDING ZONE SYSTEM (F)	<b>F-CFP-1-001-J4</b>  JACK (J4) CABLE (001-XXX) FLOOR (1-10) SYSTEM (F)
<b>BCDS SEGMENT B CABLES</b>		
LABEL	FROM TAP	TO CUSTOMER OUTLET (CFP)
<b>B-1-005</b>  CABLE NO. (001-XXX) FLOOR (1-10) SYSTEM (B)	<b>B-4A-TP1-5</b>  PORT NUMBER TAP NUMBER BRANCH DESIGNATOR SYSTEM (B)	<b>B-CFP-1-005-J2</b>  JACK (J2) CABLE (001-XXX) FLOOR (1-10) SYSTEM (B)

Figure A-40. Typical Cable Labeling Instructions, Segment B Cables Using Remote Distributors

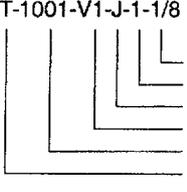
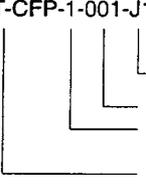
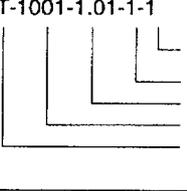
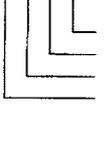
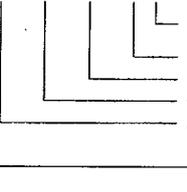
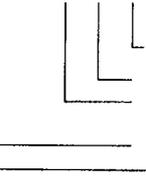
SEGMENT B CABLES WITHOUT REMOTE DISTRIBUTORS		
LABEL	FROM COMM ROOM	TO CUSTOMER OUTLET (CFP)
<b>TELEPHONE OR DATA SYSTEM USING 110 BLOCKS</b>		
<b>T-1-B-001</b>  CABLE NO. (001-XXX) SEGMENT FLOOR (1-10) SYSTEM (T OR D)	<b>T-1001-V1-J-1-1/8</b>  PINS ROW BLOCK (A-J) FRAME VERTICAL COMM ROOM NO. SYSTEM (T OR D)	<b>T-CFP-1-001-J1</b>  JACK (J1-J3) CABLE (001-XXX) FLOOR (1-10) SYSTEM (T OR D)
<b>TELEPHONE OR DATA SYSTEM USING RACK PATCH PANELS</b>		
<b>T-1-B-001</b>  CABLE NO. (001-XXX) SEGMENT FLOOR (1-10) SYSTEM (T OR D)	<b>T-1001-1.01-1-1</b>  CONNECTOR PANEL NUMBER RACK NUMBER COMM ROOM NO. SYSTEM (T OR D)	<b>T-CFP-1-001-J1</b>  JACK (J1-J3) CABLE (001-XXX) FLOOR (1-10) SYSTEM (T OR D)
<b>FIBER OPTIC SYSTEM</b>		
<b>F-1-B-001</b>  CABLE NO. (001-XXX) SEGMENT FLOOR (1-10) SYSTEM (F)	<b>F-1001-2.01-1-1</b>  CONNECTOR PANEL NUMBER RACK NUMBER COMM ROOM NO. SYSTEM (F)	<b>F-CFP-1-001-J4</b>  JACK (J4) CABLE (001-XXX) FLOOR (1-10) SYSTEM (F)

Figure A-41. Typical Cable Labeling Instructions, Segment B Cables Without Remote Distributors

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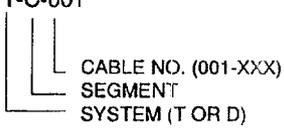
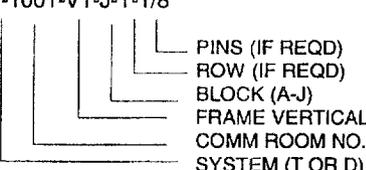
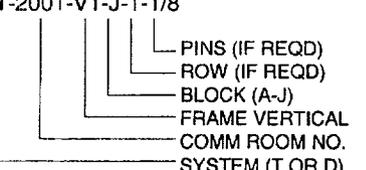
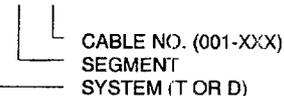
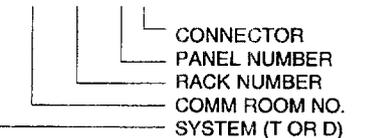
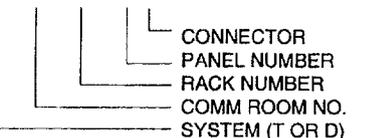
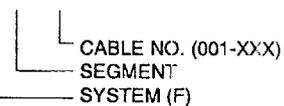
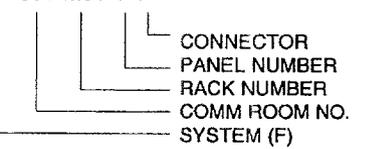
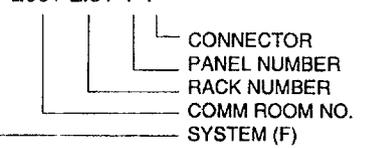
SEGMENT C CABLES		
LABEL	FROM COMM ROOM	TO COMM ROOM
<b>TELEPHONE OR DATA SYSTEM USING 110 BLOCKS</b>		
<b>T-C-001</b>  CABLE NO. (001-XXX) SEGMENT SYSTEM (T OR D)	<b>T-1001-V1-J-1-1/8</b>  PINS (IF REQD) ROW (IF REQD) BLOCK (A-J) FRAME VERTICAL COMM ROOM NO. SYSTEM (T OR D)	<b>T-2001-V1-J-1-1/8</b>  PINS (IF REQD) ROW (IF REQD) BLOCK (A-J) FRAME VERTICAL COMM ROOM NO. SYSTEM (T OR D)
<b>TELEPHONE OR DATA SYSTEM USING RACK PATCH PANELS</b>		
<b>D-C-001</b>  CABLE NO. (001-XXX) SEGMENT SYSTEM (T OR D)	<b>D-1001-1.01-1-1</b>  CONNECTOR PANEL NUMBER RACK NUMBER COMM ROOM NO. SYSTEM (T OR D)	<b>D-2001-1.01-1-1</b>  CONNECTOR PANEL NUMBER RACK NUMBER COMM ROOM NO. SYSTEM (T OR D)
<b>FIBER OPTIC SYSTEM</b>		
<b>F-C-001</b>  CABLE NO. (001-XXX) SEGMENT SYSTEM (F)	<b>F-1001-2.01-1-1</b>  CONNECTOR PANEL NUMBER RACK NUMBER COMM ROOM NO. SYSTEM (F)	<b>F-2001-2.01-1-1</b>  CONNECTOR PANEL NUMBER RACK NUMBER COMM ROOM NO. SYSTEM (F)

Figure A-42. Typical Cable Labeling Instructions, Segment C Cables

COMM ROOM	DIST	USER NUMBER ASSIGNMENTS
<b>FIRST FLOOR</b>		
1001	A1	001 THRU 024
	A2	025 THRU 048
1025	A3 (12)	049 THRU 072
	B1 (12)	073 THRU 096
	B2	097 THRU 120
	B 3(12)	121 THRU 144
	B4 (12)	145 THRU 168
	B5 (12)	169 THRU 192
	C1 (12)	193 THRU 216
	C2 (12)	217 THRU 240
	C3 (12)	241 THRU 264
	C4	265 THRU 288
	C5	289 THRU 312
	C6	313 THRU 336
	C7 (12)	337 THRU 360
	C8	361 THRU 384
	C9 (12)	385 THRU 408
	C10 (12)	409 THRU 432
	D1	433 THRU 456
	D2 (12)	457 THRU 480
	D3	481 THRU 504
	D4	505 THRU 528
	D5 (12)	529 THRU 552
	D6 (12)	553 THRU 576
<b>SECOND FLOOR</b>		
	A1	001 THRU 024
	A2	025 THRU 048
	A3	049 THRU 072
	A4 (12)	073 THRU 096
	A5	097 THRU 120
	B1	529 THRU 552
	B2	553 THRU 576
	B3	577 THRU 600
	B4	601 THRU 624
	B5	625 THRU 648
	B-6 (12)	649 THRU 672
	B7	673 THRU 696
	B8	697 THRU 720
	B9	721 THRU 744
	B10 (12)	745 THRU 768
	B11	769 THRU 792
	C1	793 THRU 816
	C2	817 THRU 840
	C3	841 THRU 864
	D1	865 THRU 888
	D2	889 THRU 912
	D3	913 THRU 936
	D4	937 THRU 960

Figure A-43. Typical User Number Assignments

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BCDS USER NUMBER ASSIGNMENTS		
AMPLIFIER	8 PORT MULTAPAR	USER DESIGNATION
AMP-NUMBER	TAP-NO-PORT	ROOM-TAP-NO *-USER-JACK
TA44  TA44	TP44-1-1	XXX-TP44-1-1-J2
	TP44-1-2	XXX-TP44-1-2-J2
	TP44-1-3	XXX-TP44-1-3-J2
	TP44-1-4	XXX-TP44-1-4-J2
	TP44-1-5	XXX-TP44-1-5-J2
	TP44-1-6	XXX-TP44-1-6-J2
	TP44-1-7	XXX-TP44-1-7-J2
	TP44-1-8	NOT AVAILABLE
	TP44-2-1	XXX-TP44-2-8-J2
	TP44-2-2	XXX-TP44-2-9-J2
	TP44-2-3	XXX-TP44-2-10-J2
	TP44-2-4	XXX- TP44-2-1 1 -J2
	TP44-2-5	XXX-TP44-2-12-J2
	TP44-2-6	XXX-TP44-2-13-J2
	TP44-2-7	XXX-TP44-2-14-J2
	TP44-2-8	NOT AVAILABLE
	TP44-3-1	XXX-TP44-3-15-J2
	TP44-3-2	XXX-TP44-3-16-J2
	TP44-3-3	XXX-TP44-3-17-J2
	TP44-3-4	XXX-TP44-3-18-J2
	TP44-3-5	XXX-TP44-3-19-J2
	TP44-3-6	XXX-TP44-3-20-J2
	TP44-3-7	XXX- TP44-3-21 -J2
	TP44-3-8	NOT AVAILABLE

\* USER INFORMATION OUTLET NUMBER IS SHARED  
WITH TELEPHONE AND DATA SYSTEMS (J1, J3, AND J4)

Figure A-44. Typical BCDS User Number Assignment

Telephone or Data Cat. 5e (T or D)				
COMM Room #	4 PAIR USER SEGMENT A	DIST. PANELS	4 PAIR USER SEGMENT B	USER ID CFP & JACK
SYS - FRAME-BLOCK-ROW-PINS	SYSTEM-FLOOR-SEGMENT-CABLE NO.	SYSTEM- ZONE DISTR-CONN	SYSTEM-FLOOR-SEGMENT-CABLE NO.	CFP-FLOOR-USER#-JACK
T(D)-VI-J-1-1/8	T(D)-1-A-001	T(D)-A1-1	T(D)-1-B-001	CFP-1-001-JX*
↕	T(D)-1-A-002	T(D)-A1-2	T(D)-1-B-002	CFP-1-002-JX*
	T(D)-1-A-003	T(D)-A1-3	T(D)-1-B-003	CFP-1-003-JX*
	T(D)-1-A-004	T(D)-A1-4	T(D)-1-B-004	CFP-1-004-JX*
	T(D)-1-A-005	T(D)-A1-5	T(D)-1-B-005	CFP-1-005-JX*
T(D)-VI-J-1-41/48	T(D)-1-A-006	T(D)-A1-6	T(D)-1-B-006	CFP-1-006-JX*
T(D)-VI-J-2-1/8	T(D)-1-A-007	T(D)-A1-7	T(D)-1-B-007	CFP-1-007-JX*
↕	T(D)-1-A-008	T(D)-A1-8	T(D)-1-B-008	CFP-1-008-JX*
	T(D)-1-A-009	T(D)-A1-9	T(D)-1-B-009	CFP-1-009-JX*
	T(D)-1-A-010	T(D)-A1-10	T(D)-1-B-010	CFP-1-010-JX*
	T(D)-1-A-011	T(D)-A1-11	T(D)-1-B-011	CFP-1-011-JX*
T(D)-VI-J-1-2-41/48	T(D)-1-A-012	T(D)-A1-12	T(D)-1-B-012	CFP-1-012-JX*
T(D)-VI-J-3-1/8	T(D)-1-A-013	T(D)-A1-13	T(D)-1-B-013	CFP-1-013-JX*
↕	T(D)-1-A-014	T(D)-A1-14	T(D)-1-B-014	CFP-1-014-JX*
	T(D)-1-A-015	T(D)-A1-15	T(D)-1-B-015	CFP-1-015-JX*
	T(D)-1-A-016	T(D)-A1-16	T(D)-1-B-016	CFP-1-016-JX*
	T(D)-1-A-017	T(D)-A1-17	T(D)-1-B-017	CFP-1-017-JX*
T(D)-VI-J-3-41/48	T(D)-1-A-018	T(D)-A1-18	T(D)-1-B-018	CFP-1-018-JX*
T(D)-VI-J-4-1/8	T(D)-1-A-019	T(D)-A1-19	T(D)-1-B-019	CFP-1-019-JX*
↕	T(D)-1-A-020	T(D)-A1-20	T(D)-1-B-020	CFP-1-020-JX*
	T(D)-1-A-021	T(D)-A1-21	FUTURE	FUTURE
	T(D)-1-A-022	T(D)-A1-22	FUTURE	FUTURE
	T(D)-1-A-023	T(D)-A1-23	FUTURE	FUTURE
T(D)-VI-J-1-4-41/48	T(D)-1-A-024	T(D)-A1-24	FUTURE	FUTURE

\*FOR TELEPHONE  
X=1; DATA X=3

Figure A-45. Typical Telephone or Data Cat. 5e Cable Schedule  
(Using 110 Blocks and Remote Distributors)

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Telephone or Data Cat. 5e (T or D)				
COMM Room #	4 PAIR USER SEGMENT A	DIST. PANELS	4 PAIR USER SEGMENT B	USER ID CFP & JACK
SYS - FRAME-BLOCK-ROW-PINS	NONE	NONE	SYSTEM-FLOOR-SEGMENT-CABLE NO.	CFP-FLOOR-USER#-JACK
T(D)-VI-J-1-1/8			T(D)-1-B-001	CFP-1-001-JX*
↕			T(D)-1-B-002	CFP-1-002-JX*
			T(D)-1-B-003	CFP-1-003-JX*
			T(D)-1-B-004	CFP-1-004-JX*
			T(D)-1-B-005	CFP-1-005-JX*
T(D)-VI-J-1-41/48			T(D)-1-B-006	CFP-1-006-JX*
T(D)-VI-J-2-1/8			T(D)-1-B-007	CFP-1-007-JX*
↕			T(D)-1-B-008	CFP-1-008-JX*
			T(D)-1-B-009	CFP-1-009-JX*
			T(D)-1-B-010	CFP-1-010-JX*
			T(D)-1-B-011	CFP-1-011-JX*
T(D)-VI-J-1-2-41/48			T(D)-1-B-012	CFP-1-012-JX*
T(D)-VI-J-3-1/8			T(D)-1-B-013	CFP-1-013-JX*
↕			T(D)-1-B-014	CFP-1-014-JX*
			T(D)-1-B-015	CFP-1-015-JX*
			T(D)-1-B-016	CFP-1-016-JX*
			T(D)-1-B-017	CFP-1-017-JX*
T(D)-VI-J-3-41/48			T(D)-1-B-018	CFP-1-018-JX*
T(D)-VI-J-4-1/8			T(D)-1-B-019	CFP-1-019-JX*
↕			T(D)-1-B-020	CFP-1-020-JX*
			T(D)-1-B-021	CFP-1-021-JX*
			T(D)-1-B-022	CFP-1-022-JX*
			T(D)-1-B-023	CFP-1-023-JX*
T(D)-VI-J-1-4-41/48			T(D)-1-B-024	CFP-1-024-JX*

\*FOR TELEPHONE  
 X=1; DATA X=3

Figure A-46. Typical Telephone or Data Cat. 5e Cable Schedule  
 (Using 110 Blocks Without Remote Distributors)



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Telephone or Data Cat. 5e (T or D)				
COMM Room #	4 PAIR USER SEGMENT A	DIST. PANELS	4 PAIR USER SEGMENT B	USER ID CFP & JACK
SYS - RACK-PNL-CONN	NONE	NONE	SYSTEM-FLOOR-SEGMENT-CABLE NO.	CFP-FLOOR-USER#-JACK
T(D)-1.01-1-1			T(D)-1-B-001	CFP-1-001-JX*
			T(D)-1-B-002	CFP-1-002-JX*
			T(D)-1-B-003	CFP-1-003-JX*
			T(D)-1-B-004	CFP-1-004-JX*
			T(D)-1-B-005	CFP-1-005-JX*
			T(D)-1-B-006	CFP-1-006-JX*
			T(D)-1-B-007	CFP-1-007-JX*
			T(D)-1-B-008	CFP-1-008-JX*
			T(D)-1-B-009	CFP-1-009-JX*
			T(D)-1-B-010	CFP-1-010-JX*
			T(D)-1-B-011	CFP-1-011-JX*
			T(D)-1-B-012	CFP-1-012-JX*
			T(D)-1-B-013	CFP-1-013-JX*
			T(D)-1-B-014	CFP-1-014-JX*
			T(D)-1-B-015	CFP-1-015-JX*
			T(D)-1-B-016	CFP-1-016-JX*
			T(D)-1-B-017	CFP-1-017-JX*
			T(D)-1-B-018	CFP-1-018-JX*
			T(D)-1-B-019	CFP-1-019-JX*
			T(D)-1-B-020	CFP-1-020-JX*
			T(D)-1-B-021	CFP-1-021-JX*
			T(D)-1-B-022	CFP-1-022-JX*
			T(D)-1-B-023	CFP-1-023-JX*
T(D)-1.01-1-24			T(D)-1-B-024	CFP-1-024-JX*

\*FOR TELEPHONE  
X=1; DATA X=3

Figure A-48. Typical Telephone or Data Cat. 5e Cable Schedule  
 (Using Rack Patch Panels Without Remote Distributors)

Fiber Optic (F)				
COMM Room #	2 FIBER USER SEGMENT A	DIST. PANELS	2 FIBER USER SEGMENT B	USER ID CFP & JACK
SYS – RACK-PNL-CONN	SYSTEM-FLOOR-SEGMENT-CABLE NO.	SYSTEM- ZONE DISTR-CONN	SYSTEM-FLOOR-SEGMENT-CABLE NO.	CFP-FLOOR-USER#-JACK
F-1.02-1-1	F-1-A-001	F-A1-1	F-1-B-001	CFP-1-001-J4
	F-1-A-002	F-A1-2	F-1-B-002	CFP-1-002-J4
	F-1-A-003	F-A1-3	F-1-B-003	CFP-1-003-J4
	F-1-A-004	F-A1-4	F-1-B-004	CFP-1-004-J4
	F-1-A-005	F-A1-5	F-1-B-005	CFP-1-005-J4
	F-1-A-006	F-A1-6	F-1-B-006	CFP-1-006-J4
	F-1-A-007	F-A1-7	F-1-B-007	CFP-1-007-J4
	F-1-A-008	F-A1-8	F-1-B-008	CFP-1-008-J4
	F-1-A-009	F-A1-9	F-1-B-009	CFP-1-009-J4
	F-1-A-010	F-A1-10	F-1-B-010	CFP-1-010-J4
	F-1-A-011	F-A1-11	F-1-B-011	CFP-1-011-J4
	F-1-A-012	F-A1-12	F-1-B-012	CFP-1-012-J4
	F-1-A-013	F-A1-13	F-1-B-013	CFP-1-013-J4
	F-1-A-014	F-A1-14	F-1-B-014	CFP-1-014-J4
	F-1-A-015	F-A1-15	F-1-B-015	CFP-1-015-J4
	F-1-A-016	F-A1-16	F-1-B-016	CFP-1-016-J4
	F-1-A-017	F-A1-17	F-1-B-017	CFP-1-017-J4
	F-1-A-018	F-A1-18	F-1-B-018	CFP-1-018-J4
	F-1-A-019	F-A1-19	F-1-B-019	CFP-1-019-J4
	F-1-A-020	F-A1-20	F-1-B-020	CFP-1-020-J4
	F-1-A-021	F-A1-21	F-1-B-021	CFP-1-021-J4
	F-1-A-022	F-A1-22	F-1-B-022	CFP-1-022-J4
	F-1-A-023	F-A1-23	F-1-B-023	CFP-1-023-J4
F-1.02-1-24	F-1-A-024	F-A1-24	F-1-B-024	CFP-1-024-J4

Figure A-49. Typical Fiber Optic Cable Schedule  
(Using Remote Distributors)

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Fiber Optic (F)				
COMM Room #	SEGMENT A	DIST. PANELS	2 FIBER USER SEG- MENT B	USER ID CFP & JACK
SYS - RACK- PNL-CONN	NONE	NONE	SYSTEM-FLOOR- SEGMENT- CABLE NO.	CFP-FLOOR- USER#-JACK
F-1.02-1-1  F-1.02-1-24			F-1-B-001	CFP-1-001-J4
			F-1-B-002	CFP-1-002-J4
			F-1-B-003	CFP-1-003-J4
			F-1-B-004	CFP-1-004-J4
			F-1-B-005	CFP-1-005-J4
			F-1-B-006	CFP-1-006-J4
			F-1-B-007	CFP-1-007-J4
			F-1-B-008	CFP-1-008-J4
			F-1-B-009	CFP-1-009-J4
			F-1-B-010	CFP-1-010-J4
			F-1-B-011	CFP-1-011-J4
			F-1-B-012	CFP-1-012-J4
			F-1-B-013	CFP-1-013-J4
			F-1-B-014	CFP-1-014-J4
			F-1-B-015	CFP-1-015-J4
			F-1-B-016	CFP-1-016-J4
			F-1-B-017	CFP-1-017-J4
			F-1-B-018	CFP-1-018-J4
			F-1-B-019	CFP-1-019-J4
			F-1-B-020	CFP-1-020-J4
			F-1-B-021	CFP-1-021-J4
			F-1-B-022	CFP-1-022-J4
			F-1-B-023	CFP-1-023-J4
			F-1-B-024	CFP-1-024-J4

Figure A-50. Typical Fiber Optic Cable Schedule  
 (Without Remote Distributors)

BCDS CABLE SCHEDULE								
BCDS CABLES FIRST LEVEL			BCDS CABLES SECOND LEVEL			BCDS CABLES THIRD LEVEL		
BRANCH CABLES ( BCDS)			BRANCH CABLES ( BCDS)			BRANCH CABLES ( BCDS)		
FROM	TO	LENGTH	FROM	FROM	LENGTH	FROM	TO	LENGTH
TA-44	44TP1	25'	TA-45	45TP1	40'	TA-46	46SP1	10'
44TP1	44TP2	50'	45TP1	45TP2	20'	46SP1	46ATP1	25'
44TP2	44TP3	120'	45TP2	45TP3	15'	46ATP1	46ATP2	25'
44TP3	44TP4	(NOTE A)	45TP3	45TP4	15'	46ATP2	46ATP3	25'
44TP4	44TP5	70'	45TP4	45TP5	15'	46ATP3	46ATP4	(NOTE A)
44TP5	44EH1	30'	45TP5	45TP6	15'	46ATP4	46ATP5	25'
44EH1	4TP6	(NOTE A)	45TP6	45SP1	15'	46ATP5	46ATP6	25'
44TP6	44TP7	60'	45SP1	45ATP1	45'	46ATP6	46ATP7	25'
44TP7	44TP8	135'	45ATP1	45ATP2	20'	46ATP7	46ATP8	(NOTE A)
44TPB	44TP9	(NOTE A)	45ATP2	45ATP3	20'	46ATP8	46ATP9	25'
			45ATP3	45ATP4	20'	46ATP9	46ATP10	25'
TA-48	44TP1	60'	45ATP4	45ATP4	20'	46ATP10	46ATP11	25'
48TP1	44TP2	15'	45SP1	45ATP5	30'	46ATP11	46ATP12	(NOTE A)
48TP2	44TP3	45'	45BTP1	45BTP1	70'			
48TP3	44TP4	75'	45BTP2	45BTP2	20'	46SP1	46BTP1	65'
48TP4	44TP5	50'	45BEH1	45BTP3	(NOTE A)	468TP1	46BTP2	15'
48TP5	48EH1	50'	45BTP3	45BTP4	20'	46BTP2	468TP3	15'
48EH1	48TP6	(NOTE A)	45BTP4	45BTP5	20'	46BTP3	46BTP4	15'
48TP6	48TP7	15'	45BTP5	45BTP6	20'	46BTP4	46BTP5	20'
48TP7	48TP8	60'				46BTP5	468TP6	(NOTE A)
48TP8	48TP9	65'				46BTP6	46BTP7	50'
			TA-51	51TP1	50'	46BTP7	46BTP8	15'
			51TP1	51TP2	20'	46BTP8	46BTP9	15'
TA-49	49TP1	50'	51TP2	51TP3	20'	46BTP9	468TP10	20'
49TP1	49TP2	30'	51TP3	51TP4	30'	46BTP10	46BTP11	20'
49TP2	49TP3	30'	51TP4	51TP5	20'	46BTP11	46BTP12	(NOTE A)
49TP3	49TP4	30'	51TP5	51TP6	20'			
49TP4	49TP5	125'	51TP6	51TP7	20'	TA-47	47DC1	10'
49TP5	49TP7	30'	51TP7	51TP8	20'	47DC1	47DC2	55'
49TP6	49TP6	30'	51TP8	51TP9	20'	47DC2	47TP1	10'
49TP7	49EH1	20'	51TP9	51TP10	60'	47TP1	47TP2	15
49EH1	49TP8	(NOTE A)	51TP10	51TP11	20'	47TP2	47TP3	(NOTE A)
49TP8	49TP9	75'				47TP3	47TP4	15'
49TP9	49TP10	30'	TA-52	52SP1	20'	47TP4	47EH1	15'
49TP10	49TP11	30'	52SP1	52ATP1	15'			
49TP11	49TP12	30'	52ATP1	52ATP2	25'			

Figure A-51. Typical BCDS Cable Schedule

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APPENDIX B  
DEFINITIONS

This is a glossary of terms used in the PDS documentation. Some definitions have been slightly modified to better illustrate unique PDS concepts.

**Acceptance Tests:** Tests used to determine if the transmission cable and components meet a defined specification.

**Adapter:** A device that enables different sizes or types of plugs to mate with one another, providing for the rearrangement of leads or making interconnections between cables.

**Administration:** The method for labeling, documentation, and usage needed to implement moves, additions, and changes of the telecommunications infrastructure.

**Americans With Disabilities Act (ADA):** Civil Rights Law. United States Department of Justice regulations and guides, which ensure that individuals with disabilities have access to, or can use, every public place and business facility.

**Analog:** A format that uses continuous variables such as voltage amplitude or frequency variations to transmit information.

**Anneal:** To soften and relieve strains of any solid material, such as metal or glass, by heating to just below its melting point and then slowly cooling it.

**Annealed Wire:** Soft wire.

**Attenuation:** The decrease in magnitude of a wave as it travels through any transmitting medium such as a cable or circuitry.

**10BASE5:** A network conforming to IEEE 802.3 LAN standard, also known as standard Ethernet, and carries information at rates of 10 MBPS, uses coaxial cables up to a distance of 500 meters (1640 feet).

**10BASEF:** Operates over fiber optics on a Star topology with a physical central Hub acting as the network distribution point.

**Backbone:** Premises Distribution System terminology for that part of the distribution system, including both wire and fiber cables, which is often called the riser.

**Bandwidth:** The width of a communication channel, measured as a frequency (hertz per second), and is a major factor in determining how much information it can carry.

**Baseband:** A signaling technique in which the signal is transmitted in its original form and not changed by modulation.

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**Bend Radius:** The radius that cable can bend before the risk of damage or decrease in transmission performance.

**Bits per Second (BPS):** The number of bits passing a point per second.

**Braid:** Textile or metallic filaments interwoven to form a tubular structure that may be applied over one or more wires or flattened to form a strap.

**Broadband ISDN:** A proposed form of the Integrated Services Digital Network (ISDN), which will carry digital transmission at rates equal to or greater than the T-1 rate (1.544 megabits per second).

**Broadband LAN:** Local area network (LAN) which uses frequency division multiplexing (FDM) to divide a single physical channel into a number of smaller independent frequency channels. The different channels created by FDM can be used to transfer different forms of information such as voice, data, and video.

**Buffering:** 1. A protective material extruded directly on the fiber coating to protect the fiber from the environment (tight buffered). 2. Extruding a tube around the coated fiber to allow isolation of the fiber from stresses on the cable (loose buffered).

**Building Entrance:** The room or space inside a building where telecommunications cables enter and leave the building.

**Cabinet:** A freestanding and self-supporting enclosure for housing electrical and/or electronic equipment. It is usually fitted with doors and/or side panels.

**Cable Loss:** The amount of radio frequency (RF) signal attenuated by coaxial cable transmission. The cable attenuation is a function of its frequency, media type, and cable distance. For coaxial cable, higher frequencies have greater loss than lower frequencies and follow a logarithmic function.

**Cable System:** The medium used to interconnect stations, often called the premises network.

**CATV:** Community Antenna Television - refers to the use of coaxial cable to transmit TV or other signals to subscribers from a single-headed location.

**C Connector:** A bayonet-locking connector for coaxial. Named after Carl Concelman.

**Channel:** The telecommunications circuit composed of the outlet/connector in the work (user) area, the horizontal section of the UTP cabling from the work area outlet/connector to the horizontal termination in the telecommunications closet, and the patch cord.

**Characteristic Impedance:** A frequency-dependent resistance that qualifies the complex opposition to current flow offered by a transmission line.

**Cladding:** The material surrounding the core of an optical fiber.

**Coaxial Cable:** A cylindrical transmission line composed of a conductor centered inside a metallic tube or shield, separated by a dielectric material, and usually covered by an insulating jacket.

**Composite:** The line side of a concentrator or multiplexer that includes all of the multiplexed data.

**Compression:** Two types: data compression, which reduces the number of bits required to represent data (accomplished in many ways), and analog compression, which reduces the bandwidth needed to transmit an analog signal. Also called compaction.

**Conductor:** A material suitable for carrying an electric current.

**Connector:** A device of suitable electric conductance and mechanical strength used to splice the ends of two or more cable conductors or as a terminal connector on a single conductor.

**Core:** The central region of an optical fiber through which light is transmitted.

**Cross Connect:** The apparatus in a distribution system providing for the termination of a twisted pair or optical fibers and the rearrangement and testing of circuits. In a wire cross connect, incoming and outgoing twisted pairs terminate on separate connecting blocks, and patch cords complete the circuits.

**DCE:** Data Communication Equipment (synonymous with modem) - the equipment that provides the functions to establish, maintain, and terminate a connection, as well as the signal conversion required for communications between the Data Terminal Equipment (DTE) and the telephone line.

**DC Loop Resistance:** Cable conductor resistance with the far end of the cabling shorted. This is the resistance for both conductors of a coax cable.

**Decibel:** dB - the standard unit used to express the relative strength of two signals. When referring to a signal measured at two places in a transmission system, it expresses either the gain or loss in power between the input and output.

**Delay Skew:** The difference in the propagation delay between any pairs in the same cable.

**Dial-Up Line:** The typical home or business telephone line.

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**Dielectric:** An insulating medium.

**Dispersion:** The broadening of the input light pulses along the length of the fiber.

**Distributed Architecture:** A LAN that uses a shared communication medium; used on bus or ring LAN's; uses shared access methods.

**Distribution Frame:** 1. Wall- or floor-mounted vertical frame with protectors or terminal blocks (or both) used to terminate cable pairs. 2. Structure with terminations for connecting the horizontal and backbone cabling in such a manner that interconnections and cross connections may be made.

**Distribution Panel:** A wiring board that provides a patch panel function and mounts a rack.

**DTE:** Data Terminal Equipment - the end-user machine (terminal, computer, controller, etc.), which plugs into a unit and is the termination point of the communication circuit (DCE).

**Echo:** A faint return of the transmitted signal to the originating modem when a signal is relayed by a communications satellite.

**EIA:** Electronic Industries Alliance - The U.S. organization of electronics manufacturers. It is responsible for the development and maintenance of industry standards for the interface between data processing machines and data communications equipment.

**EISA:** Extended Industry Standards Architecture - A 32-bit adaption of the 8/16-bit buses originally developed by IBM and now standard in almost all PC's that use Intel's 8086 and 80X86 microprocessors. The EISA bus is a joint development with Compaq and other PC manufacturers.

**Elastomer:** Any material that will return to its original shape after being stretched or distorted.

**ELFEXT:** Equal Level Far End Crosstalk is the ratio of the attenuated signal on one pair to the crosstalk on an adjacent pair at the far end.

**Equipment Room:** A centralized space for telecommunications equipment that serves the occupants of the building. Equipment housed herein is considered distinct from a telecommunications closet because of its nature or complexity of the equipment.

**Ethernet:** A baseband local area network specification developed by Xerox, Intel, and Digital Equipment Corporation to interconnect computer equipment using coaxial cable and transceivers.

**Facility Equipment Room:** A room or wiring closet used to store extended networking components that link one building with another building. These products include remote bridges and remote repeaters as well as X25 gateways and wide area networks.

**F-Connector:** A standard 75-ohm connector used on drop cable.

**FDDI:** Fiber Distributed Data Interface - an American National Standards Institute (ANSI) defined token-passing ring using fiber optics.

**Fiber Optic Cable:** A cable consisting of one or more optical fibers protected by buffering material and inner cable components, central member, water blocking gel, and an outer jacket.

**FSK:** Frequency Shift Keying - a modulation technique whereby two different tones represent either the 0 or the 1 state binary information.

**Full Duplex:** Two-way communication in which each modem simultaneously sends and receives data at the same rate.

**Half Duplex:** Two-way communication in which data is sent only one direction at a time.

**Half Duplex Transmission:** Transmission in either direction but not in both directions simultaneously.

**Horizontal Cabling:** Consists of cabling that extends between and includes the horizontal cross connect and the telecommunications outlet.

**Horizontal Cross Connect:** A cross connect of horizontal cabling to other cabling; e.g., horizontal, backbone equipment.

**Hub:** In LAN, the center of a Star topology network or cabling system.

**Hybrid Cable:** An assembly of two or more cables (of the same or different types or categories) bound to form a single unit.

**IEEE-488:** Institute of Electrical and Electronics Engineers-488 - a parallel interface bus consisting of 8 bi-directional data lines, 8 control lines, and 8 signal grounds, which provides for connection to an IEEE-488 device.

**IEEE-802:** Standards for the interconnection of local network computers equipment, deals with the physical link layers of the ISO model.

**Input Impedance:** The ratio of the voltage at the sending end of the line to the current in the line at the sending end.

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**Insertion Loss:** The loss in signal strength as the signal travels down a cable inserted between a source and receiver in dB.

**Insulation:** A material having good dielectric properties and used to separate close electrical components such as cable conductors and circuit components.

**Interconnect:** Typically, a jack and plug device that connects circuits in large cables to those in smaller cables.

**Intermediate Cross Connect:** A cross connect between the main cross connect and the horizontal cross connect in backbone cabling.

**Internetwork:** Between two distinct networks.

**Intranetwork:** Within one network.

**ISA: Industry Standards Organization:** - A standard approach to network design that introduces modularity by dividing the complex set of communications protocols into more manageable slices.

**Kilo:** Prefix meaning thousand.

**LAN: Local Area Network** - A network that is located in a localized geographical area and whose communication technology provides a high-bandwidth, low-cost medium to which many nodes can be connected.

**Line Fault:** A fault such as an open circuit, short circuit, or ground line in an electric line or circuit.

**Link:** A transmission path between two points, not including terminal equipment, work area cables, and equipment cables.

**Load:** A device that consumes or converts the power delivered by another device.

**Main Cross Connect:** The cross connect in the (main) equipment room for connecting entrance cables, backbone cables, and equipment cables.

**MBPS:** Megabit per second.

**Mega:** Prefix meaning million.

**Micron:** One thousandth of a millimeter, or one millionth of a meter. It is used to specify the core of fiber optic cable.

**MIL SPEC:** Military specification.

**MIPS:** Millions of instructions per second.

**Modem:** A contraction of modulate and demodulate.

**Modular:** When equipment is made of "plug units" that can be added together to make a system.

**Module:** Short for card module. A program unit or subdivision that performs one or more functions.

**Multimode Fiber:** An optical waveguide that allows many bound modes to propagate.

**Multiplex:** To transmit two or more signals over a single channel.

**N-Connector:** A threaded connector for coaxial. N is named after Paul Neill.

**NEC:** National Electrical Code.

**Network:** A series of nodes connected by communications channels.

**Node:** A workstation or terminal.

**Nominal:** Value of a measurable property by which a conductor or component is identified.

**OEM:** Original Equipment Manufacturer.

**OS/2:** An operating system developed by IBM and Microsoft for PS/2, PC AT, and compatible computers.

**Packet:** A collection of bits that contains both control information and data.

**Panels:** Flat, rectangular structural members used for external surface of equipment. Panels are designed to be mounted on the mounting flanges of cabinets or racks.

**Pathway:** A facility for the placement of telecommunications cable.

**PDN:** Public Data Network - a packeted-switched or circuit-switched network available for use by many customers.

**Plenum Cable:** A cable that is Underwriters' Laboratories Inc. (UL) listed as having adequate fire resistance and low-smoke-producing characteristics for installation without conduit in ducts.

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**Polymer:** A substance made of many repeating chemical units or molecules. The term polymer is often used in place of plastic, rubber, or elastomer.

**Propagation Delay:** The time interval required for a signal to be transmitted from one end of the circuit to the other.

**Proprietary LAN:** A LAN that runs the equipment of one vendor.

**PSN:** Packet Switching Network - a network that enables external computers and terminals to communicate with other computers linked to the network.

**PVC:** polyvinylchloride - a general-purpose thermoplastic used for wire and cable insulations and jackets.

**Raceway:** A channel for holding electric wires or cables.

**Rack:** An open structure for mounting electrical or electronic equipment.

**Riser:** Main distribution cable segments that run between floors or sections of a building.

**RJ11:** Configured as 4 or 6 contact modular phone-type plug.

**RJ45:** An 8-contact modular AT&T phone-type plug that has 4-pair unshielded twisted-pair wire (8 wires twisted in pairs).

**RS232:** An EIA recommended standard (RS) - most common standard for connecting data processing devices. RS232 defines electrical characteristics of the signal in the cable that connects DTE with DCE; it specifies 25-pin connector.

**RS232C:** A technical specification published by the EIA that specifies the mechanical and electrical characteristics of the interface for connecting DTE and DCE.

**Segment:** A length of coaxial cable made of one or more cable sections connected together with barre connectors or T-connectors.

**Shield:** A sheet, screen, or braid of metal (usually copper, aluminum, or other conducting material) placed around or between electric circuits or cables to contain unwanted radiation.

**Single-Mode Fiber:** An optical fiber in which the signal travels in one mode.

**SMDS:** Switched Multimegabit Data Service - a public connectionless packet-switch data service that provides LAN-like performance and features over a metropolitan area.

**SNA:** System Network Architecture - developed by IBM.

**SONET:** Synchronous Optical Network - an emerging broadband fiber network formed by a family of network elements that conform to the SONET interface requirements. SONET is a transport network of synchronous multiplexed tributary signals.

**Standing Wave:** The stationary pattern of waves produced by two waves of the same frequency traveling in opposite directions on the same transmission line.

**Star:** A network topology consisting of one central node with point-to-point links to several other nodes.

**ST Connector:** A metal connector with a straight tip (ST) to join the ends of optical fibers so their fine light-conducting cores meet exactly, ensuring precise optical alignment.

**STP:** Shielded Twisted Pair - two wires, usually loosely wound around each other, to help cancel out any induced noise in balanced circuits.

**Subrate:** A customer channel transmission rate less than 64 kilobit per second; i.e., 2.4, 4.8, or 19.2 Kb/s.

**T1:** The basic 24 channels, 1.544 MBPS pulse code modulation system used in the USA.

**66-Type Wiring:** A type of distribution system cross connect and termination hardware developed by AT&T in the mid 1950's.

**110-Type Connecting Block:** The part of a 110-type cross connect that terminates twisted-pair wiring and can be used with either jumper wires or patch cords to establish circuit connections.

**110-Type Wiring:** The distributions system hardware developed by AT&T, originally known as 88-type wiring.

**Telco:** Short for Telephone Company.

**Telecommunications:** The communication of information over some distance, including inter-building and intrabuilding distances. Synonym: Signal Transmission.

**Telecommunications (Communications) Closet:** An enclosed space for housing telecommunications equipment, cable terminations, and cross connects. The closet is the recognized cross connect between the backbone cable and horizontal cabling.

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**Telepower Pole:** A raceway placed between the ceiling and floor in conjunction with ceiling distribution systems. It is used for the concealment of telecommunications and electrical wiring from the ceiling space to the work area. Synonym: Power Pole.

**Thermoplastic:** A plastic material that softens and flows when heated and becomes firm when cooled. This process can be repeated many times.

**Thermoset:** A plastic material that is cross-linked by a heating process known as curing. Once cured, thermoset cannot be reshaped.

**Thin Ethernet:** IEEE 802.3 LAN that uses smaller-than-normal diameter coaxial, also known as Cheapernet.

**TIA:** Telecommunications Industry Association.

**Tight Buffer:** A cable construction where each fiber is tightly buffered by a protective thermoplastic coating to a diameter of 900 micron.

**TNC:** A threaded connector for miniature coaxial, an abbreviation of threaded Neil Concelman. Contrast with ENC.

**Token Bus:** A LAN access mechanism and topology in which all stations actively attached to the bus listen for a broadcast token or supervisory frame; stations wishing to transmit must receive the token before doing so.

**Token Ring:** The token access procedure used on a network with sequential or ring topology; passes tokens from adapter to adapter.

**Topology:** The configuration of network nodes and links. Description of the physical geometric arrangement of the links and nodes that makes up a network. Examples of topologies are Bus, Ring, Star, and Tree.

**Transmission Line:** The conductors used to carry electrical energy from one location to another.

**Transmission Media:** The various types of wire and optical fiber cable used for transmitting voice, data, and video.

**Trunk:** A carrier facility between two switches.

**Twisted Pair:** A multiple-conductor cable whose component cables are paired together, twisted, and enclosed within a single jacket.

**UL:** Underwriters' Laboratories Inc., tested and approved by UL.

**UTP:** Unshielded Twisted Pair - two wires usually twisted around each other to help cancel out any induced noise in balanced circuits.

**Vines:** Banyan's highly regarded LAN network.

**Virtual Circuit:** A circuit, generally established on demand, that permits communication between two points without a direct, dedicated link between them.

**Voice-Grade Channel:** A channel or line that offers the minimum bandwidth suitable for voice frequencies, usually 300 to 3400 bits per second.

**Wideband:** A communications channel offering a transmission bandwidth greater than a voice-grade channel. Synonymous with broadband.

**Wire:** A rod filament of drawn or rolled metal whose length is great in comparison with the major axis of its cross section.

**Wire Cross Connect:** The apparatus at which twisted pairs are terminated to permit circuit rearrangement and testing. Cross connects are usually located in equipment rooms and service closets.

**Wiring Block:** A molded plastic that is designed in various configurations to terminate cable pairs and establish pair location on a 110-type cross connect.

**Wiring Closet:** A room containing one or more distribution racks and panels used to connect various cables together to form physical networks.

**Wiring Concentrator:** A lobe concentrator that allows multiple attaching devices access to the ring at a central point such as a wiring closet or in an open work area.

**Work Station:** An input/output device that allows either the transmission of data or the reception of data from a host system, as needed to perform a job.

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3. DOCUMENT TITLE

KSC Telecommunication Premises Distribution Systems, Design of, Standard for

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