14.4.2 Design and Structural Requirements

Data center telecommunications spaces such as the MDA and entrance room(s), shall be sized for full data center occupancy, including all anticipated expansions and planned applications.

All data center spaces for telecommunications shall have the same mechanical and electrical redundancy as the computer room(s).

The computer room shall provide an operational environment in line with the limits and requirements set out in the applicable telecommunications cabling and data center standards for an $M_1I_1C_1E_1$ environment (see ISO/IEC TR 29106 or TIA TSB-185).

See Section 7 regarding architectural requirements and recommendations for telecommunications spaces, including door sizes and ceiling heights.

14.4.3 Entrance Rooms

14.4.3.1 Introduction

The entrance room may include both access provider and customer-owned cabling. This space may include the access provider demarcation hardware and access provider equipment and the location where conversion takes place between cabling that is suitable for outside plant applications and cabling that is suitable for premises (i.e., inside plant) applications.

The entrance room interfaces with the data center through the MDA. However, direct connections from intermediate distribution areas (IDAs) or horizontal distribution areas (HDAs) to the entrance rooms are permitted to avoid exceeding circuit distance limitations. The entrance room may be adjacent to or combined with the MDA.

14.4.3.2 Requirements

Access providers that serve the building shall be contacted to ascertain the point(s) of entry to the property and the requirements for their telecommunications cabling, terminations, and equipment.

Class C2 and higher data centers shall have diverse entrance facilities, preferably with route diversity from the data center to different access providers. For example, a Class C2 data center may be served from multiple central offices and multiple service provider point-of-presences that enter the property at different locations.

The location of each building entrance facility shall be coordinated with routing of access provider pathways as well as internal pathways and shall not conflict with the location of other building facilities such as power, gas, and water.

14.4.3.3 Recommendations

Each building point-of-entry supporting an access provider's outside plant facilities should be located on different (or even opposite) sides of the building. Conduit duct banks and their associated maintenance holes and other pathways from the access provider central offices and service provider point-of-presences to the building's entrance facilities should be separated by at least 20 m (66 ft) along their entire routes.

A conduit duct bank with appropriately placed maintenance holes that surrounds a data center and incorporates multiple building entrance facilities should be considered for the data center. At least one conduit for replacement cables should be set aside for each internal and entrance pathway to facilitate rapid replacement of cables. The use of innerduct, either conventional or fabric, is recommended to aid in cable management and increased utilization of available conduit space.

When using multiple entrance rooms, entrance rooms should be at least 20 m (66 ft) apart and be in separate fire protection zones. The two entrance rooms should not share power distribution units or air conditioning equipment.

Telecommunications entrance cabling for data centers should not be routed through a common equipment room unless cabling is segregated from common access via conduit or other means.

Entrance rooms should be outside the computer room proper to improve security. However, they may be placed in the computer room or consolidated with the main distribution area if cabling distances for circuits is an issue, security is not an issue, or other security measures are used to ensure security (such as escorting and monitoring the activities of all technicians in the computer room).

Fiber density inside optical fiber cables are increasing rapidly to keep up with greater data bandwidth. This has impact on splice/patching volume in ER, which should be considered when designing an ER. This may go all the way up to providing greater floor space for ER.

The following should be considered when designing the entrance room:

- Cable quantities, dimensions, and weights
- Required number and sizes of conduits
- Conduit, tray, optical fiber duct and other pathway weight and fill capacities
- Physically clear and simple demarcation point between the access provider and customers

14.4.3.4 Additional Information

Where used for the purpose of demarcation, the entrance room typically has separate areas for access provider demarcation:

- Demarcation for balanced twisted-pair circuits (e.g., DS-0, ISDN BRI, telephone lines, DS-1 [T-1 or fractional T-1], ISDN Primary Rate, E-1 [CEPT-1])
- Demarcation for coaxial cabling circuits, (e.g., DS-3 [T-3] and E-3 [CEPT-3])
- Demarcation for optical fiber circuits (e.g., SONET/SDH, Fast Ethernet, 1/10/40/100 Gigabit Ethernet)

Each of these functions may be provided on customer-provided meet-me racks, cabinets, or frames where all service providers hand-off their circuits (see Section 14.6.3).

If an access provider demarks its services into cabinets or racks, the customer typically installs cabling from that access provider's demarcation point to the desired patching location or user equipment.

14.4.4 Main Distribution Area (MDA)

14.4.4.1 Introduction

The MDA includes the main cross-connect (MC), which is the central point of distribution for the data center structured cabling system. The main cross-connect is called the main distributor (MD) in CENELEC EN 50173-5 and in ISO/IEC 24764.

Equipment typically located in the MDA includes:

- Core routers
- Core, spine, or interconnection layer LAN and SAN switches
- High-performance computing switches
- PBX or voice gateways
- T-3 (M13) multiplexers

The MDA may serve one or more IDAs, HDAs, and EDAs within the data center and one or more telecommunications rooms (TRs) located outside the computer room space to support office spaces, operations center, and other external support rooms.

The MDA may include a horizontal cross-connect (TIA) or zone distributor (ISO/CENELEC) when equipment areas are served directly from the MDA. This space is inside the computer room; it may be located in a dedicated room for improved security.

14.4.4.2 Requirements

Every data center shall have at least one MDA. A second MDA shall be provided to meet the availability requirements of the telecommunications infrastructure (e.g., Class C4). If two MDAs are present, both shall meet all requirements of the MDA as specified in the applicable data center standard.

Access provider provisioning equipment (e.g., M13 multiplexers) may be located in the MDA rather than in the entrance room to avoid the need for a second entrance room because of circuit distance restrictions.

14.4.4.3 Recommendations

A second MDA is recommended in Class C3 data centers. Each MDA should have fully diverse cable routes to access multiple entry points so that no single point of failure exists within the site.

When utilizing two MDAs, the MDAs should:

- Have core routers and switches distributed between the MDAs
- Distribute circuits between the two spaces
- Be located in different fire protection zones
- Be served by different power distribution units and air conditioning equipment

14.4.5 Intermediate Distribution Area (IDA)

14.4.5.1 Introduction

The intermediate distribution area (IDA) is the space that supports the intermediate cross-connect. The intermediate cross-connect is called the intermediate distributor (ID) in CENELEC EN 50173-5 and in ISO/IEC 24764.

It may be used to provide a second level cabling subsystem in data centers too large to be accommodated with only MDAs and HDAs. The IDA is optional and may include active equipment such as LAN and SAN switches.

The IDA may include the horizontal cross-connect (TIA) or zone distributor (ISO/CENELEC) for equipment areas served directly from the IDA.

14.4.5.2 Recommendations

The IDA may be inside the computer room but can be located in a dedicated room or a secure cage within the computer room for additional security.

14.4.6 Horizontal Distribution Area (HDA)

14.4.6.1 Introduction

The HDA is used to serve equipment not supported by a horizontal cross-connect (HC) or zone distributor (ZD) in an IDA or MDA. The HDA is the distribution point for cabling to the EDAs.

Equipment typically located in the HDA includes:

- LAN switches
- SAN switches
- Keyboard/video/mouse (KVM) switches

This equipment is used to provide network connectivity to the equipment located in the EDAs. A small data center may not require any HDAs as the entire data center may be able to be supported from the MDA. A typical data center will have several HDAs.

14.4.6.2 Recommendations

The HDA is typically inside the computer room, but it can be located in a dedicated room or a secure cage within the computer room for additional security.

14.4.7 Zone Distribution Area (ZDA)

14.4.7.1 Introduction

The ZDA is an optional interconnection point within the horizontal cabling located between the HDA and the EDA to allow frequent reconfiguration and added flexibility.

The consolidation point in the ZDA is called the local distribution point or LDP in CENELEC EN 50173-5 and in ISO/IEC 24764.

14.4.7.2 Requirements

Horizontal cabling shall contain no more than one ZDA between the HC in the HDA and the mechanical termination in the EDA.

14.4.7.3 Recommendations

The zone distribution area may also serve as a zone outlet for nearby equipment in the computer room.

14.4.8 Equipment Distribution Area (EDA)

14.4.8.1 Introduction

The EDA is the space allocated for IT compute processing and IT storage equipment, including all forms of telecommunications equipment (e.g., computer equipment, telephony equipment).

The telecommunications outlet (TO) in the EDA is called the equipment outlet (EO) in ISO/IEC 24764, CENELEC EN 50173-5, and ANSI/TIA-942-B.

14.4.8.2 Requirements

EDA areas shall not serve the purposes of an entrance room, MDA, IDA, or HDA.

14.5 Outside Plant Cabling Infrastructure

14.5.1 Underground Service Pathways

14.5.1.1 Requirements

The upper surface of underground cable pathways shall be no less than 600 mm (24 in) below the surface.

Non-metallic conduits shall be encased in concrete with a minimum 17.24 MPa (2500 lbf/in^2) compressible strength where there is vehicular traffic above or a bend in the conduits.

Telecommunications entrance pathways shall terminate in a secure area within the data center.

The telecommunications entrance pathways shall be coordinated with other electrical underground pathways (e.g., conduits) and mechanical underground piping systems (e.g., water, waste) while maintaining appropriate pathway separation from physical and operational perspectives.

14.5.1.2 Recommendations

The data center site should include multiple duct banks with customer owned maintenance holes from the property line to the data center.

Duct banks should consist of a minimum of four 100 mm (trade size 4) or equivalent conduits or raceways. If initial plans include more than three access providers providing service to the facility, one additional 100 mm (trade size 4) or equivalent conduit or raceway should be provided for every additional access provider. Each carrier's cabling should be in separate, dedicated conduits or raceways. Carriers should not share pathways.

The number of conduits should consider expected carrier and campus cabling requirements, growth, and conduit fill capacities.

Where not defined by the AHJ, duct banks and conduits should be located at a sufficient depth, typically 600 mm (24 in) to 750 mm (30 in) below surface grade, so both live or dynamic and dead (static) or earth loads can be sustained by the conduit structure. Conduits should be a depth greater than the depth of anticipated future digging.

In regions susceptible to frost, the top of the conduit(s) should be below the frost line. Where this is not practical, adequate protection should be provided to ensure that conduits do not become damaged as a result of ground shifting, particularly at the point of entry into the building.

Maintenance holes and hand holes on the data center property should have locks or other means of deterring access such as nonstandard bolts. The maintenance holes and hand holes should have intrusion detection devices connected to the building security system and monitoring of the maintenance holes and hand holes by video surveillance or other means.

Redundant duct banks should have a 20 m (66 ft) separation minimum along the entire route from the property line to the facility. Where possible, redundant maintenance holes should be connected with at least one 100 mm (trade size 4) or equivalent conduit or raceway.

Conduits for cable replacement should be designated and marked separately from those for additional cables.

When multiple access providers are providing service to the facility, coordination of security requirements of each individual access provider should be within the secure space.

The secure area that houses the telecommunications entrance facility (pathway termination) should preferably be in a telecommunications entrance room that is separate from the computer room.

Any pull boxes or splice boxes for data center cabling (entrance cabling or cabling between portions of the data center) that are located in public spaces or shared tenant spaces should be lockable. They should also be monitored by the data center security system using either a camera or remote alarm.

Entrance to utility tunnels used for telecommunications entrance rooms and other data center cabling should be lockable. If the tunnels are used by multiple tenants or cannot be locked, they should be monitored by the data center security system using either a camera or remote alarm.

14.5.2 Aerial Service Pathways

14.5.2.1 Requirements

Routes for aerial access pathways shall follow same provisioning guidelines from an availability and security perspective as underground data pathways. All aerial pathways shall be properly bonded and grounded as per AHJ requirements.

14.5.2.2 Recommendations

The use of aerial cabling pathways should generally be avoided because of vulnerability to outages. Aerial cabling route selection should take into consideration a number of factors, including, but not limited to, terrain, soil conditions, aesthetics, proximity to direct-buried and underground utilities, access, and weather conditions.

Customer-owned satellite dish farms or aerial towers should be located within the secure perimeter of the facility.

14.6 Access Providers

14.6.1 Access Provider Coordination

14.6.1.1 Requirements

Data center designers shall coordinate with all access providers to determine the access providers' requirements and to ensure that the data center's circuit, demarcation, and entrance facility requirements are provided to satisfy the access providers' specifications.

14.6.1.2 Additional Information

Access providers typically require the following information when planning entrance facilities:

- Address of the building
- General information concerning other uses of the building, including other tenants
- Plans with detailed drawings of telecommunications entrance conduits from the property line to the entrance rooms, including location of maintenance holes, hand holes, and pull boxes
- Assignment of conduits and innerducts to the access provider
- Floor plans for the entrance rooms
- Assigned location of the access providers' protectors, racks, and cabinets
- Routing of cabling within entrance room (e.g., under access floor, over cabinets and racks, other)
- Expected quantity and type of circuits to be provisioned by the access provider, including any planned or foreseen additions or upgrades
- Media types and approximate distances of circuits to be provisioned by the carrier
- Service-level agreements
- Detailed schedules for the project, including date that the access provider will be able to install entrance cabling and equipment in the entrance room and required service activation date
- Requested location and interface for demarcation of each type of circuit to be provided by the access provider
- Carrier office diversity desired, preferably at least two separate access provider offices and service provider point-of-presences
- Carrier route diversity desired, preferably a minimum distance between any two routes of at least 20 m (66 ft) along their entire routes
- Specification of pathways to be used for access provider cabling (e.g., aerial cabling allowed or all underground)
- Type and rating of firestopping measures used at the site
- Requested service date
- Name, telephone number, and e-mail address of primary customer contact and local site contact
- Security requirements for lockable containment and cabinets
- Colocation providers may be required to provide customer name and contact details, if requesting on behalf of their customers

The access providers typically provide the following information:

- Space and mounting requirements for protectors and terminations of balanced twisted-pair cabling
- Quantity and dimensions of access provider's cabinets and racks or space requirements if they are to be provisioned in client cabinets and racks
- Power requirements for equipment, including receptacle types
- Access provider equipment service clearances
- Location of serving access provider central offices
- Route of access provider cabling and minimum separation between routes
- Specification on pathways used (e.g., all underground or portions of routes that are served by aerial cabling)
- Installation and service schedule

14.6.2 Redundancy

14.6.2.1 Introduction

Having multiple access providers protects against total loss of service in the event of a service outage affecting one of the access providers but not the others. However, it is necessary to ensure that the access providers are not sharing facilities that would result in one or more single points of failure that would cause a total service outage despite having multiple access providers.

14.6.2.2 Recommendations

Continuity of telecommunications access provider services to the data center can be improved by using multiple access providers, multiple access provider central offices, and multiple diverse pathways from the access provider central offices to the data center.

The customer should ensure that its services are provisioned from different access provider offices, and the pathways to these access provider cabling centers and central offices are diversely routed. These diversely routed pathways should be physically separated by at least 20 m (66 ft) at all points along their routes.

Access providers should install circuit-provisioning equipment in both entrance rooms so that circuits of all required types can be provisioned from either room. The access provider provisioning equipment in one entrance room should not be subsidiary to the equipment in the other entrance room. The access provider equipment in each entrance room should be able to operate in the event of a failure in another entrance room.

14.6.3 Access Provider Demarcation

14.6.3.1 Introduction

The centralized location for demarcation to all access providers is a single-tenant data center is typically in the telecommunications entrance rooms. In a colocation data center, the meet me room (MMR) is the place where telecommunications service providers (e.g., access providers, content providers, internet service providers) connect to customers and each other. This room may be the same or different room as the telecommunications entrance rooms. The telecommunications service providers or data center owner may opt to locate telecommunications service provider equipment either in the telecommunications entrance rooms or MMRs.

14.6.3.2 General Requirements

In buildings where base isolation is used, access providers shall provide sufficient cable slack to accommodate displacement of the base isolation units.

14.6.3.3 General Recommendations

Access providers should provide demarcation for their circuits in a common owner specified cabinet or rack rather than in their own cabinets or racks as this simplifies cross-connects and management of circuits. Separate demarcation cabinets or racks for each type of circuit may be desirable (e.g., low speed, E-1/T-1, E-3/T-3, optical fiber for STM-x/OC-x services and Ethernet delivery). Cabling from the computer room to the entrance room should terminate in the demarcation areas.

14.6.3.4 Demarcation of Low-speed Circuits

14.6.3.4.1 Recommendations

Access providers should be asked to provide demarcation of low-speed circuits on insulation displacement connection (IDC) connecting hardware. While service providers may prefer a specific type of IDC connecting hardware (e.g., 66-block), they may be willing to hand off circuits on another type of IDC connecting hardware upon request. Access provider should coordinate the type of connectors used with those used by the data center.

Cabling from the low-speed circuit demarcation area to the main distribution area should be terminated on IDC connecting hardware near the access provider IDC connecting hardware.

Circuits from access providers are terminated using one or two pairs on the access provider IDC connecting hardware. Different circuits have different termination sequences as illustrated in Figure 14-7 and Figure 14-8.

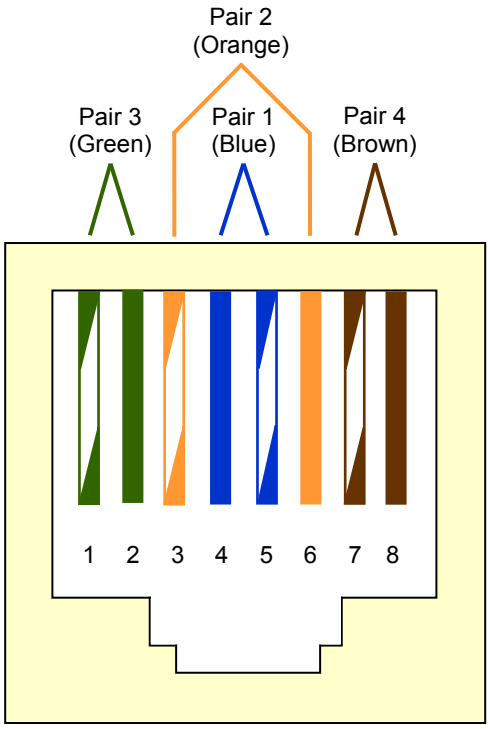

Figure 14-7
Cross-Connection Circuits to IDC Connecting Hardware Cabled to Modular Jacks in the T568A 8-Pin Sequence

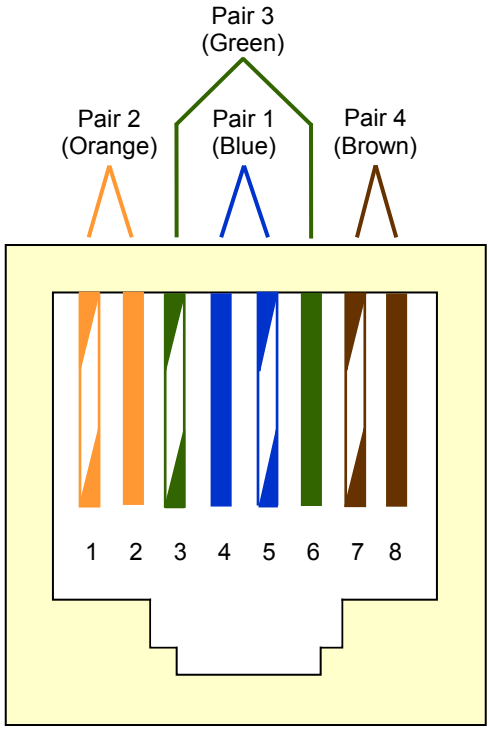

Figure 14-8
Cross-Connection Circuits to IDC Connecting Hardware Cabled to Modular Jacks in the T568B 8-Pin Sequence

Each 4-pair cable from the entrance room to the other spaces in the data center should be terminated in an IDC connector or an eight-position modular jack of compatible performance where the cable terminates outside the entrance room. The IDC connector or eight-position modular jack telecommunications outlet/connector should meet the modular interface requirements specified in standards such as the IEC 60603-7 series of standards.

Pin/pair assignments should be as shown in the T568A sequence, or optionally per the T568B sequence to accommodate certain 8-pin cabling systems as necessary. The colors shown are associated with the horizontal distribution cable. Figure 14-7 and Figure 14-8 depict the front view of a female telecommunications outlet/connector and provide the list of the pair positions for various circuit types.

14.6.3.4.2 Additional Information

The conversion from access provider 1-pair and 2-pair cabling to 4-pair cabling used by the data center structured cabling system can occur either in the low-speed circuit demarcation area or in the main distribution area (MDA).

The access provider and customer IDC connecting hardware can be mounted on a plywood backboard, frame, rack, or cabinet. Dual-sided frames should be used for mounting large numbers of IDC connecting hardware (3000+ pairs).

14.6.3.5 Demarcation of E-1 and T-1 Circuits

14.6.3.5.1 Introduction

Coordinate with the local access providers that will install DS-1/E-1 DSX panels in the DS-1/E-1 demarcation area. Their equipment will preferably fit in 480 mm (19-inch) racks/cabinets. However, 580 mm (23-inch) racks/cabinets may be required by some local access providers, particularly in North America.

14.6.3.5.2 Recommendations

The DSX-1 patch panels may require power for indicator lights. Thus, cabinets or racks supporting access provider DSX-1 patch panels should have at least one electrical circuit or power strip to power DSX-1 panels. As most DSX-1 facilities use -48 V_{DC} or +24 V_{DC} to power their indicators, provisions for DC power sources and fuse panels should be included in any DSX facility.

Cabinet or rack space should be allocated for access provider and customer patch panels, including growth. Access providers may require cabinet or rack space for rectifiers to power DSX-1 patch panels.

A single 4-pair cable can accommodate one T-1 transmit and receive pair. When multiple T-1 circuits are carried on a multipair cable arrangement, multiple cables should be provided; transmit signals should be carried on one multipair cable and the receive signals driven through a separate multipair cable.

If support staff has the test equipment and knowledge to troubleshoot T-1 circuits, the DS-1 demarcation area can use DSX-1 panels to terminate T-1 cabling to the main distribution area. These DSX-1 panels should have either modular jacks or IDC terminations at the rear although wirewrap terminations are acceptable and may still be used.

DSX-1 panels for the main distribution area can be located on the same racks, frames, or cabinets as the ones used for distribution cabling. If DSX panels are separate, they should be located in a space adjacent to the cabinets or racks used for distribution cabling.

The owner or the owner's agent may decide to provide multiplexers (e.g., M13 or similar multiplexer) to demultiplex access provider E-3/T-3 circuits to individual E-1/T-1 circuits. Multiplexers may be placed in the computer room, extending the distance from the entrance rooms that E-1/T-1 circuits can be provisioned. E-1/T-1 circuits from a customer-provided multiplexer should not be terminated in the entrance room E-1/T-1 demarcation area.

The coaxial or optical fiber connecting hardware can be located on the same or separate racks, frames, or cabinets as the ones used for other access provider patch panels. If they are separate, they should be adjacent to the racks/cabinets assigned to the access provider's equipment.

As with other services, the access provider should be consulted to determine and agree to the format of the services from an E-1/T-1 carrier. The normal practice is to have these services provided via telecommunications outlet/connectors.

Access providers should be asked to hand-off E-1/T-1 circuits on RJ48X jacks (individual 8-position modular jacks with loop back), preferably on a DSX-1 patch panel mounted on a customer-owned rack installed in the DS-1 demarcation area. Patch panels from multiple access providers and the customer may occupy the same cabinet or rack.

14.6.3.5.3 Additional Information

Access providers can alternatively hand off DS-1 circuits on IDC connecting hardware. These IDC connecting hardware can be placed on the same frame, backboard, rack, or cabinet as the IDC connecting hardware for low-speed circuits.

The customer may request that the demarcation for E-1 or T-1 circuits be provisioned in the MDA rather than in the entrance room to ensure that circuit distance restrictions are not exceeded. See ANSI/TIA-942-B for distances for T-1 and E-1 circuits in data centers. As described in ANSI/TIA-942-B, note that customer side-DSX panels provide test access for circuits, but they reduce maximum circuit distances.

14.6.3.6 Demarcation of T-3 and E-3 Coaxial Cabling Circuits

14.6.3.6.1 Recommendations

Access providers should be asked to hand-off E-3 or T-3 coaxial circuits on pairs of female BNC connectors, preferably on a DSX-3 patch panel on a customer-owned cabinet or rack installed in the E-3/T-3 demarcation area. Patch panels from multiple access providers and the customer may occupy the same cabinet or rack.

Coordination with the local access providers should involve the installation of DS-3 DSX panels in the DS-3 demarcation area. This equipment should be mounted in 480 mm (19-inch) cabinets or racks in order to maintain consistency with other racks/cabinets. However, 580 mm (23-inch) cabinets or racks may be required by some local access providers, particularly in North America.

If support staff has the test equipment and knowledge to troubleshoot E-3 or T-3 circuits, the E-3/T-3 demarcation area can use DSX-3 panels to terminate 734-type coaxial cabling to the main distribution area. These DSX-3 panels should have BNC connectors at the rear.

The DSX-3 patch panels may require power for indicator lights. Thus, racks/cabinets supporting access provider DSX-3 patch panels should have at least one electrical circuit and a power strip. As most DSX-3 facilities use -48 V_{DC} or +24 V_{DC} to power their indicators, provisions for DC power sources and fuse panels should be included in any DSX facility.

Allocate cabinet and rack space for access provider and customer patch panels, including growth. Access providers may require cabinet and rack space for rectifiers to power DSX-3 patch panels.

Cabling from the E-3/T-3 demarcation area to the main distribution area should be 734-type coaxial cable. Cables in the E-3/T-3 demarcation area can be terminated on a customer patch panel with 75-ohm BNC connectors or directly on an access provider DSX-3 patch panel. Access provider DSX-3 patch panels typically have the BNC connectors on the rear of the panels. Thus, BNC patch panels for cabling to the main distribution area should be oriented with the front of the patch panels on the same side of the cabinet or rack as the rear of the access provider DSX-3 panels.

All connectors and patch panels for E-3 and T-3 cabling should use 75-ohm BNC connectors.

14.6.3.6.2 Additional Information

The customer may request that the demarcation for E-3 or T-3 circuits be provisioned in the MDA rather than in the entrance room to ensure that circuit distance restrictions are not exceeded. See the applicable cabling standard (e.g., ANSI/TIA-942-B) for maximum distances of T-3 and E-3 circuits over coaxial cabling in data centers. As described in ANSI/TIA-942-B, note that customer side-DSX panels provide test access for circuits, but they reduce maximum circuit distances.

14.6.3.7 Demarcation of Optical Fiber Circuits

14.6.3.7.1 Recommendations

Access providers should terminate optical fiber circuits on optical fiber patch panels installed on cabinets or racks in the fiber demarcation area. Optical fiber patch panels from multiple access providers and the customer may occupy the same cabinet or rack. The optical fiber interface should comply with requirements defined in the cabling standards being followed (e.g., IEC 61754-20 [duplex LC-APC]). If requested, access providers may be able to provide a different format connector that is compatible with existing connector formats being used to simplify equipment cord and patch cord requirements.

Coordination with the local access providers should involve the installation of optical fiber patch panels in the optical fiber demarcation area. This equipment should be mounted in 480 mm (19-inch) cabinets or racks in order to maintain consistency with other racks/cabinets. However, 580 mm (23-inch) cabinets or racks may be required by some local access providers, particularly in North America.

Cabling from the optical fiber demarcation area to the main cross-connect in the main distribution area should be coordinated to ensure that the correct quantity, circuit type, media type and interface type are provided.

14.6.3.7.2 Additional Information

The customer may request that the demarcation of optical fiber circuits be provisioned in the MDA rather than in the entrance room to ensure that service provision performance requirements and onward circuit distance restrictions are not exceeded.

In a high-density fiber environment, access providers should consider installing free-standing frames such as two-post frames.

Dark fiber circuits (optical fiber circuits that include optical fiber cable and connectors, but no equipment) should also be terminated in the fiber demarcation area. Dark fiber circuits may either be provided and maintained by the data center owner or by a third-party, such as an access provider. They may be terminated in the patch panels provided by the access provider or by the data center owner.

14.7 Telecommunications Cabling Pathways

14.7.1 General

14.7.1.1 Requirements

Except where otherwise specified, data center cabling pathways shall adhere to the specifications of relevant cabling and containment specifications such as ANSI/TIA-569-D, CENELEC EN 50174-2, or ISO/IEC 14763-2.

Pathways shall be sized for full data center occupancy, including all anticipated expansions and planned applications.

The maximum depth of telecommunications cabling within a solid bottomed cabling pathway (e.g., cable tray, duct) shall not exceed 150 mm (6 in), regardless of the depth of the cable pathway.

For cabling pathway systems that do not contain a solid bottom, the maximum depth of installed cabling is determined by the spot loading and pressure it exerts on the support points of the pathway system. The height of the cable can be determined by using Equation 14-1 or 14-2, where L is the largest distance between support points in the specific cable pathway system and H is the resultant calculated allowed height of the cables.

For values of L as measure in millimeters (mm):

$$H\ (mm) = \frac{150}{1 + (L \times 0.0007)} \qquad (14\text{-}1)$$

For values of L as measured in inches (in):

$$H\ (in) = \frac{152.4}{25.4 + (L \times 0.4516)} \qquad (14\text{-}2)$$

Cable heights in these pathways shall not exceed this calculated value. For convenience, Table 14-5 summarizes the calculated results for common interval distances between supports.

Table 14-5 Maximum Cable Stacking Height in Cabling Pathways

L *Distance between points of support (mm)*	*H* *Maximum stacking height in cable pathways (mm)*
0 mm	150.0 mm
100 mm	140.2 mm
150 mm	135.7 mm
250 mm	127.7 mm
500 mm	111.1 mm
750 mm	98.4 mm
1000 mm	88.2 mm
1500 mm	73.2 mm

L *Distance between points of support (in)*	*H* *Maximum stacking height in cable pathways (in)*
0 in	6.00 in
4 in	5.60 in
6 in	5.42 in
12 in	4.94 in
24 in	4.21 in
36 in	3.66 in
48 in	3.24 in
60 in	2.90 in

Pathway systems shall be secured in accordance with AHJ, seismic requirements for the location, and the planned long-term loading. When access floor systems are used, any one of the following methods shall be permitted:

- If approved by pathway and floor system vendors, attachment to metal struts that are captured below the floor by two or more access floor stringers may be acceptable.
- Attachment to metal struts below the access floor that are suitably attached to the permanent floor
- Attachment via threaded rod directly to the permanent floor
- Attachment to channel bases bolted to floor slab

Structured cabling shall not share space within a dedicated optical fiber raceway with optical fiber equipment cords and patch cords. Cables shall not be placed on the bare concrete in contact with earth to avoid moisture. Plan cable tray capacities for the data center at full occupancy. Pay particular attention to cable tray capacities at the distributors and at intersections of cable trays.

14.7.1.2 Recommendations

Where it is not possible to adequately size pathways for full data center occupancy, including future expansions and applications, consider other media (such as optical fiber) or different network architectures (such as distributed LAN and SAN switching) to reduce cabling requirements.

In locations where seismic activity could create a potential risk, telecommunications pathways should be braced per AHJ and applicable standards (see Section 8).

There should be separate raceways or a divider in the raceway to separate balanced twisted-pair and optical fiber cabling. Where it is not practical to separate optical fiber and balanced twisted-pair cabling, optical fiber cabling should be on top of, rather than underneath, balanced twisted-pair cabling.

Optical fiber equipment cords and patch cords should be installed in a dedicated optical fiber pathway that ensures that proper bend radius control is maintained throughout the installation.

Optical fiber cabling should not touch the slab or lay on top of the access floor when it exits a cable tray.

Cabling and cabling pathways should be installed overhead if ceiling heights permit.

All telecommunications cabling under the access floor should be installed in a cabling pathway that is listed or classified by a nationally recognized testing laboratory (NRTL). In the equipment cabinet aisles, allocate separate aisles for power and telecommunications cabling. Telecommunications cabling should be in the hot aisles (the aisles at the rear of the cabinets) and the power cabling should be in the cold aisles (the aisles at the front of the cabinets). Placing the telecommunications cabling in the cold aisles is not recommended as the telecommunications raceways may block airflow to perforated tiles, which should be located in the cold aisles.

14.7.2 Security

14.7.2.1 Requirements

Telecommunications cabling for data centers shall not be routed through spaces accessible by the public or by other tenants of the building unless the cables are in enclosed conduit or other secure pathways.

14.7.2.2 Recommendations

Physical access to cabling infrastructure should be limited strictly to data center cabling engineers and access provider personnel (under data center supervision) on a strictly need-to-access basis.

Any maintenance holes or hand holes on the data center property should have a lock or other means to prevent unauthorized access.

14.7.3 Separation of Power and Telecommunications Cabling

14.7.3.1 Requirements

To minimize coupling between power cabling and balanced twisted-pair cabling, the separation and segregation between power cabling and balanced twisted-pair cabling shall follow the requirements specified by the AHJ and defined in the cabling and pathways standards being followed.

AHJ may require a barrier or greater separation than specified in the cabling and pathways standards.

Where they are used, metallic cabling pathways shall be properly bonded and grounded as per AHJ requirements and applicable standards (e.g., ANSI/NECA/BICSI-607, ANSI/TIA-607-C, ISO/IEC 30129).