DATA CENTER

Best Practices Guide: High Density Cable Management Solutions

Describes recommended cabling solutions for high density port solutions based on Brocade's FC8-64 FC port blade.

BROCADE

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INTRODUCTION

Good cable management improves serviceability and availability of the SAN. A good cable management solution provides customers with the ability to dynamically scale and adapt to changes in their IT infrastructure while minimizing required service time. This document provides customers deploying high density solutions with general guidelines for proper cable management.

The demand for high density solutions are increasing as the need for the following grows:

- Reduced footprint, energy efficiency (minimize cable impact on air flow)
- Server consolidation and virtualization
- Storage consolidation and virtualization

The demands are resulting in:

- Highly utilized racks minimizing the foot print
- Increased cables per rack

This guide describes:

- Overview of the FC8-64 high density FC port blade
- Challenges with unstructured high density port solutions
- Structured high density cable management solutions based on LC and MPO/MTP® patch panels
- Reference configuration for 256 port LC and 512 port MPO/MTP solutions
- Part numbers for cables and patch panels and vendor contact information

NOTE: For complete details on data center cabling practices, refer to the *Best Practices Guide: Cabling the Data Center* (PN: GA-BP-036-01). For additional FC8-64 and mSFP hardware details, refer to the *Brocade DCX Backbone Hardware Reference Manual* or the *Brocade DCX-4S Backbone Hardware Reference Manual.*

Terminology

Here are some common terms used in this best practices guide.

Term	Description
mSFP Transceiver	A narrower version of the standard 8Gb transceiver.
mSFP Cable	A fiber cable with a narrower LC connector.
LC	Lucent Coupler
MPO/MTP	Industry acronym for Multi-fiber Push-On connector; MTP is a trademarked name and is synonymous with MPO.
Patch Cord	Single or multiple strand of fiber cables used for connectivity.
RU	Rack Unit (4.4 centimeters/1.75 inches)

NOTE: In this document, the terms MPO and MTP are used interchangeably and represent MPO and MTP connections.

Overview of the FC8-64 FC port blade

The Brocade® FC8-64 high density 64-port Fibre Channel blade (Figure 1) designed for the DCX® Backbone family combines industry leading port density, performance, scalability, and reliability to maximize the benefits of SAN and server consolidation. It's the industry's first and only 64-port 8 Gbps Fibre Channel blade that enables mid to large enterprise customers to deploy high density modular chassis-based solutions to minimize physical footprint without compromising performance.

The new high density Fibre Channel port blade increases the chassis density by 25%, enabling the DCX to scale up to 512 ports and the DCX-4S to scale up to 256 ports with 8 Gbps performance.

The Brocade DCX family provides nearly six times the performance of competitive offerings. Performance capabilities include:

Brocade DCX:

- Up to 512 ports operating simultaneously at full 8 Gbps speed
- Up to 1024 ports in a single rack (two chassis)
- 4.096 Tbps of chassis bandwidth (in each direction)

Brocade DCX-4S:

- Up to 256 ports operating simultaneously at full 8 Gbps speed
- Up to 768 ports in a single rack (three chassis)
- 2.048 Tbps of chassis bandwidth (in each direction)

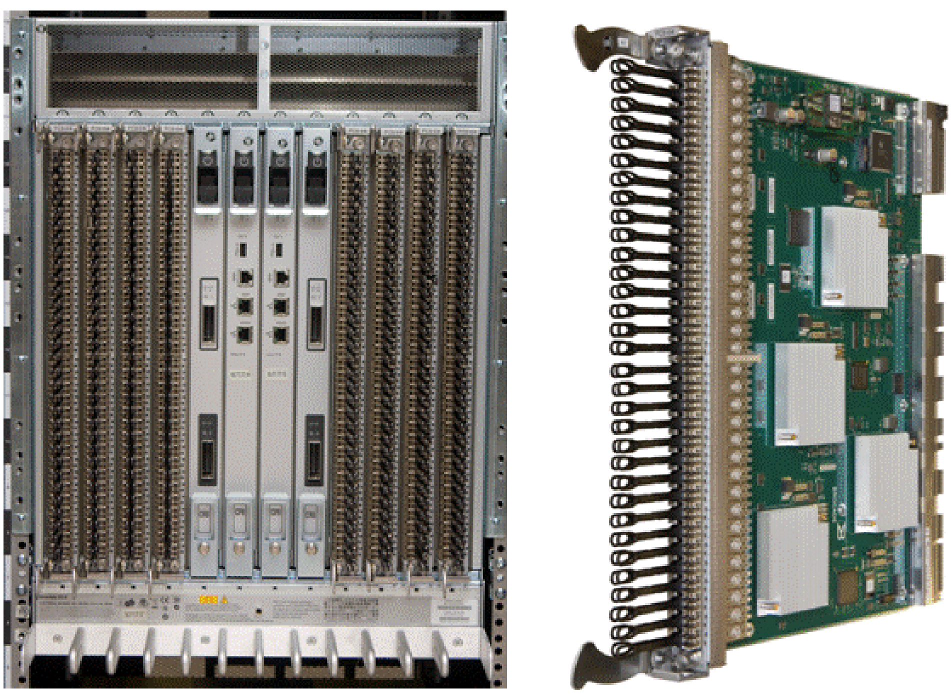


Figure 1. Brocade DCX with FC8-64 FC port blade

As an industry leader and innovator in high availability SAN solutions, Brocade and its partners developed a space efficient version of the standard Small Form Factor Pluggable (SFP+) media that enables high density port configurations as well as improved serviceability (Figure 2). These new "mini" SFPs (mSFP) retain all of the performance and functionality of the standard SFP+ and include individual port isolation for improved serviceability and availability. The FC8-64 port blade utilizes mSFPs rather than standard SFPs.

Figure 2. Mini SFP (mSFP) with pull tab and a traditional SFP+

The following table provides an overview of standard SFPs versus mSFPs. The mSFP leverages the same technology as standard SFPs but in a smaller form factor in order to support high density SAN solutions.

Specification	SFP+	mSFP
Speed Grade	Same (2/4/8Gb)	Same (2/4/8Gb)
Operating Distance	Same	Same
Availability of SWL Transceivers	Yes	Yes
Availability of LWL Transceivers	Yes	No
Regulatory Compliance	Same	Same
Dimensions – Fiber pitch	6.25mm	5.25mm
Dimensions – Width	13.55mm	11.40mm
Dimensions - Depth	Same (56.40mm)	Same (56.40mm)
LC patch cords	Any LC patch cord	mSFP patch cords provided by major cable vendors
Supplier	Brocade	Brocade

The mSFP fiber pitch and width are narrower than standard SFPs, resulting in the need for newer OM-3 fiber cables with narrower LC connectors. Due to these changes, the standard LC connector was modified by major cable vendors to accommodate the new fiber pitch and width. Refer to "Appendix B: Equipment List" for cable manufacturer and part number details.

The new cables (Figure 3) provide the same flexibility in connectivity as standard LC cables:

- mSFP-LC cable: Provides the FC8-64 port blade with the ability to connect to other port blades, switches, devices, and LC patch panels.
- mSFP-mSFP cable: Allows one FC8-64 port blade to connect to another FC8-64 port blade as ISLs.
- mSFP-MPO cable: Allows a trunked MPO cable to connect to multiple mSFP ports. Currently, six mSFP connectors are supported in one trunk cable.

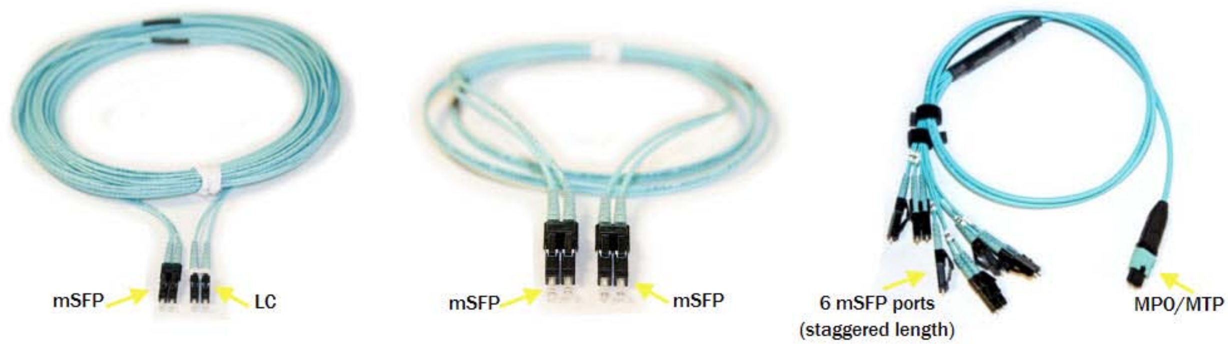


Figure 3. mSFP cable types

Planning

As port density per director and rack increase, having an appropriate cable management plan is key during servicing or scaling of a fabric. The cable management plan should include current and future SAN design requirements. Cables can be managed in a variety of ways, such as by routing cables below the chassis, to either side of the chassis, through cable channels on the sides of the cabinet, or using patch panels. When planning a cable management solution and the cable routing path, take into account the location of the rack's power strip and the DCX power supplies to eliminate cable interference when servicing the power supplies and cords.

The cable management plan may involve wiring a new data center or upgrading the cabling in an existing data center.

- If an existing data center is being upgraded, evaluate, capture, and understand the present cabling infrastructure thoroughly.
- Document the current (if any) and projected network topologies using an application such as Microsoft Visio or Excel. Focus on the physical aspects, especially equipment interfaces. Document the various cable types and counts present, proposed, and projected, approximate routed distances to distribution areas and equipment, present and anticipated equipment port counts. Additionally, document any areas of concern, and any established internal cabling standards.
- Plan to accommodate for current and future growth. Build in flexibility, so that the patching structure will allow a device to connect to any other device in the data center. This will permit devices to be located anywhere within the data center.
- When implementing a high density solution, install a Brocade DCX cable management comb under the chassis door. This comb allows for simple cable management and can be installed without service disruption. Route the cables down in front of the blades to keep LEDs visible. Leave at least one meter of slack for each fiber optic cable to provide room to remove and replace blades.

Challenges with Unstructured High Density Solutions

All three growth factors—volume, performance, and distance—have placed enormous strain on IT organizations, requiring miles of cable infrastructure to interconnect servers, storage, and Fibre Channel fabrics for fast, reliable data and application delivery. Unfortunately, many organizations still rely on traditional point-to-point cable solutions, reactively deploying cables one at a time to suit immediate needs.

The resulting cable clutter inhibits intelligent, pragmatic growth, contributing to an inefficient growth strategy that will only worsen over time. The tasks of verifying proper connectivity, troubleshooting, and managing device change also become more complex and time-consuming, and can lead to planned or unplanned downtime of critical business applications.

This inefficient approach also contributes to the over-heating of data centers—particularly within raised flooring and around the racks where cable clutter primarily occurs—requiring additional resources to cool the systems.

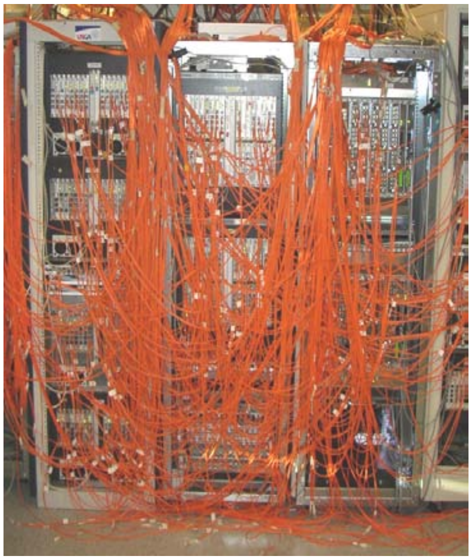


Figure 4. Cable clutter

Using a Structured Approach

Cable management solutions designed specifically for Brocade SAN infrastructures (utilizing the Brocade DCX Backbone family) enable a reliable, flexible, and highly efficient cable infrastructure throughout the data center.

Depending on their specific requirements, organizations can choose from various structured fiber-optic cable management solutions. By moving from traditional low-density, duplex patch cord cable solutions to high-density, structured cable solutions (reducing bulk cable volume by 75 percent), organizations can implement the physical layer in a much more manageable and flexible manner while streamlining data center reconfigurations and simplifying management. These cable technologies are also more energy-efficient, helping organizations to consolidate their IT infrastructures.

Cabling High Density, High Port Count Fiber Equipment

As networking equipment becomes denser and port counts in the data center increase to several hundred ports, managing cables connected to these devices becomes a difficult challenge. Traditionally, connecting cables directly to individual ports on low port-count equipment was considered manageable. Applying the same principles to high-density and high-port-count equipment makes the task more tedious, and it is nearly impossible to add or remove cables connected directly to the equipment ports.

Using fiber cable assemblies that have a single connector at one end of the cable and multiple duplex breakout cables at the other end is an alternative to alleviate cable management. Multifiber Push-On (MPO) cable assemblies are designed to do just that. The idea is to pre-connect the high-density, high-port-count Lucent Connector (LC) equipment with LC-MPO fan-out cable to dedicated MPO modules within a dedicated patch panel. Once fully cabled, this patch panel functions as if it were “remote” ports for the equipment. These dedicated patch panels ideally should be located above the equipment whose cabling they handle for easier access to overhead cabling. Using this strategy drastically reduces equipment cabling clutter and improves cable management.

Here are some of the advantages and disadvantages of implementing LC or MPO/MTP cabling solutions in static or dynamic environments:

Cabling Solution	Low Maint.	Easy Fault Isolation	Easy Cable Replacement	Minimal Cabling Mgmt Space Required	Low Cost Solution	Extensive Cable Connection Mgmt Required
Static LC to LC	√√	√√√	√√√	√	√√√	√
Static MPO/MTP	√√√	√√	√	√√√	√	√
Dynamic LC to LC	√	√√	√√√	√	√√	√√
Dynamic MPO/MTP	√	√	√	√√√	√	√√

KEY: The checkmarks represent a sliding scale with √√√ representing the optimal solution for that category.

Low Maintenance: Ability to modify environment through additional port usage, or changes in port usage.

1. Single LC-LC cables can be added or removed from environment as needed.
2. Trunk cables need to be added in groups of single cables. This makes expanding easy through clean cable management.

Easy Fault Isolation: Ability to troubleshoot faults down to the cable or trunk which is causing problems.

1. LC-LC cable faults can be traced to a single cable and that cable can be replaced.
2. MPO trunk cables can be traced to the trunk/LC cable at fault and either the MPO trunk can be replaced or a single LC-LC cable can be bypassed.

Easy Cable Replacement: Ability to replace defective cables as needed.

1. If a single LC-LC cable fails, that cable can be replaced.
2. If a single cable fails in a trunk, that cable can be bypassed with an LC to LC cable.

Minimal Cabling Mgmt Space Required:

1. LC-LC cables are larger and require more space for cable runs and patch panel connectors.
2. MPO trunks require less space for cable runs and fewer patch panel connectors.

Low Cost Solution:

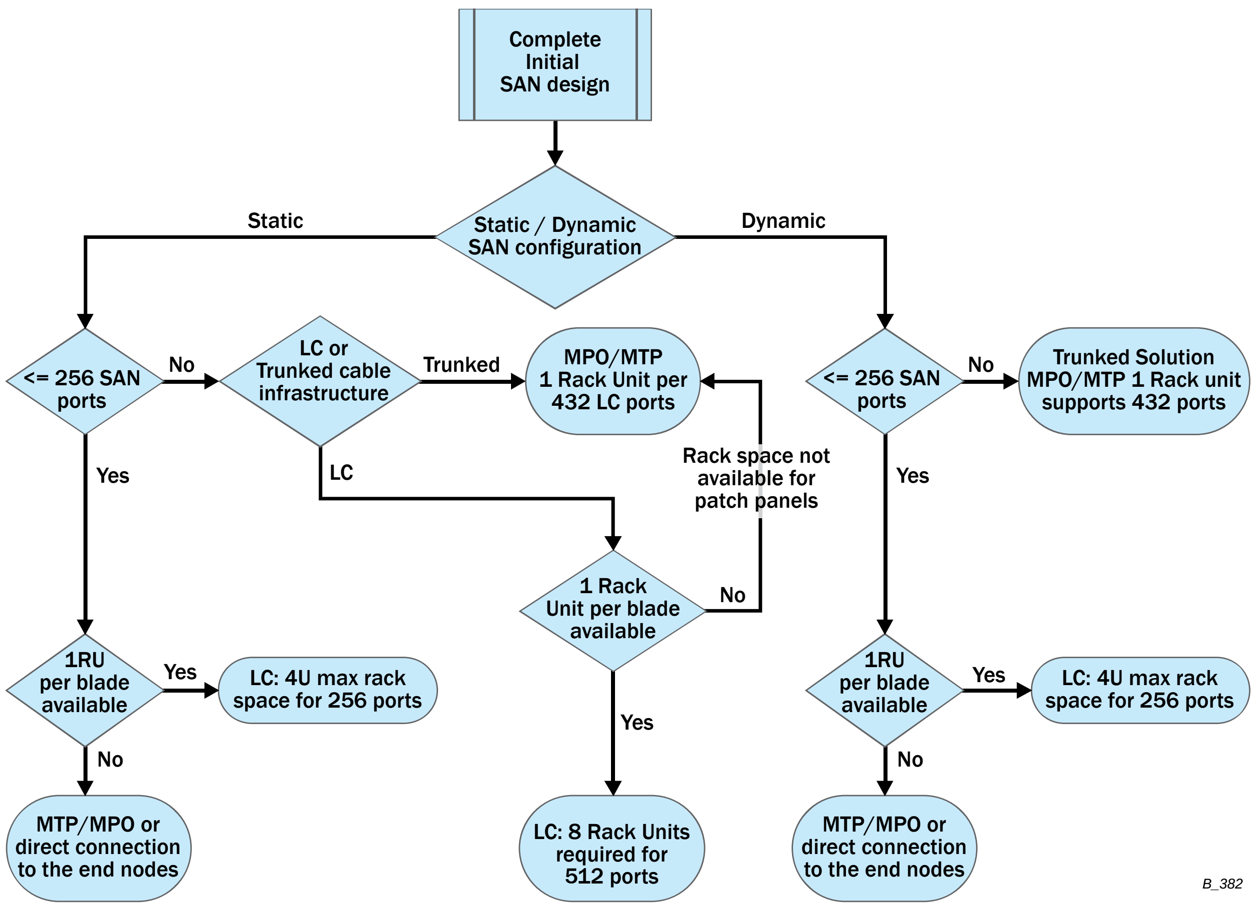
1. LC-LC single cables cost less than MPO cables.
2. MPO trunk cables cost more than LC-LC cables.

Extensive Cable Connection Mgmt Required:

1. LC-LC single cables require more cable management.
2. MPO trunk cables require less cable management.

Selecting the appropriate cable management solution is dependent on your unique environment. The following flow chart is designed to assist you in determining the appropriate structured cable management solution for your environment based on key items to consider:

- Is the SAN static or dynamic during its operational life cycle?
- Are the storage and server devices within ten meters of the DCX Backbone or is there a central distribution panel?
- Is there a trunked cable (e.g. MPO/MTP) infrastructure already in place?
- Is an individual fibre cable (e.g. LC, non-trunked) a requirement for fault isolation?



With proper cabling and patch panel labeling, both solutions (LC & MPO/MTP) provide flexibility in terms of servicing and managing cables. With MPO/MTP, users have reduced cable density and since ports are in groups of six, they also have a faster ability to identify a port for servicing if necessary but required expertise in replacing individual connections within the trunk.

Trusting the Standards

Industry cabling standards are designed to protect the end user. Whether these standards are in draft or ratified state, they provide a firm foundation for establishing a coherent infrastructure, and guidelines for maintaining high levels of cable performance. Cabling standards define cabling specifications looking out to the next several years, thus supporting future desires for higher speed transmissions. Standards enable vendors to use common media, connectors, test methodologies, and topologies, and allow planners to design a cabling layout in the data center without worrying about compatibility issues.

There are a number of standards organizations and standards. The best-known cabling standards are listed below:

Data Centers Specific Standards:

- United States -- ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers
- Europe -- CENELEC EN 50173-5 Information Technology- Generic Cabling Systems- Part 5: Data Centers
- International -- ISO/IEC 24764 Information Technology- Generic Cabling for Data Centre Premises

General Commercial Building Cabling Standards:

- United States -- ANSI/TIA-568 Generic Telecommunications Cabling for Customer Premises
- Europe -- EN 50173-1 Performance Requirements of Generic Cabling Schemes
- International -- CSA ISO/IEC 11801:2009 Information Technology: Generic Cabling for Customer Premises

Cabling Administration Standards:

- United States -- ANSI/TIA-606 Administration Standard for the Commercial Telecommunications Infrastructure

NOTE: Cabling standards are reviewed and changed every five to ten years, which allows them to keep pace with technology advances and future requirements. Know and trust the standards, and apply common sense when designing, implementing, testing, and maintaining data center cabling. Standards may be purchased online from IHS at http://global.ihs.com/.

Establishing a Naming Scheme

Once the logical and physical layouts for the cabling are defined, apply logical naming that will uniquely and easily identify each cabling component. Effective labeling promotes better communications and eliminates confusion when someone is trying to locate a component. Labeling is a key part of the process and should not be skipped. A suggested naming scheme for labeling and documenting cable components is suggested below (examples appear in parentheses):

- Building (SJ01)
- Room (SJ01-5D11)
- Rack or Grid Cell: Can be a grid allocation within the room (SJ01-5D11-A03)
- Patch Panel: instance in the rack or area (SJ01-5D11-A03-PP02)
- Workstation Outlet: Instance in the racks or area (SJ01-5D11-A01-WS02)

- Port: Instance in the patch panel or workstation outlet (SJ01-5D11-A03-PP02_01)
- Cable (each end labeled with the destination port)

(Building and Rooms may be excluded if there is only one instance of this entity in the environment.)

Once the naming scheme is approved, start labeling the components. Be sure to create a reference document that will become part of the training for new data center administrators.

NOTE: Additional recommendations can be found in the standard ANSI/TIA-606 Administration Standard for the Commercial Telecommunications Infrastructure.

SETUP AND CONFIGURATION - UP TO 256 PORT SOLUTION

Equipment Requirements

The following items are required to implement this LC cable management solution for a 256 port LC patch panel solution utilizing the Brocade DCX with four FC8-64 port blades:

- Four XBR-DCX-0306 1RU 72 port LC-LC patch panels
- 256 mSFP-LC cables of 2-meter length
- Roll of Velcro & scissors
- Four cord management sleeves and labeling kit

Time Requirements

Once the LC cables are properly labeled, allot 45-60 minutes per blade for proper installation and cable routing.

Cabling Solution

This section describes how to cable up a 256 port LC solution using FC8-64 port blades. Once the cable labeling scheme has been defined, as described in the “Establishing a Naming Scheme” section in this document, label the ports on the LC patch panel using the cable to port mapping table listed in Appendix A. It is important to map the DCX slot and port number to the patch panel/shelf/port number on the LC patch panel.

For a 256 port configuration, four sets of 1 rack unit LC patch panels with three shelves each are required. Each 1RU LC patch panel supports 72 LC ports, which maps to a director blade. Therefore, when connecting a FC8-64 port blade to a patch panel, it will have eight LC patch panel ports available, which can be used to allocate additional fiber cables for redundancy. For this solution, there will be 32 unused patch panel ports.

In the following example, 2-meter cables are used to connect the director ports to the ports on the patch panel. This length is sufficient if the patch panel is placed directly above or below the DCX. If this is not possible, a 3-meter length cable is recommended.

NOTE: If both 1-meter and 2-meter cables are available, use the 2-meter cables for ports 16-31 and ports 48-63. This would minimize the extra fiber that must be managed inside the rack.

Patch Panel Installation:

1. Install the patch panels below the cable comb with a 1 rack unit gap between the cable comb and the patch panel. For additional details, refer to the installation guide that ships with the patch panels.
2. Test each shelf by sliding out each tray for service accessibility (Figure 5).

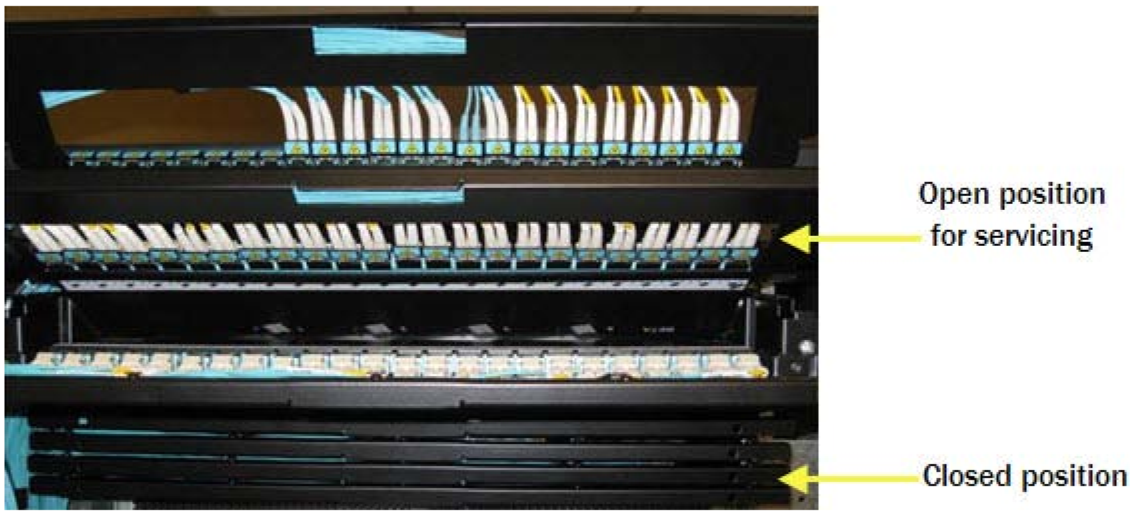


Figure 5. Patch panel

Cabling Installation (Front Side, Director Ports to Patch Panel):

1. Start cabling from the top ports (e.g. port 31).
2. Bundle the cables with Velcro in groups of eight to match the ASIC or trunk boundaries. This will facilitate servicing of the system through easy identification of the cable path.
3. Work down to the bottom port.
4. Bundle the 32 cables using Velcro (ports 0-31).

   CAUTION: Do not use plastic zip ties or metal tie wraps. These types of ties can cause sheathing and overstress the patch cables, causing signal loss.
5. Connect each cable to an LC patch panel port using the numbering schema defined in Appendix A.

   If a different methodology is chosen, it is important to be consistent across all port blades and patch panel ports. This will minimize the confusion as to which director ports are allocated to which LC patch panel ports. Allocate 30-centimeters (12-inches) of slack at the patch panel to enable the patch panel's top and middle shelf to be raised into the up position for servicing.
6. Repeat Steps 1 through 5 for the second column of ports on the same blade (ports 32-63).
7. Bundle the 64 cables below the cable comb using Velcro.
8. Route the cables to the side of the rack (when facing the director, cables from director Slot 1-4 should be routed to the left and down; cables from director Slot 9-12 should be routed to right and down).

   NOTE: Do not route cables from Slot 1-4 towards the right as this could cause the fiber cables to be damaged if ICL cables are used in the configuration.
9. Each bundle of 64 cables is about 3.75 inches in circumference. Wrapping and labeling this bundle (68) with a cord management sleeve will protect the fiber and make it easier to identify and service the port blade.

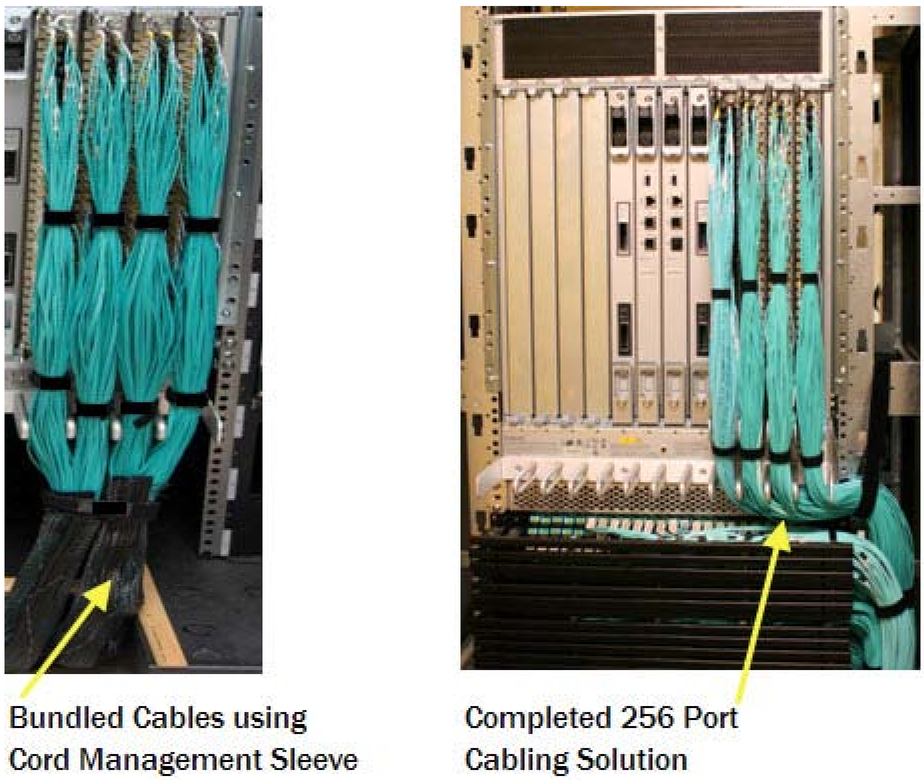


Figure 6. 256 ports wrapped/bundled and completed cabling solution

The above illustration depicts the 256 port cabling solution in its completed state. This methodology provides for an attractive environment that facilitates cooler equipment, troubleshooting, and manageable growth or changes.

Cabling Installation (Back Side, From Devices to Patch Panel):

When connecting cables from outside devices to the backside of the patch panel, the cables should be routed through the patch panel's backside punch-out holes. There are three options for routing cables through the back of the patch panel (Figure 7):

1. Remove the cable glands and run the cables through the punch-out holes in the back side of the patch panel.

2. Remove the cable glands, wrap a cord management sleeve around the cables, and run the cables through the punch-out holes in the back side of the patch panel.

3. Keep the cables glands in place, create (cut) incisions in the cable glands to prevent scraping of the cables against the metal and to allow for cable routing, and route the cables through the cable gland slots and the punch-out holes in the back side of the patch panel. Ensure that the incisions in the cable glands are made prior to installing the patch panels in the rack.

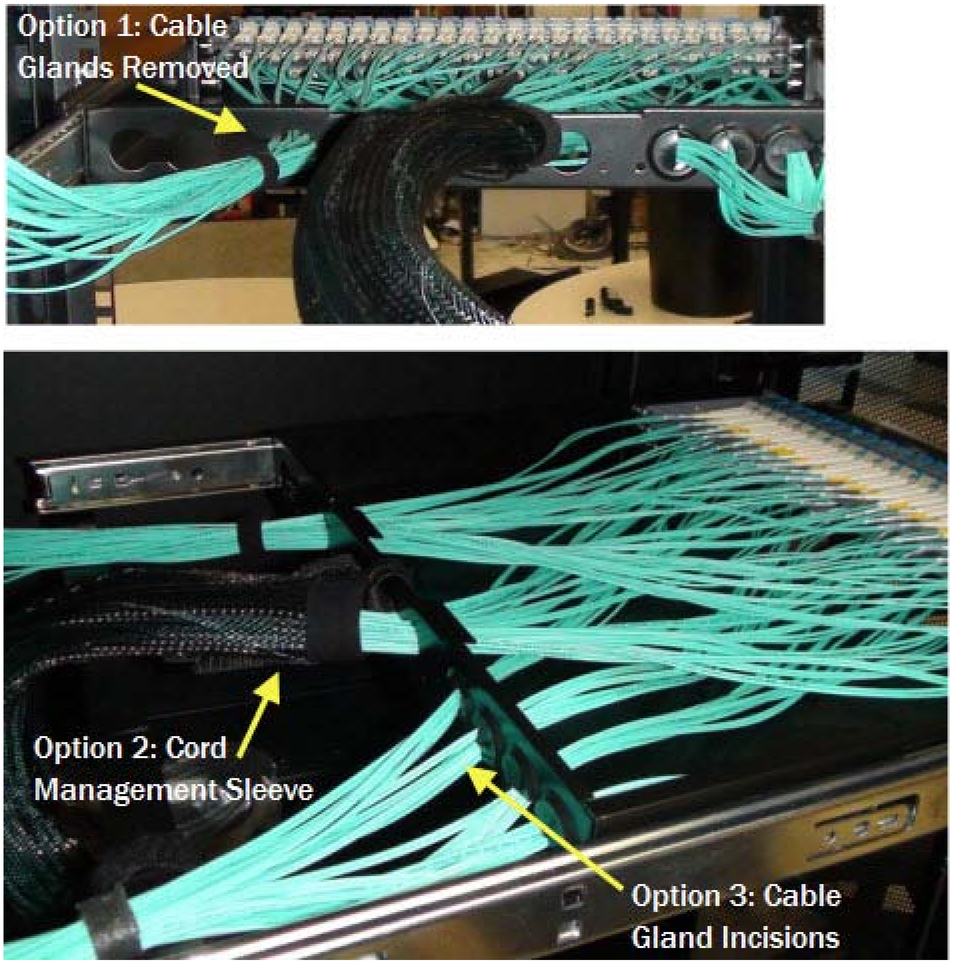


Figure 7. Device to Patch Panel Cabling

SETUP AND CONFIGURATION - 512 PORT SOLUTION

Equipment Requirements

The following items are required to implement this MPO/MTP cable management solution for a 512 port solution utilizing the Brocade DCX with eight FC8-64 port blades:

- Two XBR-DCX-0307 1RU 72 port MPO-MPO patch panels
- 96 mSFP-MPO/MTP cables of 2 meter length
- Roll of Velcro & scissors
- Eight cord management sleeves and labeling kit

Time Requirements

Once the MPO/MTP cables are properly labeled, allot 20-30 minutes per blade for proper installation and cable routing.

Cabling Solution

This section describes how to cable up a 512 port DCX using an MPO/MTP solution with the FC8-64 port blades. Unlike the LC direct port-to-port cable mapping, the 512 port DCX solution uses ruggedized LC-MPO fan-out cables.

These fan-out cables have a MPO connector on one end and six duplex mSFP connectors on the opposite end. Thus, each fan-out cable supports six mSFP ports. Once the cable labeling scheme has been defined, as described in the "Establishing a Naming Scheme" section in this document, label the ports on the patch panel using the MPO/MTP Cable to Port Mapping table listed in the Appendix A. It is important to map the DCX slot and port number to the LC-MPO fan-out cable and port number and patch panel/shelf/MPO port number.

Two 1 rack unit patch panel shelves, each with three MPO pass-thru panels, are required. Each 1RU MPO patch panel supports 72 MPO ports, totaling 432 LC ports for connectivity. There will be 48 unused MPO patch panel ports with this configuration.

In the following example, 2-meter cables are used to connect the director ports to the ports on the patch panel with staggered cable lengths for mSFP ports (Figure 3) to minimize the cable slack at the port.

NOTE: If both 1-meter and 2-meter cables are available, use the 2-meter cables for ports 16-31 and ports 48-63. This will minimize the extra fiber that must be managed inside the rack.

Patch Panel Installation:

1. Install the patch panels below the cable comb with a 1 rack unit gap between the cable comb and the patch panel.
2. Test each shelf by sliding out each self for service accessibility (Figure 8).

Figure 8. Installed patch panels (below cable comb)

Cabling Installation (Front Side, Director Ports to Patch Panel):

1. Start cabling from the top ports (e.g. port 31).
2. Work your way down to the bottom port.
3. Bundle the trunk cable in groups of six above the cable comb using Velcro.

   CAUTION: Do not use plastic zip ties or metal tie wraps. These types of ties can cause sheathing and overstress the patch cables, causing signal loss.

4. Connect each trunk cable to an MPO patch panel port using the numbering schema defined in Appendix A.

   If you choose your own methodology, it is important to be consistent across all port blades and patch panel ports. This will minimize the confusion as to which director ports are allocated to which MPO patch panel ports. Allocate 30-centimeters (12-inches) of slack at the patch panel to enable the patch panel's top and middle shelf to be raised into the up position for servicing.

5. Repeat Steps 1 through 4 for the second column of ports on the same blade (ports 32-63).
6. Bundle the 12 MPO cables below the cable comb using Velcro straps.
7. Route the cables to the side of the rack (when facing the director, cables from Slot 1-4 should be routed to the left and down; cables from Slot 9-12 should be routed to right and down).

   NOTE: Do not route cables from Slot 1-4 towards the right as this could cause the fiber cables to be damaged if ICL cables are used in the configuration.

8. Each bundle of 12 MPO trunk cables is about 2.5-inches in circumference. Wrapping this bundle with a cord management sleeve will not only protect the fiber but would also make it easier to identify and service the port blade if the sleeve is labeled.

Figure 9. 512 port MPO/MTP solution

Servicing High Density Solutions

When servicing during an anomaly due to the cable density, identifying and servicing fibre cables at a port level can be a challenge. The mSFP transceivers used in the FC8-64 port blade are fitted with a pull-tab to aid in installation and removal. The steps below with will ease the servicing process. For additional details, refer to the *mSFP, SFP, SFP+, and XFP Optical Transceiver Replacement Procedure*.

Connecting a cable to a empty mSFP

1. Remove the mSFP from the port. Hold the mSFP pull-tab firmly and gently pull the mSFP away from the connected port.

2. Verify the chosen optical cable supports mSFPs.

   Note: If using a recommended patch cable, the clip that holds the two fiber cables in place should be black.

3. Connect the cable to the mSFP.

4. Insert the mSFP into the port. Hold the pull-tab on the mSFP firmly and insert the mSFP into the port and slide it back into the port until the transceiver clicks (locks into place).

Removing a cable from a populated mSFP

1. Remove the mSFP from the port.

   a) Make sure the patch cable is not wrapped around the pull-tab.

   b) Loosen any cable ties used for holding the cables in place.

   c) Hold the mSFP pull-tab firmly and gently pull the mSFP away from the connected port.

2. Disconnect the cable from the mSFP.

Best Practices for Managing the Cabling

Whether implementing, upgrading, or maintaining cabling in the data center, establish a set of guidelines that are thoroughly understood and supported by the staff. Here are some cable management pointers.

During Installation

√ Avoid over-bundling the cables or placing multiple bundles on top of each other, which can degrade performance of the cables underneath. Additionally, keep fiber and copper runs separated. The weight of the copper cables can crush fiber cables that are placed underneath.

√ Consider using cables that are resistant to bend loss, such as Corning ClearWire cables.

√ Avoid mounting cabling components in locations that block access to other equipment (power strip or fans) inside and outside the racks.

√ Keep all cable runs under 90 percent of the maximum distance supported for each media type as specified in the relevant standard. This extra headroom is for the additional patch cables that will be included in the end-to-end connection.

√ For backbone and horizontal runs, install additional cables as spares.

√ Install higher cabling categories that will meet application requirements for the foreseeable future.

√ Cabling installations and components should be compliant with industry standards.

√ Don't stress the cable by doing any of the following:

   — Applying additional twists

— Pulling or stretching beyond its specified pulling load rating

— Bending it beyond its specified bend radius, and certainly not beyond 90º

— Creating tension in suspended runs

— Stapling or applying pressure with cable ties

√ Avoid routing cables through pipes and holes. This may limit additional future cable runs.

√ Label cables with their destination at every termination point (this means labeling both ends of the cable).

√ Test every cable as it is installed and terminated. It will be difficult to identify problem cables later.

√ Locate the main cabling distribution area nearer the center of the data center to minimize cable distances.

√ Do not route cables such that they block equipment cooling fans and restrict airflow.

√ For horizontal and backbone twisted-pair cabling, preserve the same density of twists in the cable pairs up to its termination.

√ Use thin and high-density cables wherever possible, allowing more cable runs in tight spaces. Ensure the selected cables meet standard specifications.

√ Dedicate outlets for terminating horizontal cables, that is, allocate a port in the patch panel for each horizontal run.

√ Include sufficient vertical and horizontal managers in your design; future changes may involve downtime as cables are removed during the changes.

√ Use angled patch panels within high-density areas, such as the cable distribution area. Use straight patch panels at the distribution racks.

√ Utilize modular cabling systems to map ports from equipment with high density port counts; as described in the earlier section titled "The Structured Approach".

Daily Practices

√ Avoid leaving loose cables on the floor; this is a major safety hazard. Use the horizontal, vertical, or overhead cable managers.

√ Avoid exposing cables to direct sunlight and areas of condensation.

√ Do not mix different cable types within a bundled group.

√ Remove abandoned cables that can restrict air flow and contribute to possible increases in operational temperatures that can affect the longevity of the system.

√ Keep some spare patch cables. The types and quantity can be determined from the installation and projected growth. Try to keep all unused cables bagged and capped when not in use.

√ Use horizontal and vertical cable guides to route cables within and between racks. Use "cable spool" devices in cable managers to avoid kinks and sharp bends in the cable. Do not wrap patch cords around these spools like a hose on a hose reel.

√ Document all cabling components and their linkage between components and make sure that this information is updated on a regular basis. The installation, labeling, and documentation should always match.

- √ Use the correct length patch cable, leaving some slack at each end for end device movements.
- √ Bundle cables together in groups of relevance (for example, ISL cables and uplinks to core devices), as this will ease management and troubleshooting.
- √ When bundling or securing cables, use Velcro-based ties every 1 to 2 meters. Avoid using zip ties as these apply pressure on the cables.
- √ Avoid routing cables over equipment and other patch panel ports. Route below or above and into the horizontal cable manager for every cable.
- √ Maintain the cabling documentation, labeling, and logical/physical cabling diagrams.

SUMMARY

Although cabling represents less than 10 percent of the overall data center network investment, expect it to outlive most network components and be the most difficult and potentially costly component to replace. When purchasing the cabling infrastructure, consider not only the initial implementation costs, but subsequent costs as well. Understand the full lifecycle and study local industry trends to arrive at the right decision for your environment.

Choose the strongest foundation to support present and future network technology needs—comply with TIA/ISO cabling standards. Build in additional capacity, as it is much easier to install now than later. Use higher bandwidth grades of cabling to postpone having to re-cable as technologies advance. The cabling itself calls for the right knowledge, the right tools, patience, a structured approach, and most of all, discipline. Without discipline, it is common to see complex cabling “masterpieces” quickly get out of control, leading to increased support costs and increased down time.

Since each environment is different, there is no single solution that will meet all of your cable management needs. Following the guidelines and best practices highlighted in this paper will go a long way to providing you with the information required for the successful deployment of a cabling infrastructure in your data center.

APPENDIX A: CABLE TO PORT MAPPING

LC Cable to Port Mapping

LC Patch Panel#		Director Blade #	Description
Shelf	Port	Port	
Shelf 1	1	0	
	2	1	
	3	2	
	4	3	
	5	4	
	6	5	
	7	6	
	8	7	
	9	8	
	10	9	
	11	10	
	12	11	
	13	12	
	14	13	
	15	14	
	16	15	
	17	16	
	18	17	
	19	18	
	20	19	
	21	20	
	22	21	
	23	22	
	24	23	
Shelf 2	1	24	
	2	25	
	3	26	
	4	27	
	5	28	
	6	29	
	7	30	
	8	31	
	9	32	
	10	33	
	11	34	
	12	35	
	13	36	
	14	37	
	15	38	
	16	39	
	17	40	
	18	41	
	19	42	
	20	43	
	21	44	
	22	45	
	23	46	
	24	47	
Shelf3	1	48	
	2	49	
	3	50	
	4	51	
	5	52	
	6	53	
	7	54	
	8	55	
	9	56	
	10	57	
	11	58	
	12	59	
	13	60	
	14	61	
	15	62	
	16	63	
	17		
	18		
	19		
	20		
	21		
	22		
	23		
	24		

NOTE: Print and past the table on the rack door or a log book located near the rack for easy identification devices.

MPO/MTP Cable to Port Mapping

MPO/MTP Patch Panel#		Director Blade #			Description
Shelf	Port	Director Port	Trunk (MPO/MTP)	Trunk Port	
Shelf 1	1	0	1	1	
	2	1		2	
	3	2		3	
	4	3		4	
	5	4		5	
	6	5		6	
	7	6	2	1	
	8	7		2	
	9	8		3	
	10	9		4	
	11	10		5	
	12	11		6	
	13	12	3	1	
	14	13		2	
	15	14		3	
	16	15		4	
	17	16		5	
	18	17		6	
	19	18	4	1	
	20	19		2	
	21	20		3	
	22	21		4	
	23	22		5	
	24	23		6	
Shelf 2	1	24	5	1	
	2	25		2	
	3	26		3	
	4	27		4	
	5	28		5	
	6	29		6	
	7	30	6	1	
	8	31		2	
	9	32	7	1	
	10	33		2	
	11	34		3	
	12	35		4	
	13	36		5	
	14	37		6	
	15	38	8	1	
	16	39		2	
	17	40		3	
	18	41		4	
	19	42		5	
	20	43		6	
	21	44	9	1	
	22	45		2	
	23	46		3	
	24	47		4	
Shelf 3	1	48		5	
	2	49		6	
	3	50	10	1	
	4	51		2	
	5	52		3	
	6	53		4	
	7	54		5	
	8	55		6	
	9	56	11	1	
	10	57		2	
	11	58		3	
	12	59		4	
	13	60		5	
	14	61		6	
	15	62	12	1	
	16	63		2	
	17				
	18				
	19				
	20				
	21				
	22				
	23				
	24				

NOTE: Print and past the table on the rack door or a log book located near the rack for easy identification devices.

APPENDIX B: EQUIPMENT LIST

Chassis

Chassis	Description
Brocade DCX	Built for large enterprise networks, the 14U Brocade DCX has eight vertical blade slots to provide up to 512 Fibre Channel ports.
Brocade DCX-4S	Built for midsize networks, the 8U Brocade DCX-4S has four horizontal blade slots to provide up to 256 Fibre Channel ports.

Patch Cables for mSFP Connection

The mSFP patch cables listed below are for use in the FC8-64 FC port blade. These cables are used to connect end devices to patch panel ports and to connect ports between two local patch panels.

Type	Description	Length	Corning Part Number	Molex Part Number	Amphenol Part Number
mSFP to LC	mSFP LC – standard LC, duplex, multi-mode, OM3, 50/125	1m	S50502S5120001M	106273-0525	943-99865-10001
mSFP to LC	mSFP LC – standard LC, duplex, multi-mode, OM3, 50/125	2m	S50502S5120002M	106273-0526	943-99865-10002
mSFP to LC	mSFP LC – standard LC, duplex, multi-mode, OM3, 50/125	3m	S50502S5120003M	106273-0527	943-99865-10003
mSFP to LC	mSFP LC – standard LC, duplex, multi-mode, OM3, 50/125	5m	S50502S5120003M	106273-0528	943-99865-10005
mSFP to LC	mSFP LC – standard LC, duplex, multi-mode, OM3, 50/125	10m	S50502S5120010M	106273-0529	943-99865-10010
mSFP to mSFP	mSFP LC – mSFP LC, duplex, multi-mode, OM3, 50/125	1m	S5S502S5120001M	106273-0560	943-99866-10001
mSFP to mSFP	mSFP LC – mSFP LC, duplex, multi-mode, OM3, 50/125	2m	S5S502S5120002M	106273-0561	943-99866-10002
mSFP to mSFP	mSFP LC – mSFP LC, duplex, multi-mode, OM3, 50/125	3m	S5S502S5120003M	106273-0562	943-99866-10003
mSFP to mSFP	mSFP LC – mSFP LC, duplex, multi-mode, OM3, 50/125	5m	S5S502S5120005M	106273-0563	943-99866-10005
mSFP to mSFP	mSFP LC – mSFP LC, duplex, multi-mode, OM3, 50/125	10m	S5S502S5120010M	106273-0564	943-99866-10010

Trunk Cables for mSFP Connection

Type	Description	Length	Corning Part Number	Molex Part Number	Amphenol Part Number
mSFP to MTP	mSFP LC - MTP-female, 12 fiber, 12" breakout, OM3, 50/125	Need to specify length when ordering	PN varies based on length H93S5TE9-BMU-XXXM (XXX = length)	N/A	PN varies based on length 943-99867-1XXXX (XXXX = length)
mSFP to MTP	mSFP LC - MTP-female, 12 fiber, 6" breakout, OM3, 50/125	2m	N/A	106272-0327	N/A
mSFP to MTP	mSFP LC - MTP-female, 24 fiber, 12" breakout, OM3, 50/125	2m	N/A	106272-0328	N/A

Patch Panel

Vendor	Type	Rack Unit	Number of Ports	Brocade Part Number	CommScope Part Number
Brocade or CommScope	LC-LC	1U	72	XBR-DCX-0306	3603D-1U-UP UHD w(3) 3603P-48LC-LS
Brocade or CommScope	MPO-MPO	1U	72 MPO or 432 LC	XBR-DCX-0307	3603D-1U-UP UHD w(3) 3603D-1U-72MPO

Velcro Cable Ties

Use Velcro-based ties instead of plastic zip ties or metal tie wraps. Over-tightening plastic zip ties or metal tie wraps can cause sheathing and overstress the patch cables, causing signal loss and impacting performance. Velcro cable ties come in a roll or in predetermined lengths. Bundle groups of relevant cables with Velcro cable ties as you install the cables, which will help you identify cables later and facilitate better overall cable management.

Labelers

Labelers are used to print sticky labels for devices and cables. Here are some considerations when you choose a hand-held labeler:

- Should be capable of operating using batteries
- Can print labels on smooth, textured, flat, and curved surfaces
- The actual label material should resist solvents, chemicals, and moisture
- Labels are durable and resist fading
- Adhesive should be long-lasting

If you choose a labeler with bundled software, install it on a client workstation. You can then customize labels, print labels in batches, and store the formats for future printing.

APPENDIX C: THIRD-PARTY VENDORS

Cable Management Vendors

Corning
Phone: 1-800-743-2675

Molex
Phone: 1-800-833-3557

Email: onlinesales@arrow.com

Email for quotes outside the U.S.: iccsales@arrow.com

www.arrow.com (contact your local branch if you are already an Arrow customer)

Amphenol
Phone: 1-510-209-6831

www.amphenol.com

www.cablesondemand.com

Patch Panel Vendors

CommScope
Phone: 1-800-344-0223

Email: support@systimax.com