LEVITON
Network Solutions

White Paper

Prepare for Data Center Growth with a Centralized Patching Field

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Consolidation and Colocation Transform Large Data Centers

Many companies are at a crossroads between outsourcing or upgrading their data centers to keep up with technology, while lowering capital expenditures and operating expenses. As more businesses look to public cloud services like Amazon AWS and Microsoft Azure to host their data and applications, they are consolidating their on-premises data centers.

For example, since 2015, financial corporation Capital One has consolidated from eight data centers to three, while General Electric consolidated from 34 data centers to four. And the U.S. Government has consolidated a total of 1.7 million square feet of data center space as part of the Federal Data Center Consolidation Initiative, with a goal of closing 25 percent of tiered and 60 percent of non-tiered data centers by the end of fiscal 2018 through the Data Center Optimization Initiative.

Many companies are also choosing to eliminate on-premises data centers but still manage their hardware through colocation services. IT research firm 451 Research reports that the data center colocation market reached $27 billion in annual revenue in 2015, and projects the global colocation market will jump to $33.2 billion by 2018.

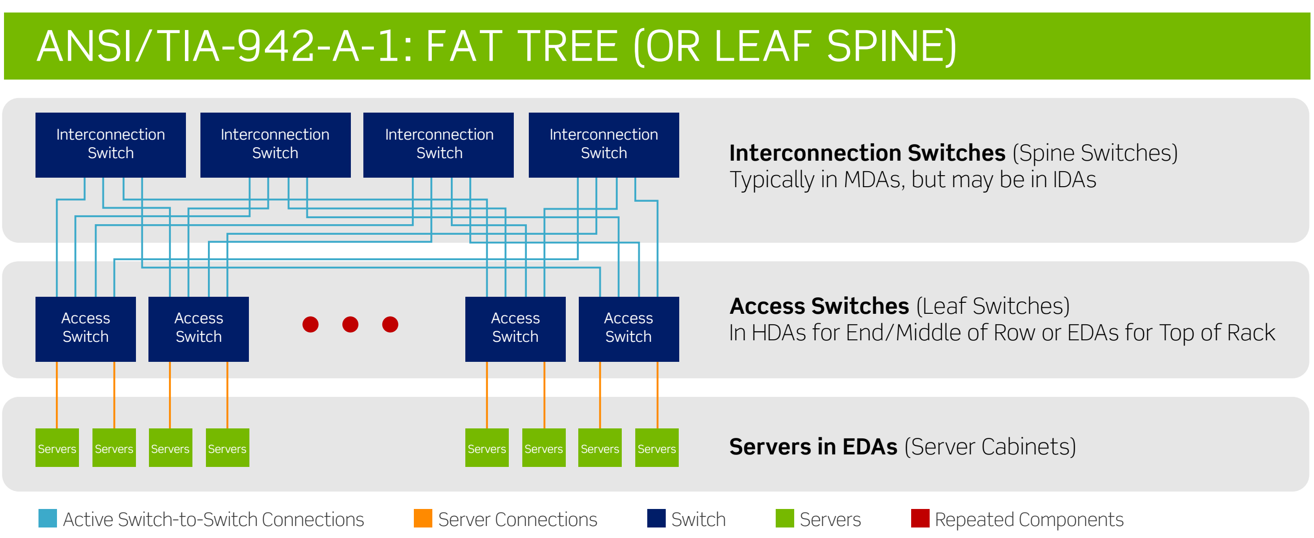
In many cases, consolidation is not a simple elimination of facilities. Companies and government agencies often require at least some new space to support larger, highly utilized and efficient data center operations. They also need a more centralized infrastructure, and many will purchase new hardware as well to maximize efficiency gains and equipment lifespan.

Adopting a Two-Tier Switch Architecture

Whether enterprise or government, any data center consolidation will involve changes in the data center architecture to support demand for greater bandwidth and higher densities. Many data centers are adopting new architectures that reduce the number of switching tiers. They are also beginning to adopt fiber optic networks throughout the entire data center. Fiber has mainly been used for backbone cabling to support high-speed transmission, but it will become more common in server cabinets and equipment over the next few years.

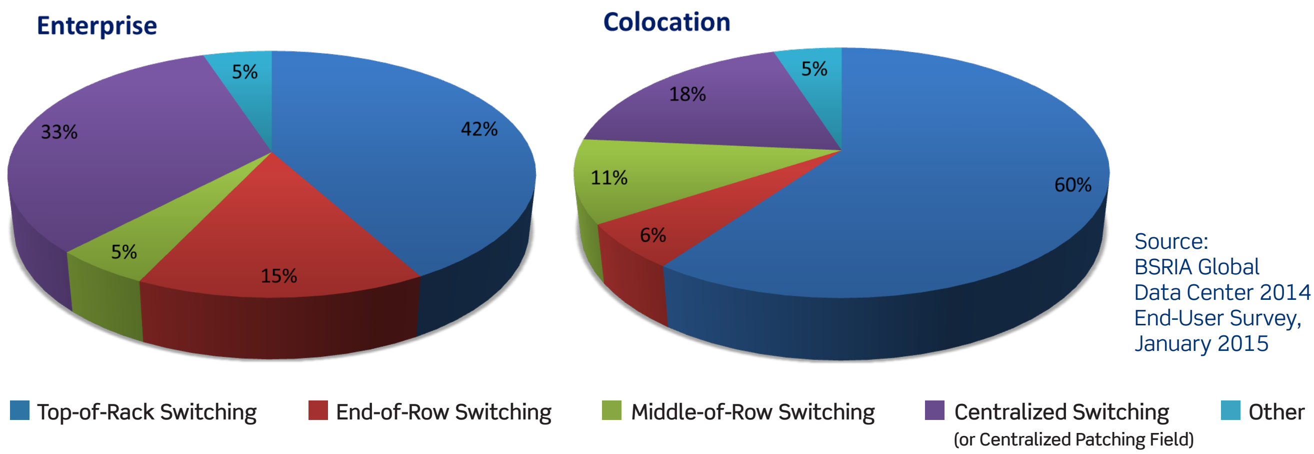
In 2013, the TIA updated the TIA-942-A Telecommunications Infrastructure Standard for Data Centers with an addendum that specifies guidelines for switch fabrics and topologies. These guidelines describe two-tier or even one-tier designs that better support low latency, server virtualization, and cloud computing than a traditional three-tier design.

Figure 1. Two-Tier Switch Architecture



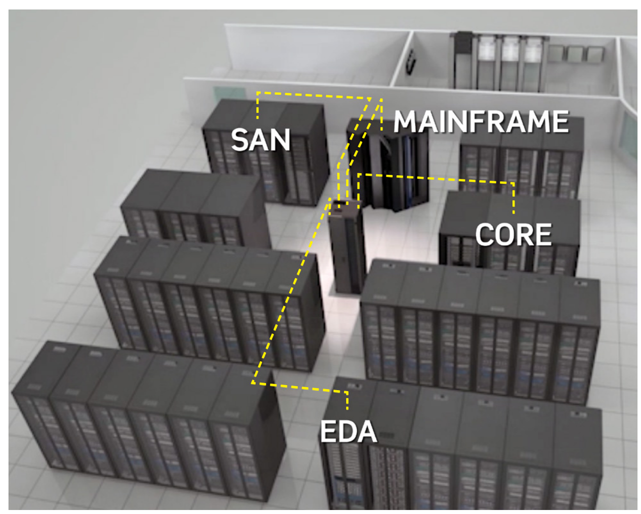
A two-tier or leaf-spine architecture addresses these challenges and has become the standard for greenfield data centers. All access switches are connected to every interconnection switch, providing a redundant path. Traffic runs east-west, reducing latency between access switches. This is a very scalable fabric. The leaf-spine architecture has led to an increase in Top-of-Rack and Centralized switching topologies. Both of these topologies result in more fiber in the Main Distribution Area (MDA).

Figure 2 - Top-of-Rack and Centralized Switching have become the most popular network architectures.



Along with centralized switching, a centralized patching field is installed in the MDA, serving as the main cross-connect patching location for all fiber channels in the data center. It can support cabling from network servers, core switches, the SAN, mainframe, and disk or tape storage.

This approach keeps things centralized to make network management easier. In larger facilities, the centralized patching field keeps moves, adds, and changes much more manageable. And as a data center infrastructure grows, the management area doesn't. Workers aren't required to go to remote areas of a facility to do connection work: they're able to handle it from the patching field.



A centralized patching field in the MDA, aggregating fiber from every data center zone.

There are other distinct benefits to using a centralized patching field:

- A centralized patching field should replicate the switches or respective equipment devices, port for port. This greatly simplifies maintenance and MACs. Also, there is little need to access the cabinets that house high-dollar assets like switches and routers. This makes these assets more secure and minimizes the risk of damage or downtime.
- A centralized patching field does not have to be centrally located: since it does not require power or cooling, it can be located away from the active equipment in its own floor space, or isolated in a separate room. This frees up premium floor space in the data center for additional revenue-generating cabinets housing switches and servers.
- Traffic can easily be redirected at the patching field while equipment gets serviced or changed out, saving time and lowering operating expenditures associated with tech refreshes.

Addressing Connection Points and Loss Budgets

In a fiber network, each connector interface in the channel has a loss of signal power associated with it. So when considering a centralized patching field, one of the concerns that may arise is the potential for higher channel insertion loss with additional connection points in the channel. The chart below lists maximum link lengths and maximum channel insertion loss for 10, 40, and 100 Gb/s multimode, as set by IEEE. Multimode is still the most cost-effective solution for fiber link distances under 150 meters for higher speed transmissions.

Figure 3: Overview of IEEE multimode loss budgets for 10/40/100/400 Gb/s

Year Ratified	IEEE Standard	Name Designation	Data Rate	Fiber Type	Number of Fibers (Tx & Rc)	Connector Interface	Max. Link Length (m)	Max. Channel Insertion Loss (dB)
2002	802.3ae	10GBASE-SR	10G	OM3	2	LC	300	2.6
				OM4	2	LC	400	2.9
2010	802.3ba	40GBASE-SR4	40G	OM3	8	MPO/MTP®	100	1.9
				OM4	8	MPO/MTP	150	1.5
		100GBASE-SR10	100G	OM3	20	MPO/MTP	100	1.9
				OM4	20	MPO/MTP	150	1.5
2015	802.3bm	100GBASE-SR4 (2nd Gen.)	100G	OM3	8	MPO/MTP	70	1.9
				OM4	8	MPO/MTP	100	1.5
Est. end of 2017	802.3bs	200GBASE-DR4	400G	OM3	32	MPO/MTP	70	1.8
		400GBASE-DR4		OM4	32	MPO/MTP	100	1.9
Est. 2018	802.3cd	50GBASE-SR	50G	OM4	2	LC	100	TBD
		100GBASE-SR2	100G	OM4	4	MPO/MTP	100	TBD
		200GBASE-SR4	200G	OM4	8	MPO/MTP	100	TBD

In the channel diagrams that follow (Figures 4-8), the total channel insertion loss for topologies with both two- and four-connection points meet the IEEE maximum standards when using OM3 and OM4 fiber at 100 or 150 meters. This distance meets the needs of the vast majority of enterprise data centers. In fact, according to Leviton data and information from other cabling manufacturers, 98 percent of trunk cables used by data centers are less than 100 meters, and 91 percent are less than 50 meters.

You will want to design your network based on IEEE standards to ensure interoperability and interconnectivity among different manufacturers. While there are proprietary solutions on the market offering extended distances beyond industry standards, you need to work closely with cabling and active gear manufacturers to ensure channel loss budgets will pass.

“98 percent of trunk cables used by data centers are less than 100 meters, and 91 percent are less than 50 meters.”

Integrating a Centralized Patching Field into 10, 40, and 100 Gb/s Networks

The following illustrations show typical 10, 40, and 100 Gb/s cabling topologies with two connection points in the channel — with one connection point in the switch cabinet and one in the server cabinet. Following each two-connection-point example is an illustration of the same network with a centralized patching field and appropriate changes to the cabling system components. The centralized patching field adds two more connection points, creating four total connection points in the channel.

Figure 4: 10 Gb/s Channel (10GBASE-SR) with Two Connection Points

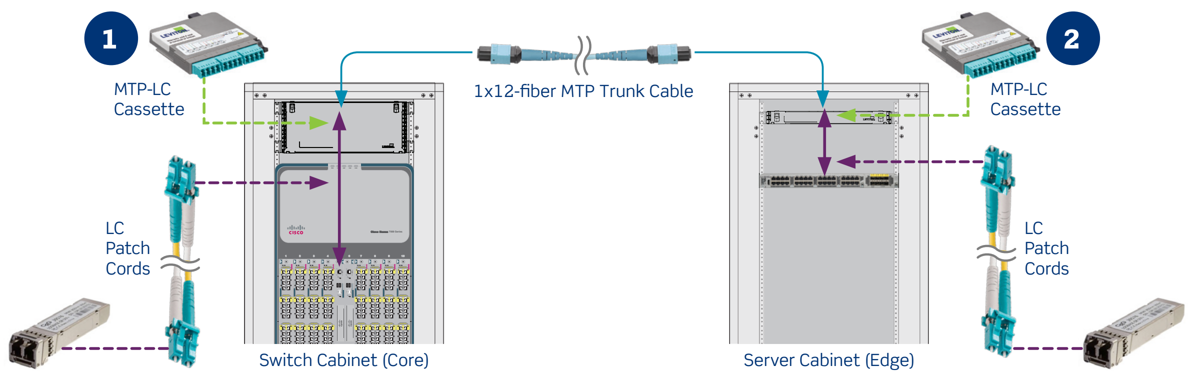


Figure 4 illustrates two connection points with MTP-LC fiber cassettes. The backbone fiber reflects a 12-fiber MTP trunk with a cable attenuation of 3db/km. LC patch cords are used to connect MTP cassettes to SFP+ transceivers.

Figure 5: 10 Gb/s Channel (10GBASE-SR) with Four Connection Points

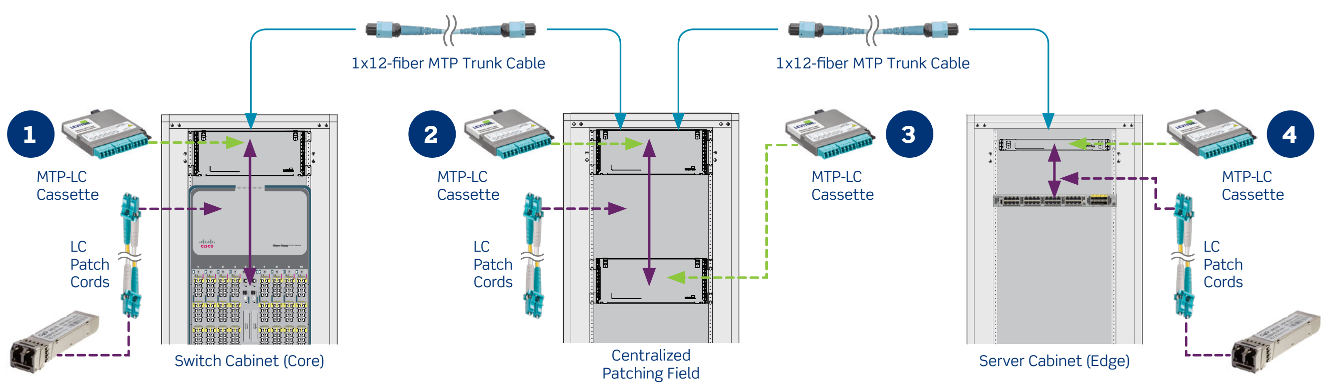
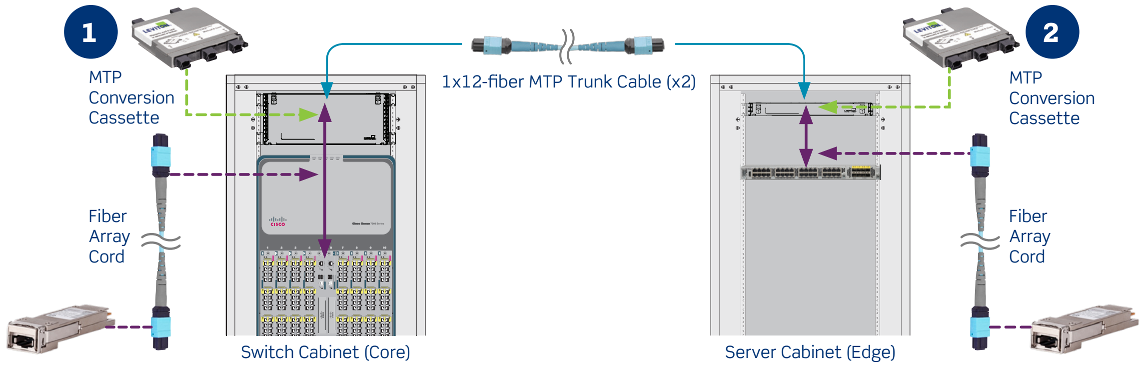


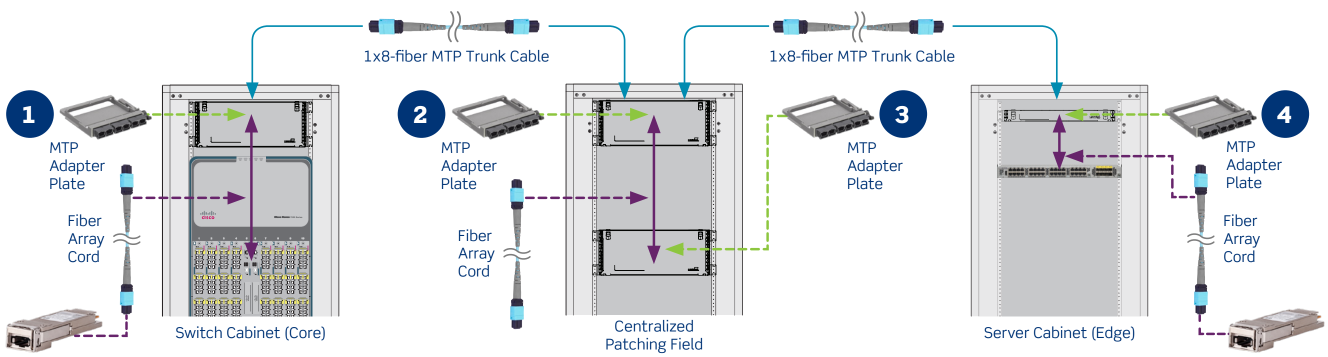
Figure 5 shows the 10 Gb/s channel with a centralized cross-connect patching field. In the central cabinet, there are two 19-inch fiber enclosures, representing the incoming trunks from switches at each end of the channel. LC patch cords connect the two links together.

Figure 6: 40 Gb/s Channel (40GBASE-SR4) with Two Connection Points



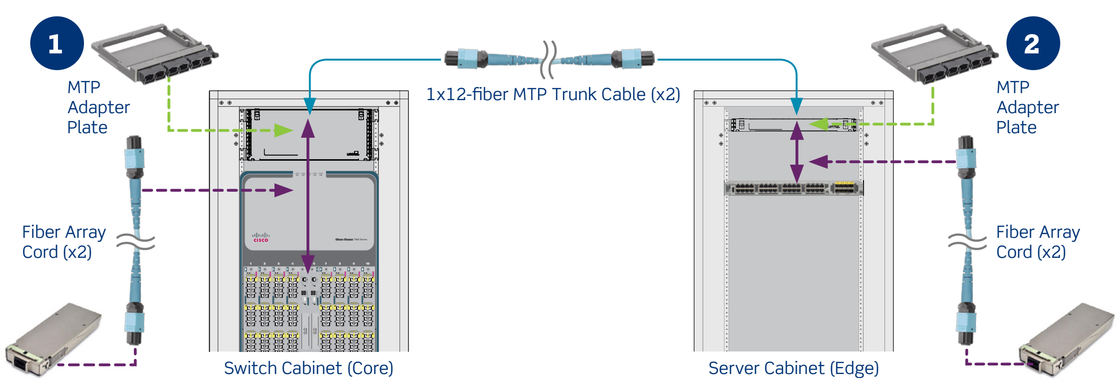
When migrating from 10 Gb/s to 40GBASE-SR4, the MTP-LC cassettes shown in Figure 4 and Figure 5 are replaced by MTP-MTP conversion cassettes. Also, 8-fiber array cords are used to connect the conversion cassettes to QSFP+ or CFP transceivers at the switch.

Figure 7: 40 Gb/s Channel (40GBASE-SR4) with Four Connection Points



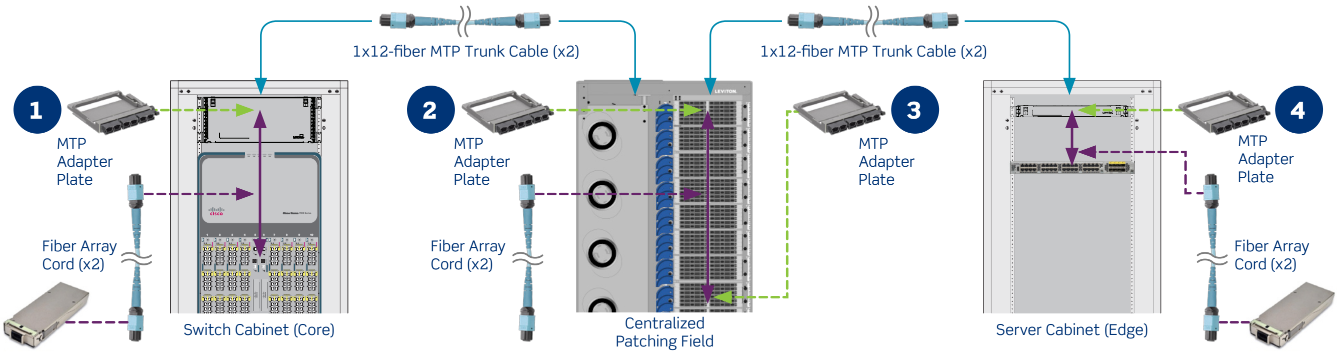
For a four-connection point channel with the centralized patching field, MTP pass-through adapter plates replace the conversion cassettes, and 8-fiber array cords connect the core switches and servers within the central patching field.

Figure 8: 100 Gb/s Channel (100GBASE-SR10) with Two Connection Points



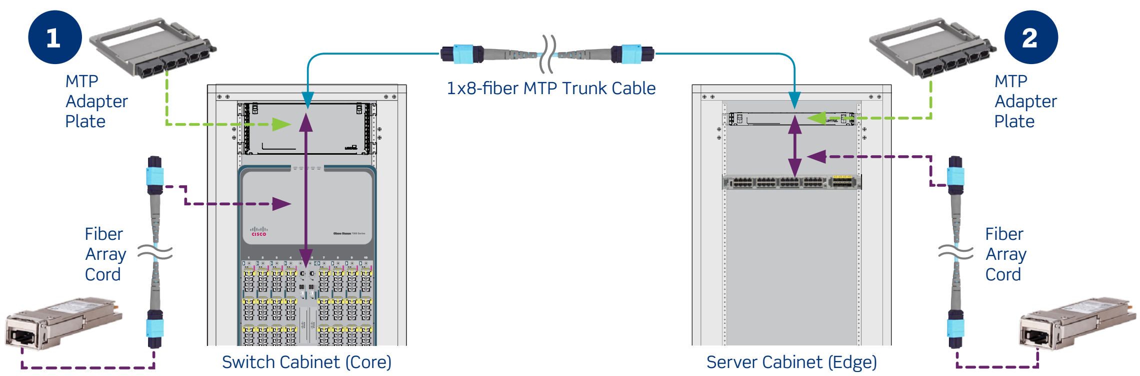
When migrating to 100GBASE-SR10, conversion cassettes are replaced by MTP pass-through adapter plates. However, if the existing 40 Gb/s topology includes the pass-through adapter plates, as shown in Figure 7, no replacement would be necessary. In this example, two 12-fiber MTP array cords are used to connect QSFP28 transceivers to the switch. If 24-fiber array cords are used instead of 12-fiber connections, they would connect either CFP, CFP2, or CPAK transceiver form factors at the switch.

Figure 9: 100 Gb/s Channel (100GBASE-SR10) with Four Connection Points



In this four-connection point 100GBASE-SR10 illustration, the traditional cabinet for the centralized patching field has been replaced with a high-density fiber distribution frame. Instead of standard 19-inch fiber enclosures, it uses modular 2RU patch decks. As with the 40 Gb/s example with four connection points, 12-fiber MTP array cords patch the two links together.

Figure 10: 100 Gb/s Channel (100GBASE-SR4) with Two Connection Points



The 100GBASE-SR4 standard, which was approved in 2015, reduces the lane count for 100GbE from 10 lanes at 10GbE (as in 100GBASE-SR10) to four lanes at 25 Gb/s, following a similar channel requirement as 40GBASE-SR4. This diagram illustrates the use of MTP pass-through adapter plates, though MTP conversion cassettes may be deployed instead.

Figure 11: 100 Gb/s Channel (100GBASE-SR4) with Four Connection Points

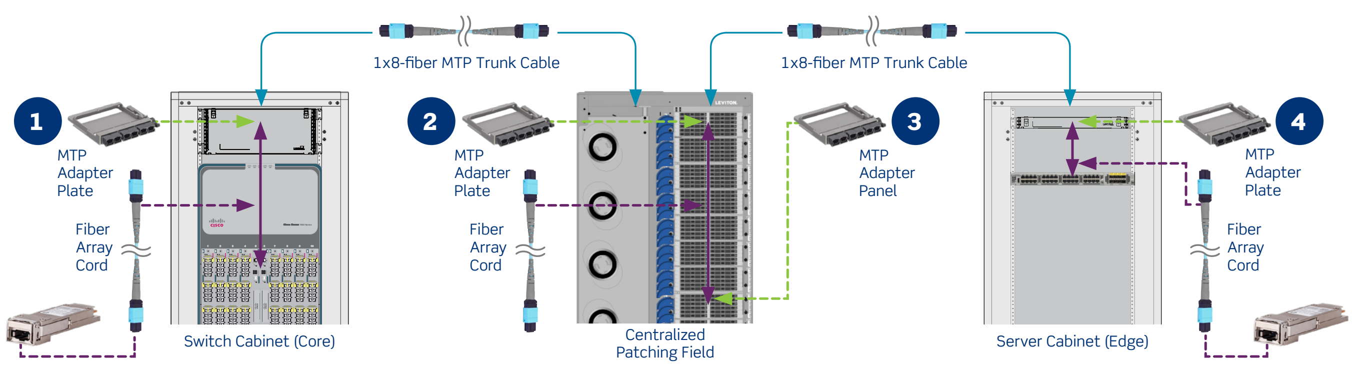


Figure 11 uses the same components from the two-connection points example, with the addition of 8-fiber MTP array cords within the centralized fiber distribution frame.

Traditional Cabinets vs Fiber Distribution Frames

Typically, centralized patching fields come in the forms of traditional cabinets or an open frame with no active equipment inside. Traditional 19-inch cabinets maintain a consistent look with other cabinets in a data center.

Figure 12

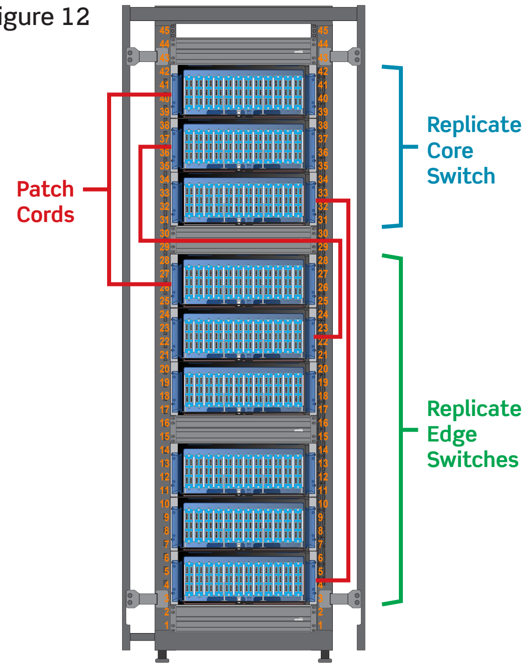


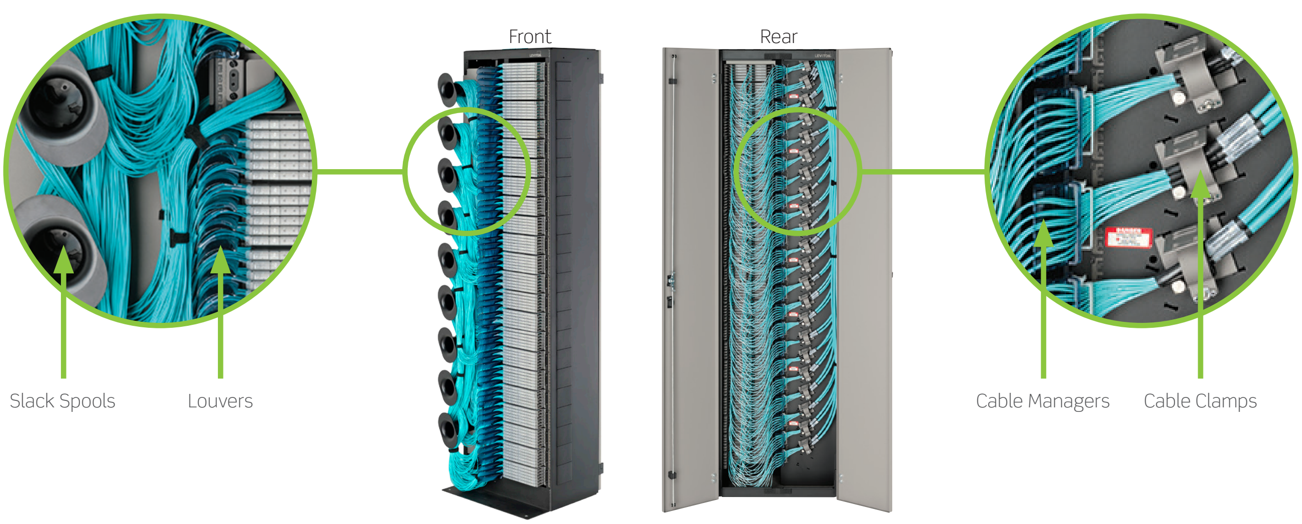
Figure 12 represents a centralized patching field in a **Traditional Cabinet**, using 4RU enclosures. The top three enclosures replicate core switches, while the middle and bottom enclosures replicate edge switches. Enclosure density can range from 72 to 144 fibers per rack unit. 96 fibers per rack unit is an optimal density, accommodating up to 3,456 fibers in a cabinet. There are ultra-high-density enclosures available today that can accept more than 5,000 fibers per cabinet.

However, managing cords and trunks in such a high-density application with traditional rack enclosures can become challenging. There is little room for adequate slack management, and fiber bend radius become a concern, especially for trunks entering the cabinet.

Distribution Frame solutions are most often used by carriers in central offices, where tens of thousands of fibers are being managed. However, in recent years, data centers have begun adopting the frames. They are capable of patching thousands of fibers, while designed with cable management to alleviate the challenges of higher densities.

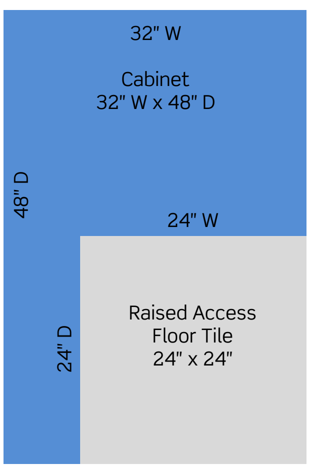
For example, the Leviton HDX Fiber Distribution Frame has the ability to patch 3,168 LC fibers or 15,552 MTP fibers on only one 2' x 2' data center floor tile, and includes vertical and horizontal cable managers that are integrated into the frame. It includes slack spools and cable clamps for properly routing cords and trunks, and unique patch decks with trays that handle horizontal cord management.

HDX Distribution Frame



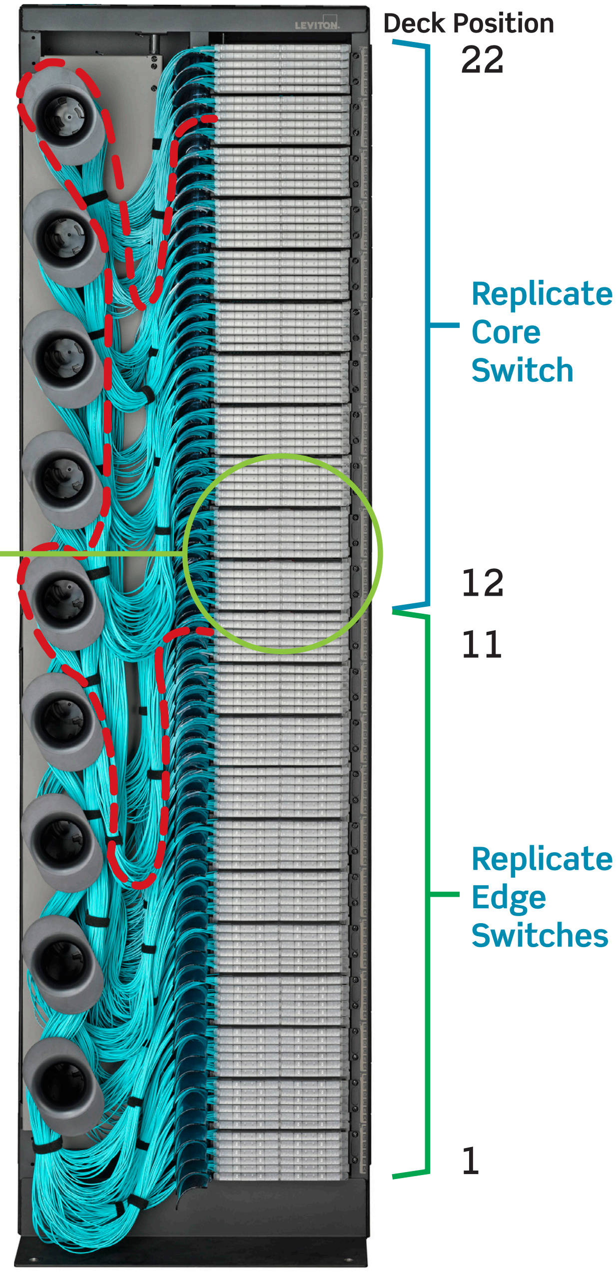
In contrast, vertical and horizontal cable management solutions for traditional cabinets are sold separately and installed at the job site. Some cabinet manufacturers kit the cable management with the cabinet, but cable management will need to be moved or adjusted horizontally and vertically based on the layout.

Also, a distribution frame leaves a much smaller footprint than a traditional cabinet. The HDX Distribution Frame occupies only one 2x2-foot data center floor tile, while a traditional cabinet occupies four data center floor tiles. Even though it takes up a much smaller footprint, the HDX Frame is capable of patching more than 3,000 fibers using LC connections. This is the highest density per square foot for an open frame system. Reducing the footprint while adding density opens up space for additional cabinets dedicated to network switches and servers — the revenue-generating cabinets in a data center.



Top View
32" W x 48" D
10.7 Square Feet Used

As with traditional cabinets used for cross-connect patching, a distribution frame replicates core switches in the top half and edge switches in the bottom half. When patching within one frame, the HDX Frame requires only one length of patch cord, at three meters. This means data center managers don't need to stock multiple-length patch cords.



Cabinet or Frame? Calculate Your Savings

Leviton offers an online calculator to help determine how much money and space you can save by using a distribution frame compared to traditional cabinets. The HDX Frame ROii Calculator will help you generate a business case for using a frame, showing the return on infrastructure investment over a five-year span. It takes the average cost of data center floor space — which can range from $35 to $150 per square foot — and factors in the number of cabinets, devices, and channels per cabinet in each zone to help generate your cost savings.

To learn more, go to **Leviton.com/HDX.**

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We invent the industry's best technologies. We build them to last. And we stand behind every product and every installation — delivering industry-leading performance and unbeatable service and support — throughout the life of your structured cabling system. Add in the peace of mind that comes from working with a stable, century-old supplier, and you get the **highest return** on **infrastructure investment**.

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