

Gen7 SAN Director

FC64-64 Line Card

PANDUIT®

Application Guide



With the introduction of the next-generation all-flash storage SAN Director, the Gen7 Fiber Channel offering has improved performance, latency, and traffic reliability. The implementation of Gen7 SAN Directors resolves I/O bottlenecks and allows for maximum throughput performance and reliability. However, Gen7 infrastructure alone is only half of the solution. To achieve these performance and reliability gains, customers need to ensure they're using cabling infrastructure that meets or exceeds these levels of hardware performance requirements for bandwidth and network reach. By trusting Panduit as your network infrastructure vendor at installation time, customers can ensure maximum performance of Gen7 fiber channel SAN fabrics using our world-class fiber solutions.

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Benefits of Structured Cabling

Structured cabling has been used in most data centers for over 30 years to bring standardization and order to the cabling, while also providing circuit protection, improving uptime, and aiding moves/adds/changes. It simplifies installation, provides slack management, and future-proofs the network by allowing easy upgrades using newer higher-speed transceivers without ripping and replacing existing infrastructure. This guide contains best practices to aid in design and installation of Gen7 FC64-64 solutions.

SAN Director Components

The Gen7 SAN Director offering is composed of a multitude of components, including a storage chassis, line cards, and optics, in addition to fiber connectivity components to connect the devices to other fiber channel equipment. Capabilities of these components are captured in the X7-4 or -8 Director Hardware Installation Guide(s), but a cursory review will help with understanding cabling options and methods throughout this guide. Additionally, the port density of Gen7 directors has increased. To accommodate this, Gen7 now accepts an SFP-DD dual SN[®] transceiver. This transceiver uses a newer VSFF (Very Small Form Factor) SN[®] fiber port. Because SN[®] is a new form factor, customers look to convert the fiber connectivity to duplex LC to accommodate traditional patching and structured cabling methods.

SAN Storage Chassis:



Image 1: X7-8
14U, 12 blades
Up to (384) 64G or (512) 32G ports



Image 2: X7-4
8U, 4 blades
Up to (192) 64G or (256) 32G ports

Line Cards:



Image 3: FC64-64*

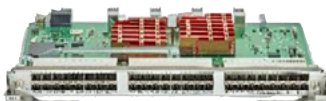


Image 4: FC64-48

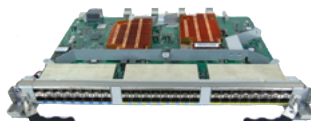


Image 5: FC32-X7-48

Optical Transceivers:



Image 6: 64G SFP+
Duplex LC



Image 7: 64G QSFP+
MPO-12



Image 8: 64G SFP-DD
Dual Duplex SN[®]*

*Only blade that accepts SFP-DD SN[®] transceivers
The SN[®] connector is a registered trademark of Senko Corporation
All images included in this guide are for reference purposes and property of Brocade[®]

How This Scales

As part of the performance and reliability functionality of Gen7, the SAN Director also allows for multiple Inter-Switch Links (ISL). Dependent on the network topology of the SAN Fabric, the number of chassis interconnected may also grow to double digits. When deploying a Core/Edge Topology, up to (9) chassis may be interconnected. If deploying a Mesh Topology, the number of chassis involved scales to (12). This interconnectivity is a one-to-all connection using the ISL trunking feature of the Core Routing blade type, using QSFP+ transceivers and MPO or Duplex LC fiber cables.

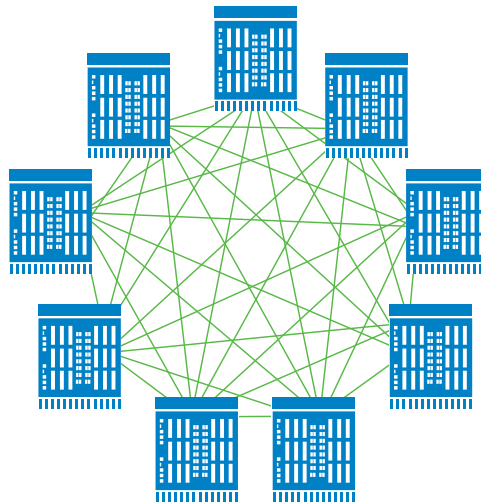


Image 9: Core/Edge 'Star' Technology Fabric

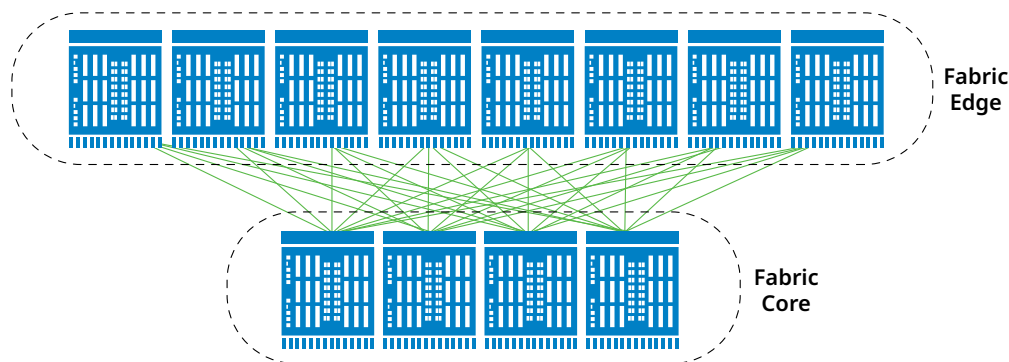


Image 10: Mesh Technology Fabric

ISL links will use industry standard fiber structured cabling. Dependent on the ISL trunking options deployed (MPO or Duplex LC), a cassette or FAP (Fiber Adapter Panel) based infrastructure would enable the one-to-all installation method to interconnect switches.

By completing the ISL trunking using the Core Routing blades, up to 33% of the chassis/blades available FC (Fiber Channel) ports would still be available for server and storage connectivity. This also ensures faster, less congested connections as there are no additional hop due to frame switching being done on non-egress port blades. If the chassis are within 100 meters, Multimode QSFP transceivers and infrastructure will be used. Longer distances will require using Duplex LC Singlemode transceivers and infrastructure.

What Can Panduit Do To Help

As a trusted name in structured cabling and connectivity solutions for decades, Panduit has listened to customer pain points that manifest with newer technology adoption; in this case how will this new optical connector fit in my existing network infrastructure? An option could be using hybrid patch cables, SN® to Duplex LC. The problem with this being that one 8-blade Gen7 SAN Director using the FC64-64, thirty-two SFP-DD port blade with 64 Duplex SN® connectors would need **512** individual hybrid patch cables to complete this: 32 ports * 2 cables per port * 8 blades.

Now let's refer back to Image 10 above showing (12) of the Gen7 chassis interconnected and imagine the cabling nightmare this creates within a single fabric. The use of the VSFF connector enables twice the density of fibers per transceiver over traditional Duplex LC Fiber Channel transceivers. Added density adds cable congestion.

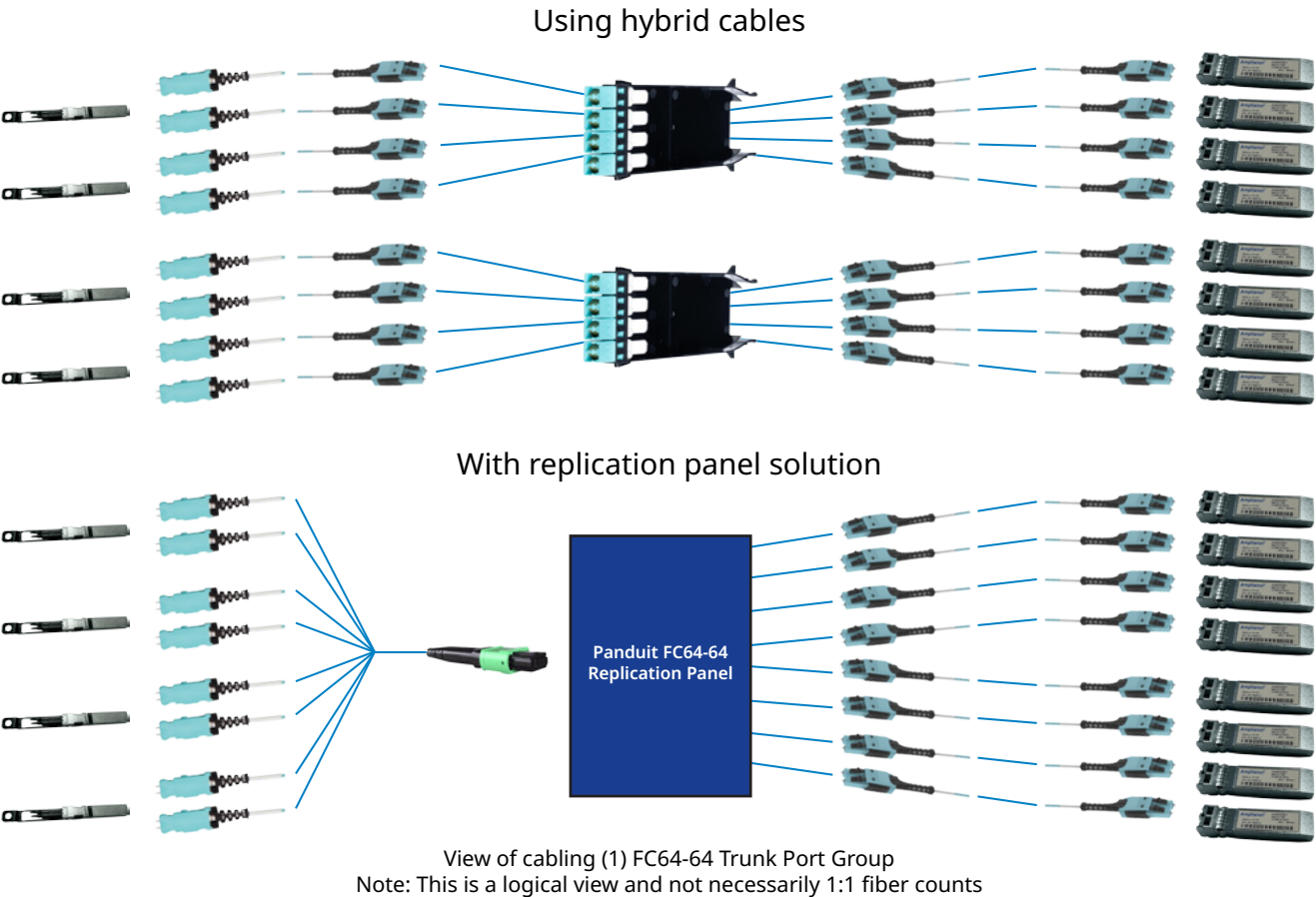


Image 11: Structured cabling with hybrid cables vs Port Replication Panel

The Better Solution

With the long history of providing world-class solutions to resolve customer problems, there is indeed a better way. The F1RBZO-7B16-10U Port Replication Panel solves multiple pain points. The panel maintains maximum port density for the Gen7 SAN Director, simplifies the cabling plant and media conversion in a 1RU-per-blade form factor, enhances cable management, enables 1:1 port replication, while delivering the capability to complete port-group trunking with a factory tested fiber media conversion platform. The solution, shown in Image 12, below is a 1RU port replication panel, with eight MPO-16 connectors on the rear and sixty-four Duplex LC connectors on the front. Each MPO-16 connector port replicates and converts eight 2F SN[®] connectors to eight 2F Duplex LC connectors as the output. This solution allows customers to connect existing LC based Fiber Channel infrastructure components while maintaining maximum port density using next-generation optical fiber connectors at the blade. The panel also follows the Gen7 SAN Director numbering scheme of 0-31 for SFP-DD ports, and 0-63 FC ports.

The F1RBZO-7B16-10U panel, in conjunction with Panduit's 8:1 SN[®] to MPO-16 low-loss breakout harness assembly (see Image 13), allows for easy trunking of the FC64-64 blades eight trunk port groups. Each SN[®] to MPO-16 assembly will physically pair with (4) SFP-DD 64G FC optical transceivers, with eight harnesses completely cabling one 32-port, FC64-64 blade. With the maximum number of blades installed in a Gen7 SAN Director X7-8 chassis at eight, one director can be fully dressed out with 64 harnesses and eight replication panels, a far cry from the 512 hybrid cables necessary to convert using duplex fiber media alone.

The 8:1 SN[®] media conversion harnesses also terminated in EEZ-Flip 2F connectors with MPO[®] connectors (16F). **Note: This is also the highest density interconnect harness on the market at 8:1 to service a full port group. Other vendors offer 4:1 breakout but still require additional individual adapter panels in lieu of a full replication panel solution for each blade.**



Image 12: Panduit FC64-64 Port Replication Panel



Image 13: Panduit 8:1 SN[®] to MPO-16 Harness

Port Replication Panel Information

The Panduit Port Replication Panel for the FC64-64 line card enables 1:1 port replication and fiber media conversion from SN[®] based transceivers to Duplex LC output, allowing the user to easily cross-connect traditional 2F infrastructure in their environment. Most Fiber Channel transceivers support Duplex LC, so conversion of the fiber connectors to traditional optical connectors ensures customers can also be ready for Gen8 FC (FC-PI-8) physical requirements of Duplex LC backwards compatibility when looking to upgrade. The 1RU panel is essentially an EIA/TIA 19" rack/cabinet mountable, factory tested 'harness-in-a-box'. By using MPO-16 inputs, the panel minimizes cabling bundles, requiring only eight MPO-based assemblies to be trunked per FC64-64 line card. This both minimizes install time but also greatly improves cable manageability for such a large SAN director. Utilizing an internal fiber fan-out harness, each MPO-16 input is able to feed eight Duplex LC fiber ports on the front of the system where it is easier to manage the cable in vertical or horizontal cable management channels like traditional patch fields. Using the 1RU panel will also ensure proper port numbering when converting back to LC, as using a standard conversion harness would not account for the zigzag port group numbering scheme as most harnesses would label 1-2, 3-4, 5-6, 7-8 and not 0-1, 2-3, 4-5, 6-7 for the starting ports.

8:1 SN[®] To MPO-16 Breakout Harness Assembly Information

The use of Panduit 8:1 VSFF breakout assemblies will also greatly assist with cable management. The harness lengths and predefined cable retention points will greatly ease the installation of the harnesses. Competitive products using SN[®] connectorized trunks require overly long breakout legs which leads to poor cable management. Cable management, upgradability, and ease of installation are key factors in this solution. In addition to being factory tested, customers can expect any MACs necessary at the blade level to be greatly improved by pull-boot connectors on Uniboot cable (two fibers under one jacket). Also being a Panduit engineered solution versus a pallet full of hybrid patch cables, the time to deploy is greatly decreased. Installing a full eight blade system with hybrid cables would require 1,024 cleaned connectors, while using the Panduit solution of 64 VSFF harnesses and 8 Port Replication Panels would require 576 cleaned connectors, a 44% reduction in field-connector-cleans. This solution also enables instant interconnect patch fields.

What This Solution Alleviates

This panel/harness solution remediates many customer issues:

- ***How long do I make my cabling?*** With predefined breakout harness lengths, customer installation is greatly improved by allowing for the SAN Director and patch field in the same cabinet or separate location; or if required, can easily be cross-connected to anywhere in the network.
- ***What should my cable management look like?*** With application specific harnesses defined for this SAN Director solution, cable management is a key component of the engineered solution. Smaller cabling bundles can be expected as well as managed more easily in the vertical cable management space due to breakout harness/trunk design.

Available Part Number Options

There are also two options for breakout with the MPO-16 to 8 x SN[®] connector assembly. Depending on routing distance and whether a pulling eye is required, the 8:1 solution is offered in both a trunk or harness form factor as shown below.

Port Replication Panel

Part Number	Description
F1RBZO-7B16-10U	Gen7 FC64 Port Replication Panel, OM4, Optimized IL, MPO-16 to Duplex LC, Universal

8:1 Trunk

Part Number	Description
GZCYPO6FH5AF***	OM4, 16F Trunk, Plenum, MPO-16 F to SN [®] , 8-to-1 (U2), Opt IL, Pulling Eye
GZCYLO6FH5AM***	OM4, 16F Trunk, LSZH, MPO-16 F to SN [®] , 8-to-1 (U2), Opt IL, Pulling Eye
GZCYBO6FH5AM***	OM4, 16F Trunk, LSZH Euroclass B2ca, MPO-16 F to SN [®] , 8-to-1 (U2), Opt IL, Pulling Eye
GSCYPO6FH5AF***	OM4+, 16F Trunk, Plenum, MPO-16 F to SN [®] , 8-to-1 (U2), Opt IL, Pulling Eye
GSCYLO6FH5AM***	OM4+, 16F Trunk, LSZH, MPO-16 F to SN [®] , 8-to-1 (U2), Opt IL, Pulling Eye
GSCYBO6FH5AM***	OM4+, 16F Trunk, LSZH Euroclass B2ca, MPO-16 F to SN [®] , 8-to-1 (U2), Opt IL, Pulling Eye



8:1 Harness

Part Number	Description
GZCRPOPFH5NF***	OM4, 16 Fiber Harness, Plenum, MPO-16 APC Female to SN [®] with 32 inch equal breakout, 8-to-1 (U2) Polarity, Optimized IL
GZCRLOPFH5NM***	OM4, 16 Fiber Harness, LSZH, MPO-16 APC Female to SN [®] with 32 inch equal breakout, 8-to-1 (U2) Polarity, Optimized IL
GZCRBOPFH5NM***	OM4, 16 Fiber Harness, LSZH Euroclass B2ca, MPO-16 APC Female to SN [®] with 32 inch equal breakout, 8-to-1 (U2) Polarity, Optimized IL
GSCRPOPFH5NF***	OM4+, 16 Fiber Harness, Plenum, MPO-16 APC Female to SN [®] with 32 inch equal breakout, 8-to-1 (U2) Polarity, Optimized IL
GSCRLOPFH5NM***	OM4+, 16 Fiber Harness, LSZH, MPO-16 APC Female to SN [®] with 32 inch equal breakout, 8-to-1 (U2) Polarity, Optimized IL
GSCRBOPFH5NM***	OM4+, 16 Fiber Harness, LSZH Euroclass B2ca, MPO-16 APC Female to SN [®] with 32 inch equal breakout, 8-to-1 (U2) Polarity, Optimized IL



X7-8 FC64-64 Line Card & Port Grouping

Each FC64-64 line card contains eight port groups. Image 14 below shows the breakout of the first group, Port Group 0, comprising physical ports 0–7. Each physical SFP-DD port will support one SFP-DD 64G FC Dual SN[®] transceiver, which will accept two SN[®] connectors.

Using one Panduit 8:1 SN[®] to MPO-16 harness assembly will enable full population of the four SFP-DD slots composing Port Group 0. Repeat this seven times for full blade port replication for the remaining Port Groups 1-7.

Note: Due to the port numbering schema of Gen7 FC64-64 line cards, a solid labeling plan is paramount

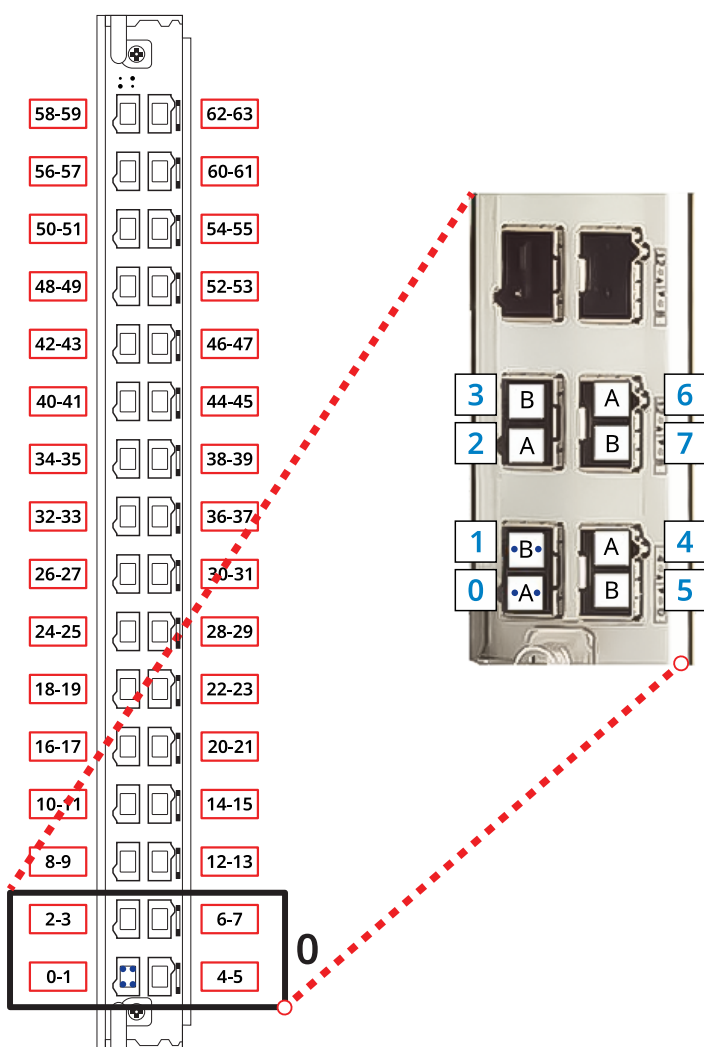


Image 14: Breakout view of FC64-64 Line Card, Port Group 0

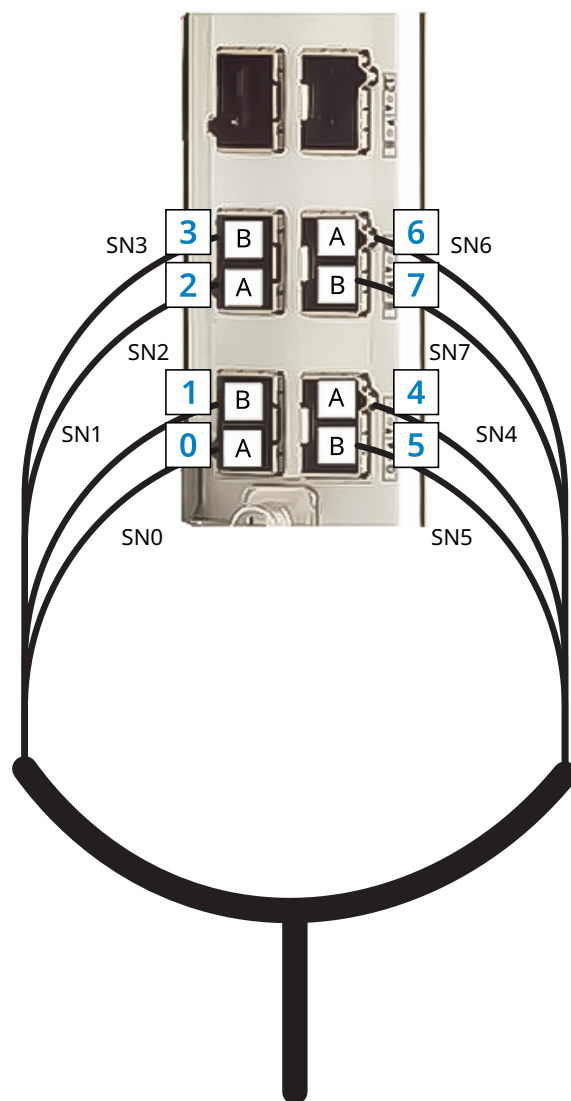


Image 15: Panduit 8:1 SN[®] harness mapping to Port Group 0

Gen7 FC64-64 Line Card to 8:1 Breakout Harness Mapping

The Gen7 SAN Director allows for eight Fiber Channel (non-ISL) blades on the following slots: Slots 3-6, and Slots 9-12. Assuming a fully populated chassis, there will be eight harnesses per slot with one, eight connector harness per port group for a total of 64 VSFF connectors per line card.

FC64-64

Slot 3			Slot 4 to Slot 6, Slot 9 to Slot 12		
FC Port	Harness #	Harness Connector	FC Port	Harness #	Harness Leg
0-1	0	PR1, PR2	0-1	0	PR1, PR2
2-3	0	PR3, PR4	2-3	0	PR3, PR4
4-5	0	PR5, PR6	4-5	0	PR5, PR6
6-7	0	PR7, PR8	6-7	0	PR7, PR8
8-9	1	PR1, PR2	8-9	1	PR1, PR2
10-11	1	PR3, PR4	10-11	1	PR3, PR4
12-13	1	PR5, PR6	12-13	1	PR5, PR6
14-15	1	PR7, PR8	14-15	1	PR7, PR8
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
48-49	6	PR1, PR2	48-49	6	PR1, PR2
50-51	6	PR3, PR4	50-51	6	PR3, PR4
52-53	6	PR5, PR6	52-53	6	PR5, PR6
54-55	6	PR7, PR8	54-55	6	PR7, PR8
56-57	7	PR1, PR2	56-57	7	PR1, PR2
58-59	7	PR3, PR4	58-59	7	PR3, PR4
60-61	7	PR5, PR6	60-61	7	PR5, PR6
62-63	7	PR7, PR8	62-63	7	PR7, PR8

Image 16: Breakdown of harnesses per Line Card (ports 16-47 are omitted as repetitive, represented by 'o').
Ensure to add them to the total port/harness count!

Network Channel Polarity View

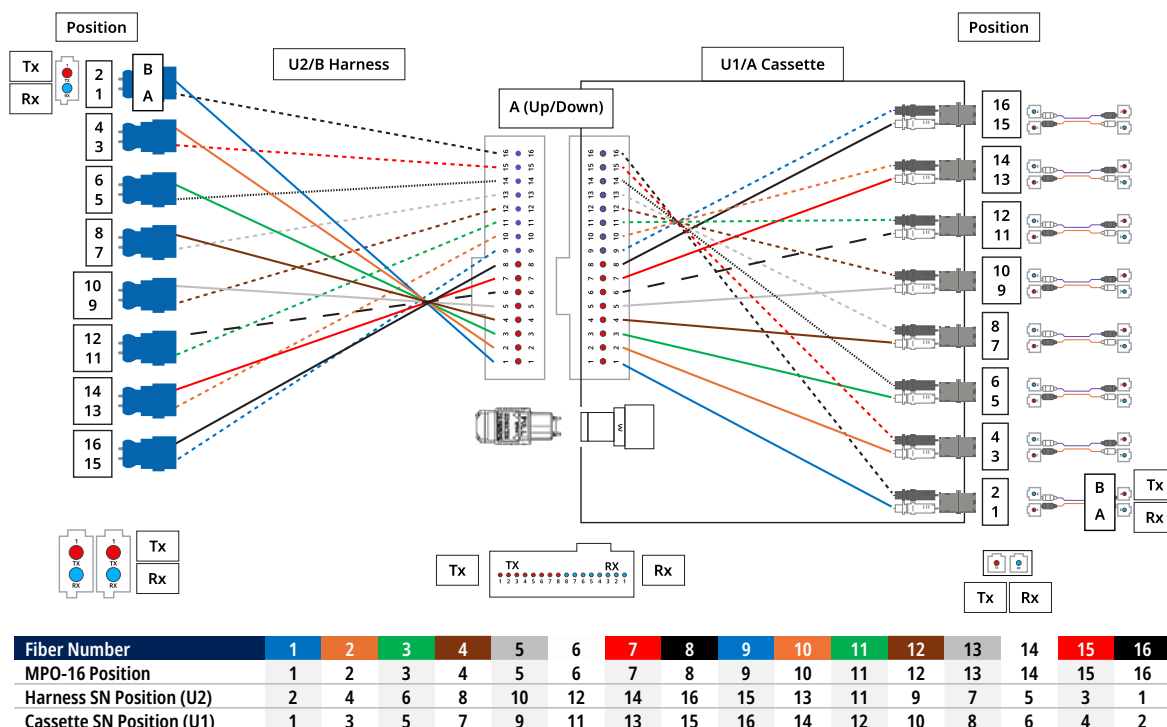


Image 17: Channel Polarity View

Applicable Standards

As part of the installation process, adherence to recognized cabling standards can ensure system performance and cabling identification (labeling), which is critical when dealing with multiple connector, high transmission bandwidth capable systems. There are multiple region specific standards to which a structured cabling system needs to adhere to, as defined below:

Commercial Building & Cabling Administration 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 Standard
- United States: ANSI/TIA-606, Administration Standard for the Commercial Telecommunications Infrastructure
- ANSI INCITS T11 FC-PI-7

Additionally, there are standards specific to data centers in which these high-end Gen7 director class systems will be installed:

Data Center Standards:

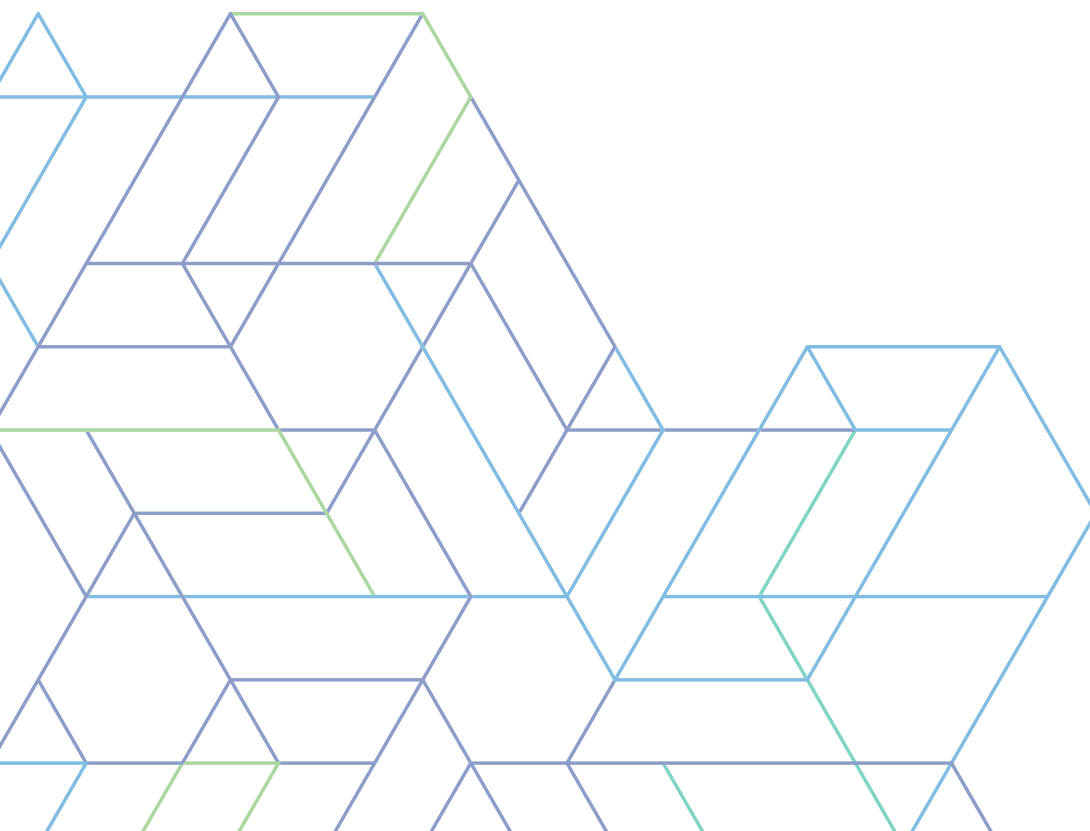
- United States: ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers
- Europe: CENELEC EN 50173-5, Information Technology, Generic Cabling Systems, Part 5: Data Centres
- International: ISO/IEC 24764, Information Technology – Generic Cabling for Data Centres
- ANSI/BICSI 002-2019 – Standards for Data Center Design

Port Replication Benefits

The process of installing a Gen7 SAN Director is well documented in the Hardware Installation Guide. With a Panduit solution that improves cable management with a port replication panel, the integrity of the install is maintained with improved airflow, no cabling clutter, and ease of moves/adds/changes without disturbing the active equipment or risk damaging high dollar value equipment is mitigated. The replication panel solution also provides the ability to collocate the central patching location (CPL) either directly in the same cabinet/rack as the Gen7 Director or provides structured links to a panel(s) located in a separately hosted location nearby. While the CPL cabling will be customer-defined based on the intended infrastructure layout, the port replication panel along with Port-Group breakout assemblies provides the flexibility to suit any intended customer install scenario.

Once port groups have been cabled out, any to/from changes to the cable plant can be managed at the interconnect consolidation point, thereby decreasing the risk of damage or disturbance to fiber at the chassis/blade level. The cabling design is simplified by installing one replication panel to every FC64-64 blade, for a true 1:1 replication. Once the interconnect location has been selected, it is as easy as adding one replication harness for every cabled port-group, for a total of eight per blade.

The ultimate reason for port replication when using large chassis based switches is hands-off operation of high dollar value equipment, which increases the agility of moves/adds/changes, as well as cable consolidation with port replication of high fiber count systems allows for better cable management and airflow. Once port groups have been cabled out, any to/from changes to the cable plant can be managed at the interconnect consolidation point, thereby decreasing risk of damage or disturbing fiber at the chassis/blade.



Additional Components To Enable Gen7 Connectivity

Beyond the FC64-64 Port Replication Solution, Panduit offers connectivity solutions for other blades, as well as for ISL trunking cabling solutions.

Enclosures/Panels:

HD Flex™ enclosures or panels shall house, organize, manage and protect fiber optic trunk cables, terminations, splices, connectors and patch cords as well as accommodate all HD Flex cassettes and fiber adapter panels (FAPs) in a 1RU, 2RU, or 4RU footprints.

The enclosures/panels allow cassettes and FAPs to be installed via the front of the enclosure tray or sliding them into the rear of the housing. This allows each individual cassette or FAPs to be removed with minimal disruption to other cassettes or FAPs. They are constructed of steel material and can be ordered in either 4-port, 6-port, or 12-port configurations that accept combinations of either 4-port, 6-port, and 12-port cassettes respectively, and available in black or white.



Image 18: HD Flex Enclosure



Image 19: HD Flex Patch Panel

HD Flex™ Enclosures, Panels, and Accessories

Part Number	Description
FLEX*U04	HD Flex *RU Enclosure, (18) 4 port cassette option
FLEX*U06	HD Flex *RU Enclosure, (12) 6 port cassette option
FLEX*U12	HD Flex *RU Enclosure, (6) 12 port cassette option
FLEX*UNP04	HD Flex *RU Patch Panel, (18) 4 port cassette option
FLEX*UNP06	HD Flex *RU Patch Panel, (12) 6 port cassette option
FLEX*UNP12	HD Flex *RU Patch Panel, (6) 12 port cassette option
FLEX-PLATE*U	HD Flex *RU Enclosure Trunk Slack Plate
FLEX-PLATE*UR	HD Flex *RU Enclosure Trunk Slack Plate & Cover
FLEX-PLATE*UPR#	HD Flex *RU Patch Panel Trunk Slack Plate
FLEX-RAIL^^EN	HD Flex Enclosure Rail Kit – Converts 1RU worth of connectivity cassettes
FLEX-RAIL^^PN	HD Flex Path Panel Rail Kit – Converts 1RU worth of connectivity cassettes

Note: Replace * with 1, 2, or 4 for enclosure height. Add WH at the end of the enclosure/panel part # for white, ex: FLEX1U04WH

Note: Replace # with W for trunk slack plate in white, ex: FLEX-PLATE1UPRW. Replace ^^ with 04 or 06 for 4 port or 6 port cassettes

Another option for Gen7 Fiber Channel cabling is direct connect with SN-SN or SN-LC patch cords. Those parts can be configured using the selector below.

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Example	F	Z	2	R	L	U	1	U	1	O	N	M	0	1	5

1 – Fiber	F = Fiber	9 – Connector Variant	1 = 1st Gen (LowProfile Duplex LC)
2 – Fiber Type	Z = OM4 S = OM4+ 9 = OS2 Singlemode	10 – Polarity / Performance	N = No Variant O = Optimized IL N = Ultra IL
3 – Fiber Count	2 = 2 Fiber	11 – Other	N = No Variant
4 – Cable Type	R = Round 2.0mm	12 – Length, Unit of Measure	M = Meters
5 – Jacket Type	P = Plenum L = LSZH (EMEA Only)	13 – Assembly Length	001 – 050 meters
6 – Connector (End A)	U1 = Duplex LC Uniboot UPC U2 = Duplex LC Uniboot APC Z1 = Duplex LC SN UPC	14	
7 (End A)		15	
8 – Connector (End B)	U1 = Duplex LC Uniboot UPC U2 = Duplex LC Uniboot APC Z1 = Duplex LC SN UPC		

Rules for Configuring Part Numbers
Connectors should be in numerical/alphabetical order
Pulling eyes not available for patch cords
OM4+ only in EMEA

Image 20: Patch Cord PDF Selector

In addition to direct connect with patch cords, trunks and interconnects can be used for other blades or ISL trunking options, with part selectors available below:

▶ Configure [Interconnects](#), [Trunks](#) and [CPQ Harnesses](#) to meet your product requirements

Cable Management Options:

There are multiple options for cable management, these are only a few suggested items:



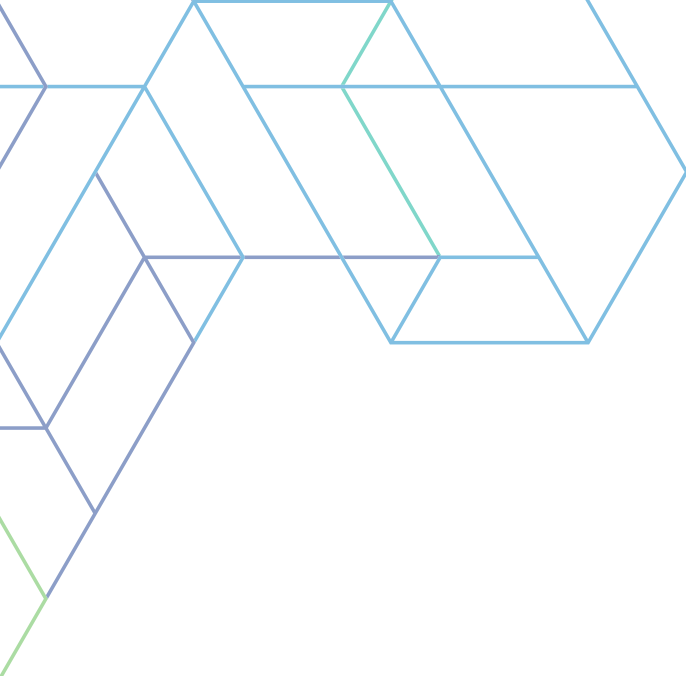
Image 22: FQCRCM



Image 23: SRB19D5BL



Image 24: NMF1



We have the knowledge
and experience to help you
make the most of your
infrastructure investment.

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