IBM z16

3931 System Cabling Best Practices

Danger notices

DANGER: To prevent a possible shock from touching two surfaces with different protective ground (earth), use one hand, when possible, to connect or disconnect signal cables. (D001)

DANGER: Overloading a branch circuit is potentially a fire hazard and a shock hazard under certain conditions. To avoid these hazards, ensure that your system electrical requirements do not exceed branch circuit protection requirements. Refer to the information that is provided with your device or the power rating label for electrical specifications. (D002)

DANGER: If the receptacle has a metal shell, do not touch the shell until you have completed the voltage and grounding checks. Improper wiring or grounding could place dangerous voltage on the metal shell. If any of the conditions are not as described, *STOP*. Ensure the improper voltage or impedance conditions are corrected before proceeding. (D003)

DANGER: An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (D004)

DANGER: When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard: If IBM supplied the power cord(s), connect power to this unit only with the IBM provided power cord. Do not use the IBM provided power cord for any other product. Do not open or service any power supply assembly. Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.

-  The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. For AC power, disconnect all power cords from their AC power source. For racks with a DC power distribution panel (PDP), disconnect the customer's DC power source to the PDP.
- When connecting power to the product ensure all power cables are properly connected. For racks with AC power, connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate. For racks with a DC power distribution panel (PDP), connect the customer's DC power source to the PDP. Ensure that the proper polarity is used when attaching the DC power and DC power return wiring.
- Connect any equipment that will be attached to this product to properly wired outlets.
- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Do not attempt to switch on power to the machine until all possible unsafe conditions are corrected.
- When performing a machine inspection: Assume that an electrical safety hazard is present. Perform all continuity, grounding, and power checks specified during the subsystem installation procedures to ensure that the machine meets safety requirements. Do not attempt to switch power to the machine until all possible unsafe conditions are corrected. Before you open the device covers, unless instructed otherwise in the installation and configuration procedures: Disconnect the attached AC power cords, turn off the applicable circuit breakers located in the rack power distribution panel (PDP), and disconnect any telecommunications systems, networks, and modems.
- Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices.

  To Disconnect: 1) Turn off everything (unless instructed otherwise). 2) For AC power, remove the power cords from the outlets. 3) For racks with a DC power distribution panel (PDP), turn off the circuit breakers located in the PDP and remove the power from the Customer's DC power source. 4) Remove the signal cables from the connectors. 5) Remove all cables from the devices.

  To Connect: 1) Turn off everything (unless instructed otherwise). 2) Attach all cables to the devices. 3) Attach the signal cables to the connectors. 4) For AC power, attach the power cords to the outlets. 5) For racks with a DC power distribution panel (PDP), restore the power from the Customer's DC power source and turn on the circuit breakers located in the PDP. 6) Turn on the devices.

-  Sharp edges, corners and joints may be present in and around the system. Use care when handling equipment to avoid cuts, scrapes and pinching. (D005)

Contents

Chapter 1. Introduction

This cabling best practices document was created to help the reader plan, install and retain cables for the mainframe. This document includes information for both internal and external cables to assist in both the initial system installation, system upgrades as well as external connections. In this context, internal cables are those pre-installed and provided within the system while external cables are considered either those cables provided with the system (i.e., power line cord, external communications network attach, etc.) or by the client (i.e., I/O, Coupling, and Storage Network Attach) and that egress from the system. To ensure system reliability and serviceability, it is critical that the system be ordered with the necessary Feature Codes (FC) (reference Table below) and the installation completed following the contents of this document. It serves as a supplement for the Installation Manual for Physical Planning (IMPP). For essential information including, but not limited to, safety notices, specifications, power requirements, and hardware management, refer to the IMPP. For visual help, 3931 Visio ® files for z16 Model A01 is available through Resource Link.

Customer Environment	Bottom Exit Cabling	Top Exit Cabling	FCs to be Ordered	Comments
Raised Floor	Yes	No	7899 only	Bottom FQC support only
Raised Floor	Yes	Yes, no Top Hat	7899 & 7816	Bottom FQC support only
Raised Floor	Yes	Yes, with Top Hat	7899 & 7898	Top & bottom FQC support
Raised Floor	No	Yes, no Top Hat	7816	No FQC support; ships bottom seal plate
Raised Floor	No	Yes, with Top Hat	7898	Top FQC support only; ships bottom seal plate
Non-Raised Floor	No (not supported)	Yes, no Top Hat	7998* & 7816	No FQC support; ships bottom seal plate
Non-Raised Floor	No (not supported)	Yes, with Top Hat	7998* & 7898	Top FQC support only; ships bottom seal plate

FC 7998: Non-Raised Floor Support (flag)

Table 1: z16 Cabling Feature Codes Combinations

Chapter 2. Line Cords

The line cords are used to power the system. There are two types of internal power sub-systems available: intelligent Power Distribution Unit (iPDU) and Bulk Powered Assembly (BPA). Regardless of the how the system is powered, the line cord is designed to exit straight out of the connector then bend with a given minimum bend radius towards the top or bottom of the frame depending on the desired system frame exiting orientation. Cables can exit through the top of the frame using one of the following feature codes: FC 7898 - Top Exit Cabling feature with Enclosure or FC 7816 - Top Exit Cabling feature without Enclosure. Cables that leave the frame through the bottom would use feature code FC 7898 - Bottom Exit Cabling feature. For cabling configurations where two line cords are on the same side of a frame, the cables are to be run in parallel underneath the reservoir brackets. More specifically, if the cables are top exiting, the bottom PDU line cord should lay on top of the top PDU line cord as they are routed upwards. The opposite will hold for bottom exiting cables. The line cords are to be retained to the reservoir bracket using a hook-and-loop fastener.

*Figure 1: Bottom Exiting Line Cords (**FC 7899)***

Figure 2: *Line Cord Being Routed Under Reservoir Bracket*

Figure 3: Bottom Exiting Line Cord

For top exit system(s) without an enclosure, the space above the system should be clear with sufficient physical space for the line cords to exit the system. In this case, the line cords would be routed directly out the top corners of the frame then plugged to the customer end. Top exit system(s) with an enclosure (**FC 7898**) support both line cord(s) and external system cable(s) exit. It similarly goes through the top of the frame, but in this case, are routed within the enclosure either towards the system front or rear, and then exit out of the enclosure (ref. Fig. 5).

*Figure 4: Top Exiting Line Cords without an Enclosure (**FC 7816**)*

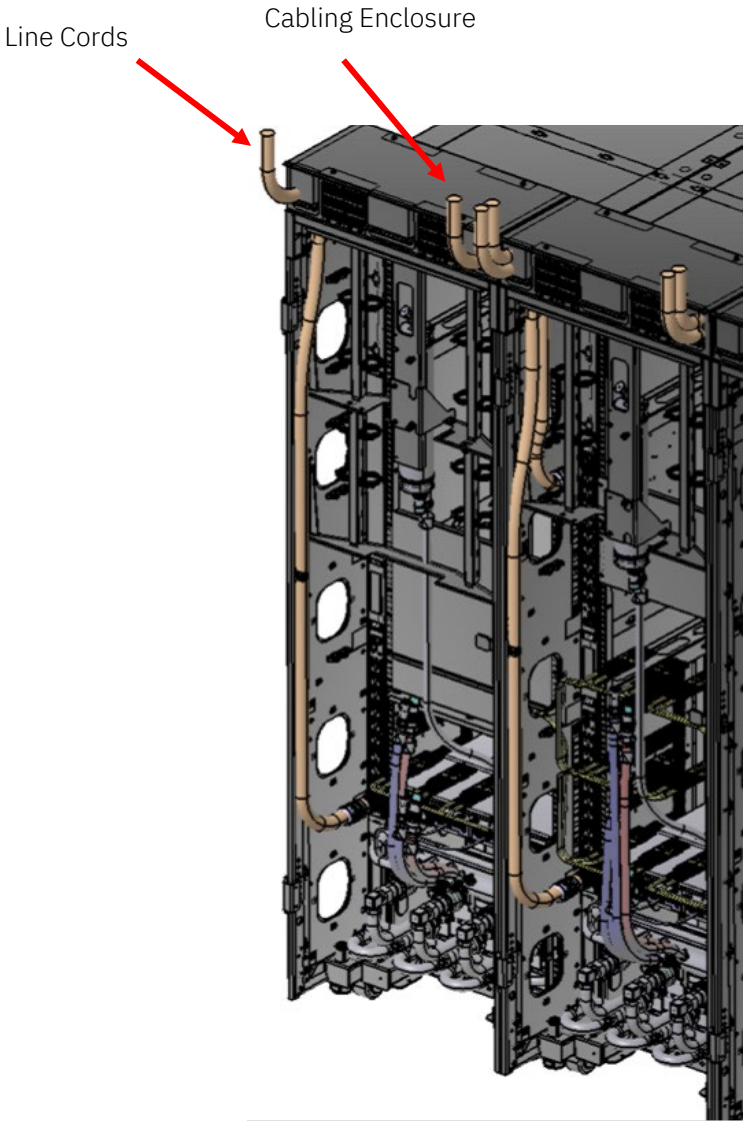


*Figure 5: Line Cords in a Top Exit Cabling Enclosure (**FC 7898**)*

For bottom exit system(s) (**FC 7899**), the line cord is routed directly to the bottom corners of the system and plugged at customer end. Line cords should be affixed and strain relieved to the tailgate using the provided bracket(s). **Note:** To ensure maneuverability, cable slack must be left to allow for a service loop under the floor.

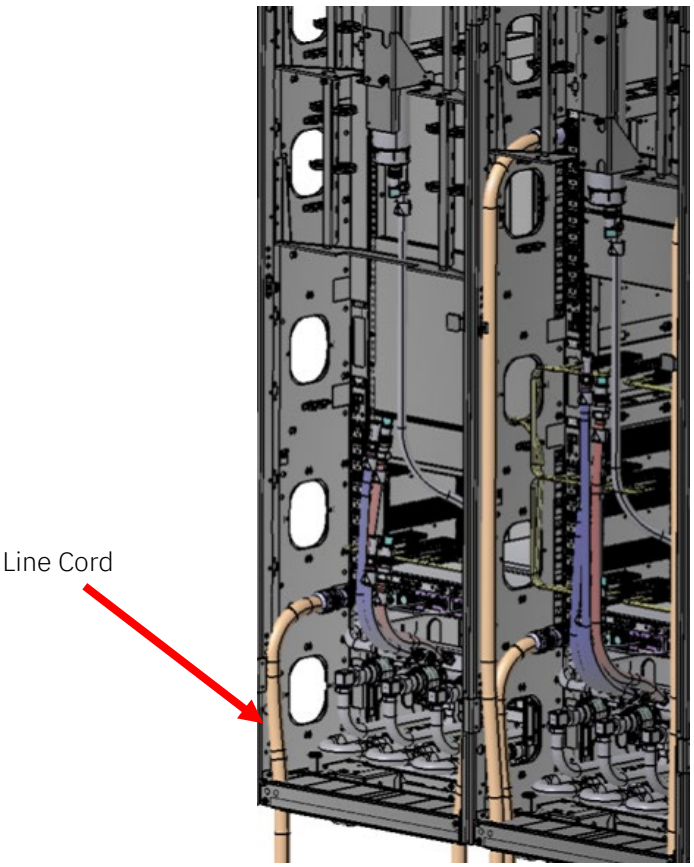


*Figure 6: Bottom Exiting Line Cords (**FC 7899**)*

Lastly, there is a line cord actuation to assist in plugging iPDU line cords available. The area to plug in a line cord into an iPDU may be congested. This tool was developed to cam the line cord in for ease in the line cord installation.

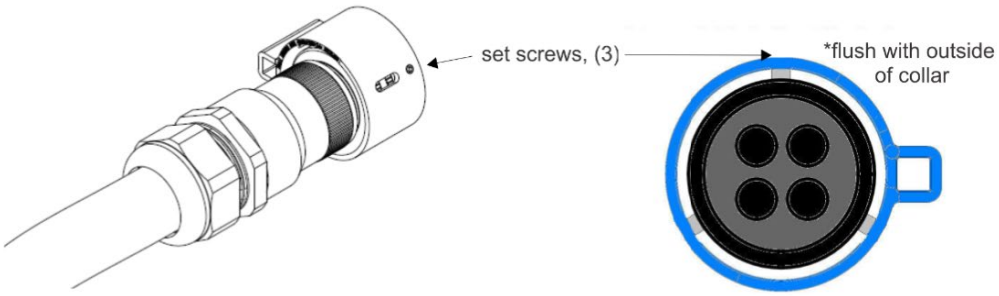


Figure 7: iPDU Cable Actuation Tool

Chapter 3. Cable Retention and Strain Relief

CPC Bracket

These brackets are used to manage, and strain relieve Peripheral Component Interconnect express+ (PCIe+) I/O cables that attach to the Central Processor Complex (CPC) drawer. The function and routing of this cable is discussed later in this document. These brackets hold the cables by using hook-and-loop fasteners.

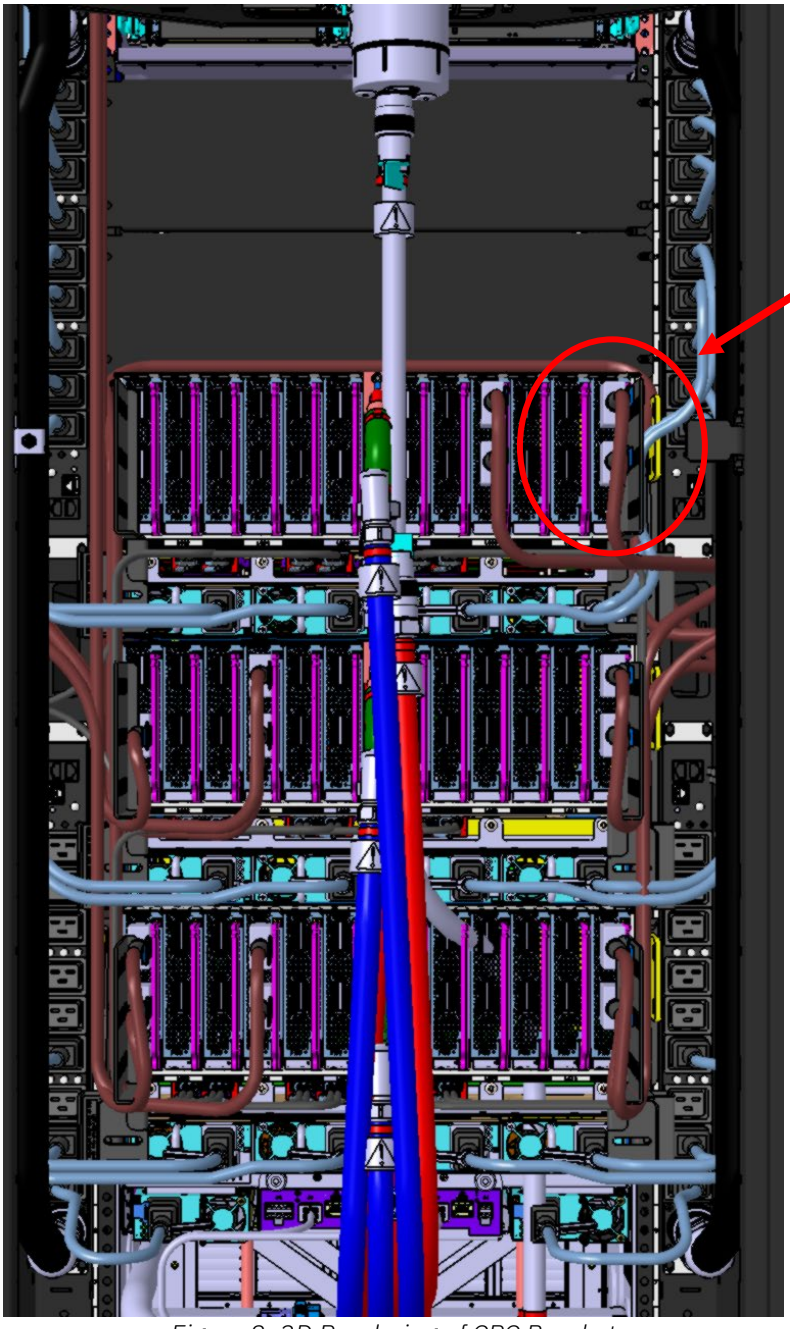


Figure 8: 3D Rendering of CPC Bracket

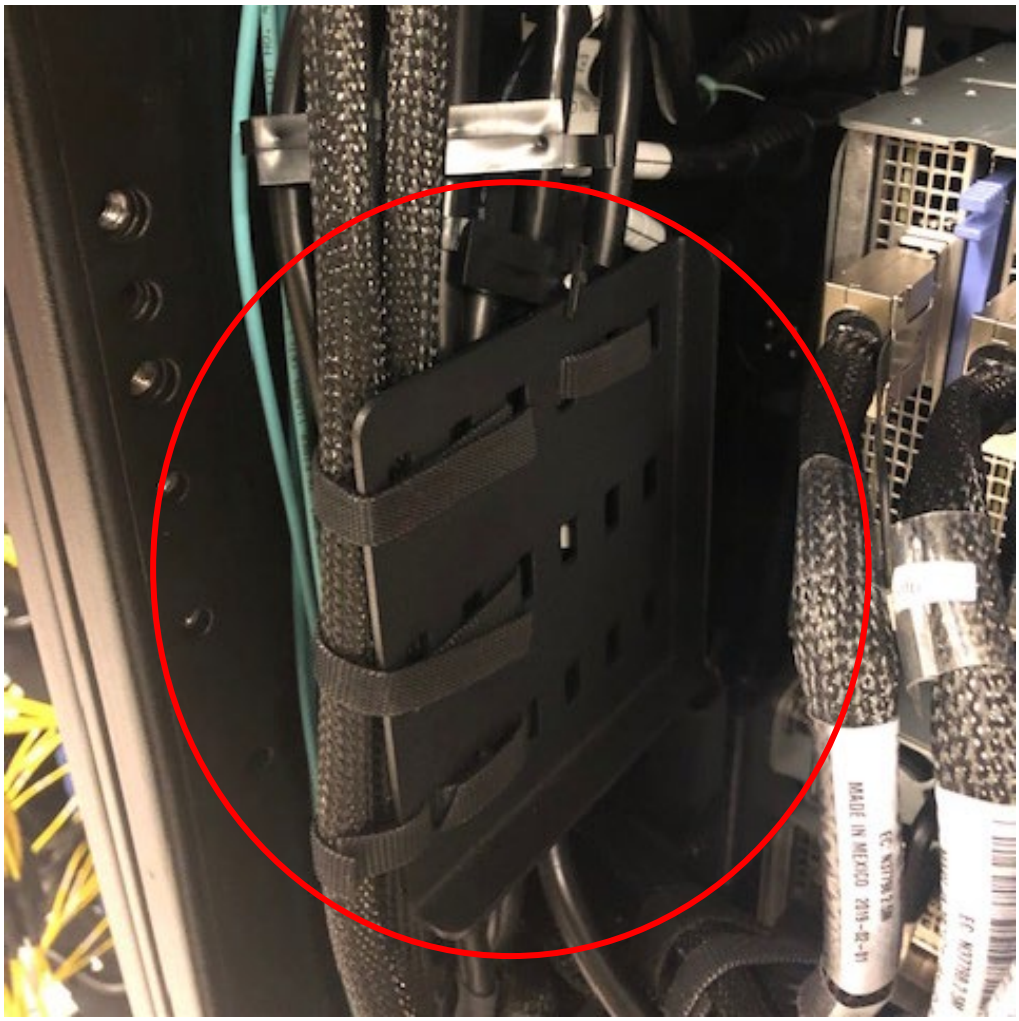


Figure 9: CPC Bracket

SMP Plastic Channel

The intention of this plastic channel is to retain the Symmetric Multi-Processing (SMP) cables and protect them as the machine is being serviced. When the SMP cables are being routed between frame A and B, it is to go through hole #3 (see Figure 30 for hole number designations). These cables are to be handled with care for they are fragile. Figures 10 & 11 depicted the SMP plastic channel. It allows the cables to be neatly routed behind the CPC drawer bracket.

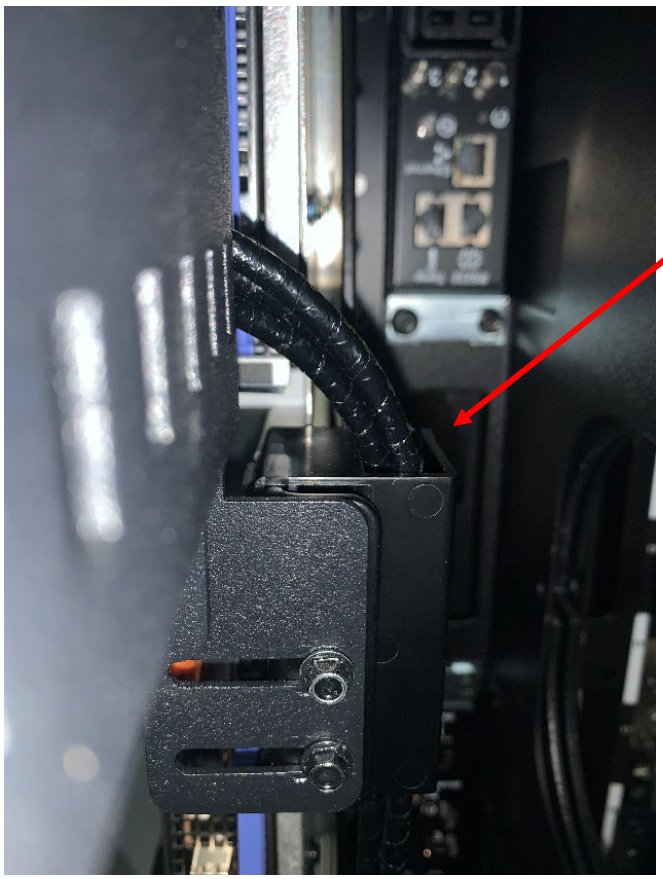


Figure 10: SMP Plastic Channel

Figure 11: SMP Plastic Channel

Clips

There are four types of cable support clips:

- Spine/mini spine hardware clip (reference Figure 12),
- Frame Side clip (reference Figure 13)
- Frame edge clip (reference Figure 14),
- Hook-and-loop fastener clips (reference Figure 15).

Note, the spine clips are intended to retain external cabling, while the other clips are used to route power supply cords, ethernets, and/or fanout cables flat against the side of the frame.

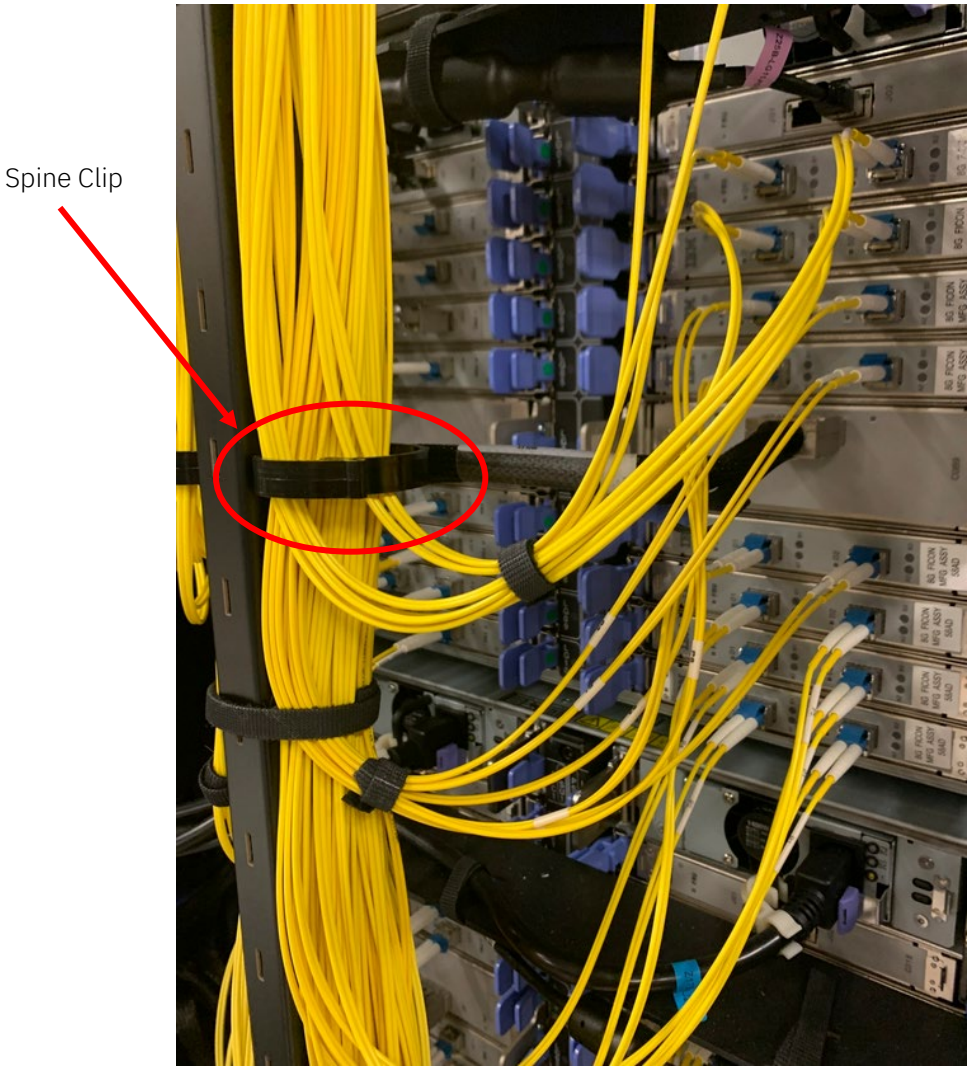


Figure 12: Spine Clips

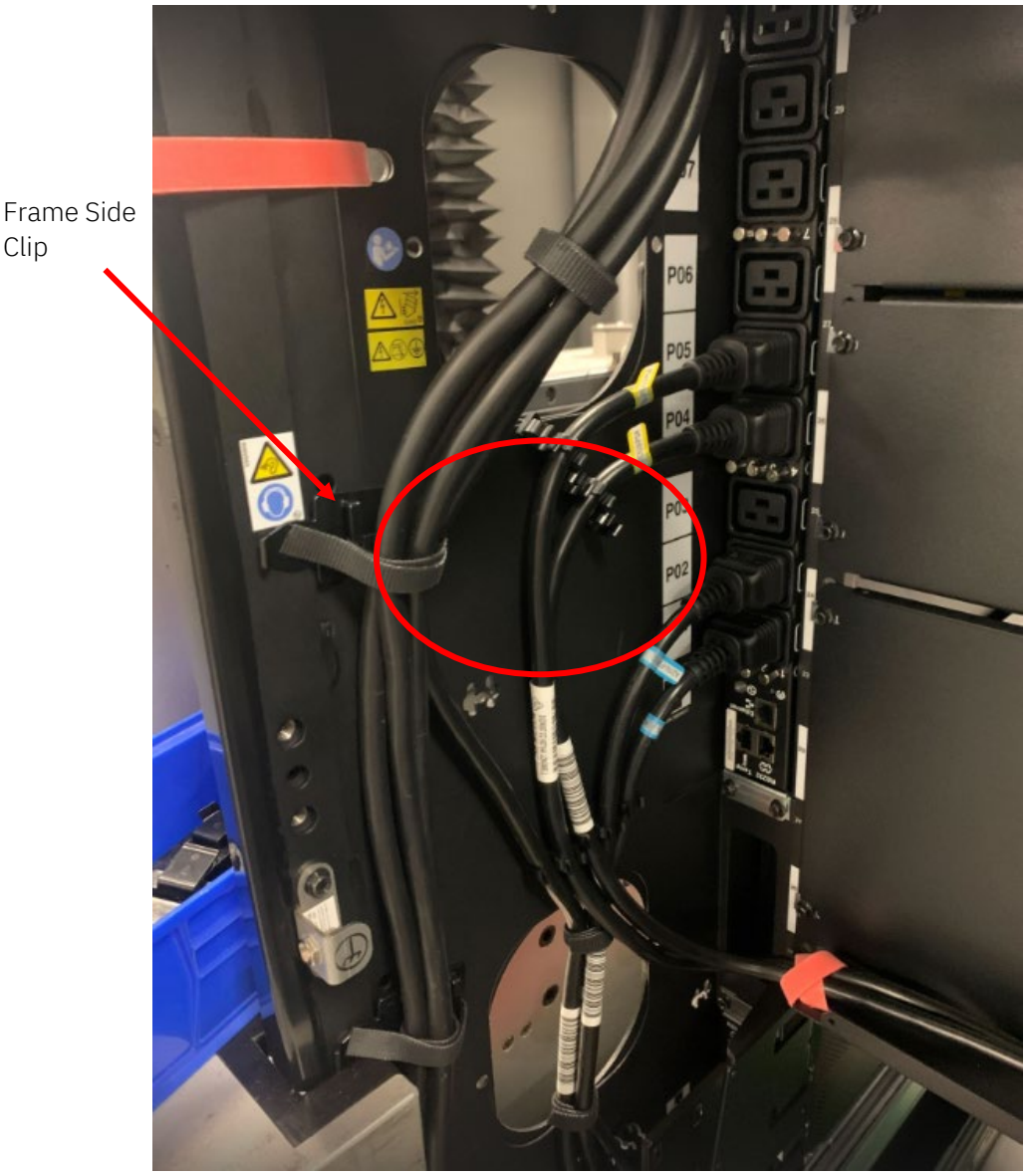


Figure 13: Frame Side Clip

Frame
Edge Clip

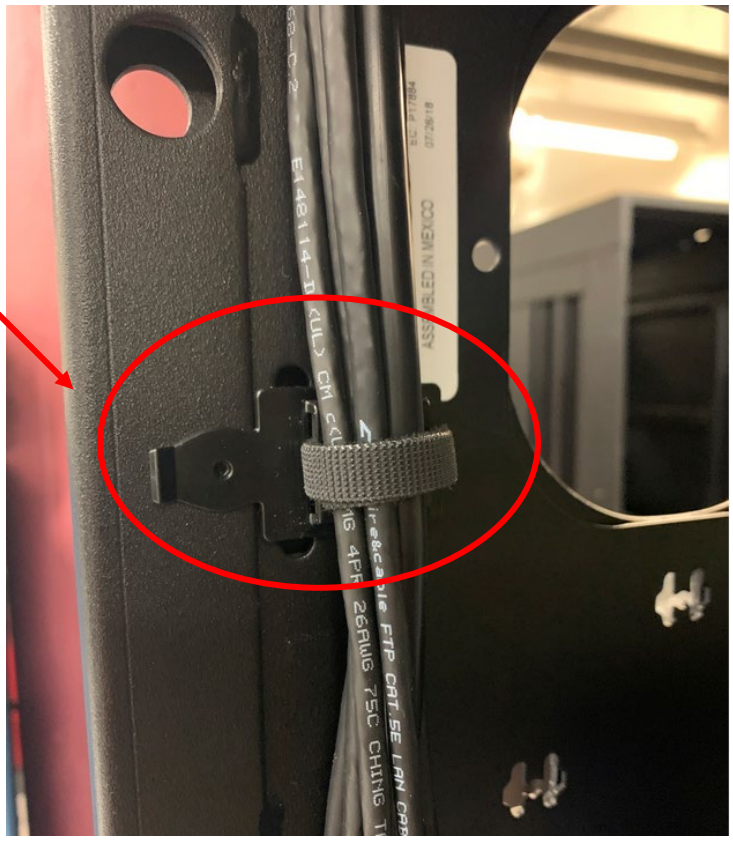


Figure 14: Frame Edge Clip

Figure 15: Hook and Loop Fastener Clip

Hook-and-Loop Fastener

Hook-and-loop fasteners are used to properly route and retain cables in place, while maintaining bend radii and providing strain relief. Figure 16 shows an example of the application of a hook-and-loop fastener clip.

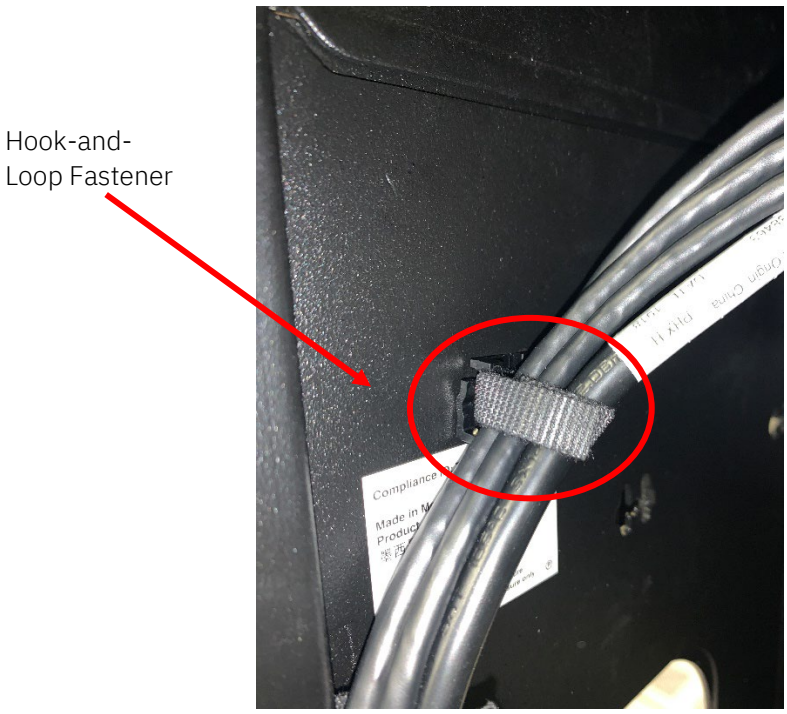


Figure 16: Hook-and-Loop Fastener

Spine

The spine is used to route external cables either up or down a given length of the Z- and/or C- frame. For z16, these are preinstalled assuming a minimum of one I/O drawer installed. When feature code (**FC 5827**) is selected for MTP brackets in a bottom exiting configuration, the spine comes with hoops to wrap FICON cables around.

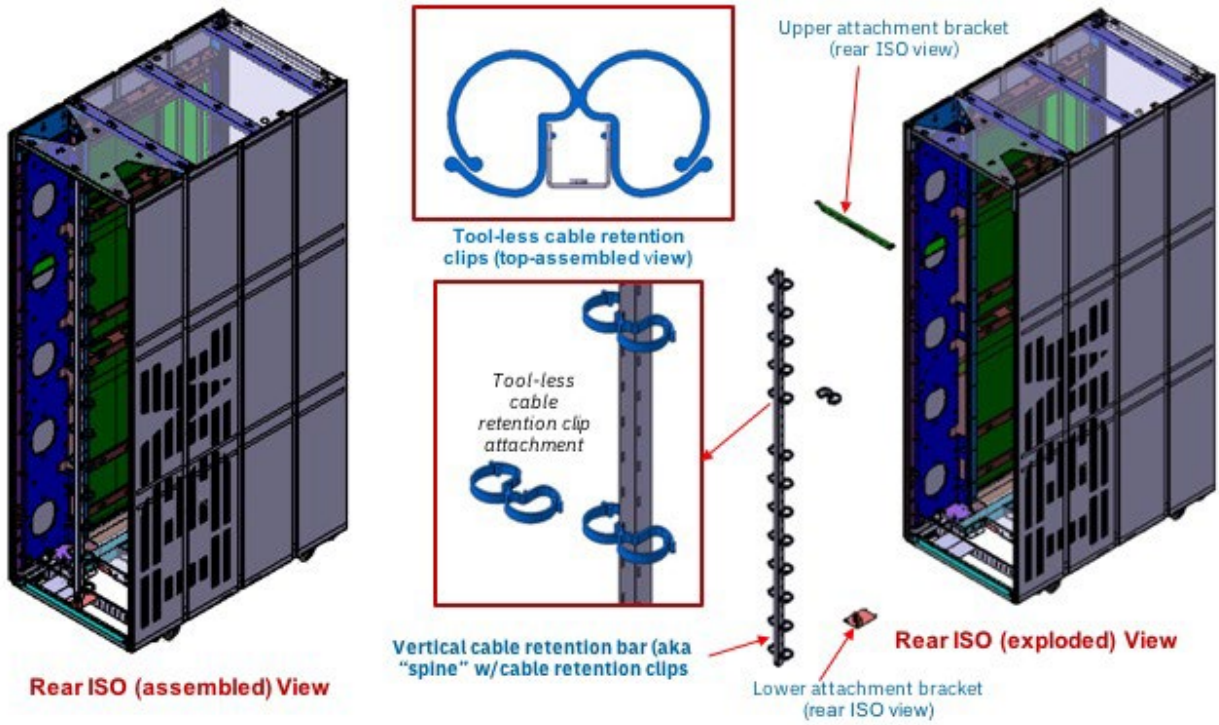


Figure 17: Spine

Cable Management Brackets & 8U Filler Plate

Cables going across the frame should be routed along a cable management bracket or the 8U filler plate's return flange for support. This bracket is intended to mount the power cords and ethernet cables only. It provides service clearance for units above and below these cables and improves iPDU serviceability. There is a cable management bracket in front of every PCIe+ I/O drawer. The 8U filler plate return flange is used if a cable crosses a frame and the cable management bracket is not present at that given location.

Figure 18: PCIe Drawer Cable Management Bracket

When I/O cage #3 is present with an adjacent Z-frame, a cable management bracket is required to route the cables across the frame (see Figure 19). This is important to secure cables coming from the Z frame and allow cards to be serviced.

Figure 19: Cable Management Bracket

Additionally, there a vertical cable management bracket. It is designed to relieve cable congestion from the upper PDUs when there are four PDUs present. The power cables that are routed on it go on inside of the bracket as shown.

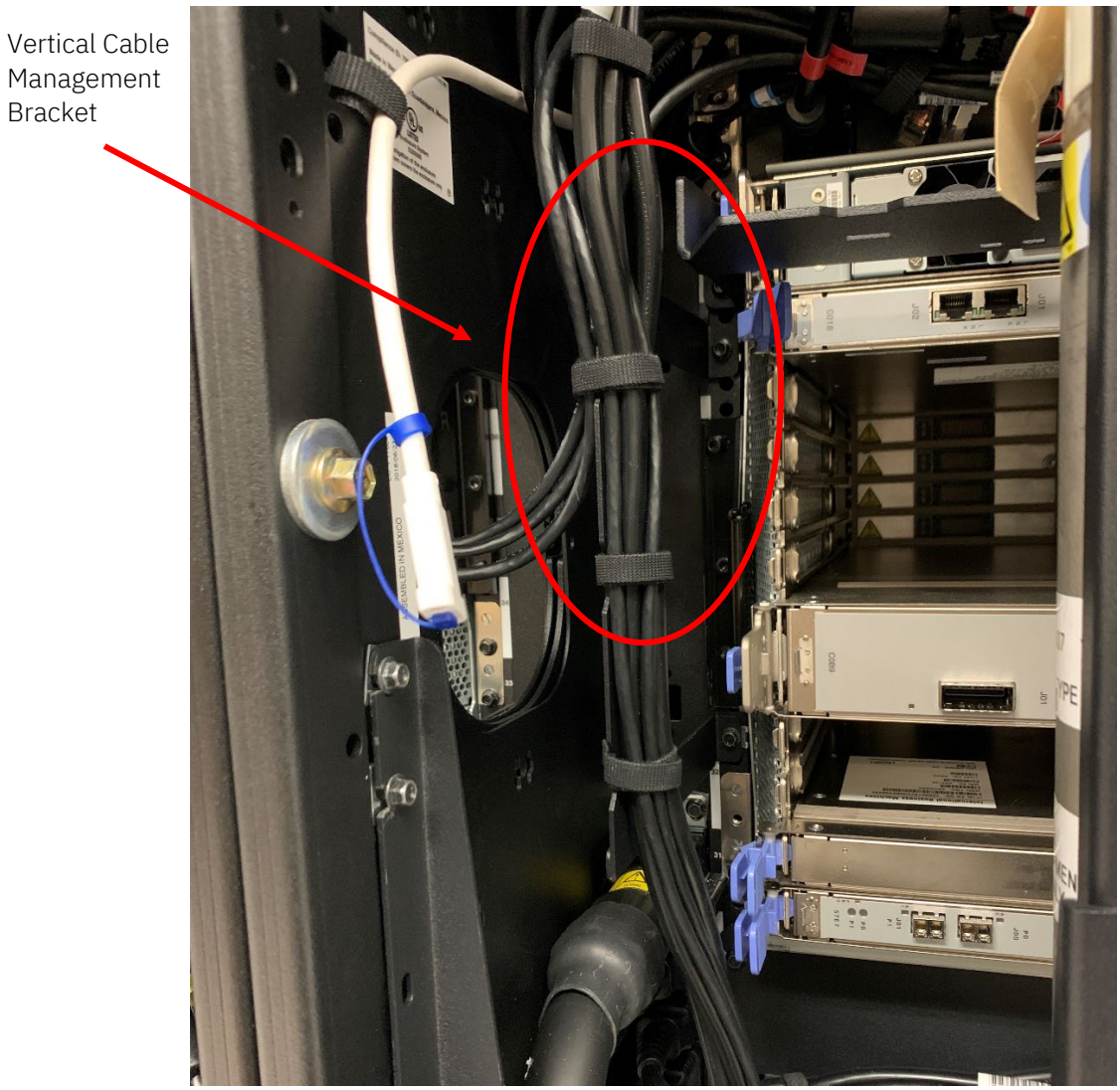


Figure 20: Vertical Cable Management Bracket

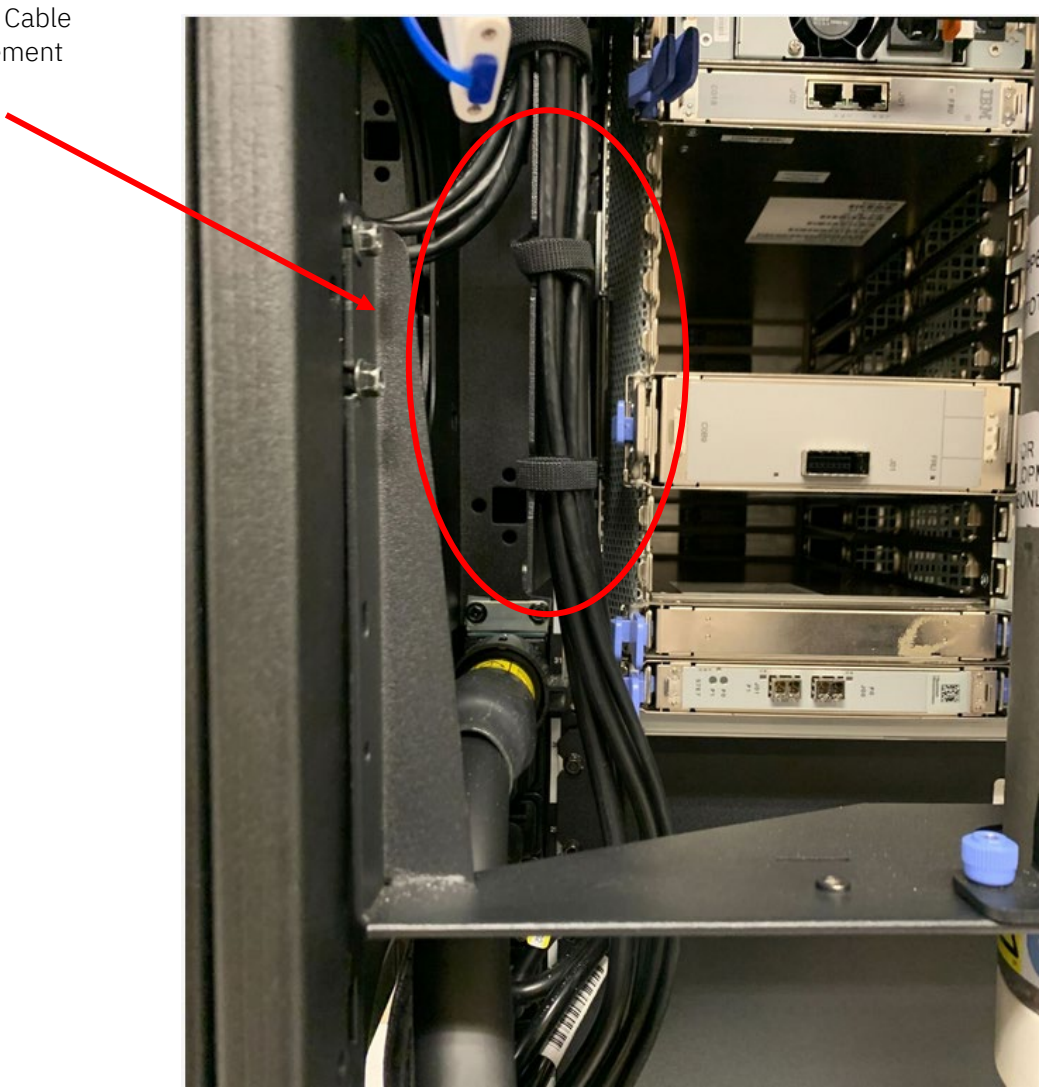


Figure 21: Vertical Cable Management Bracket

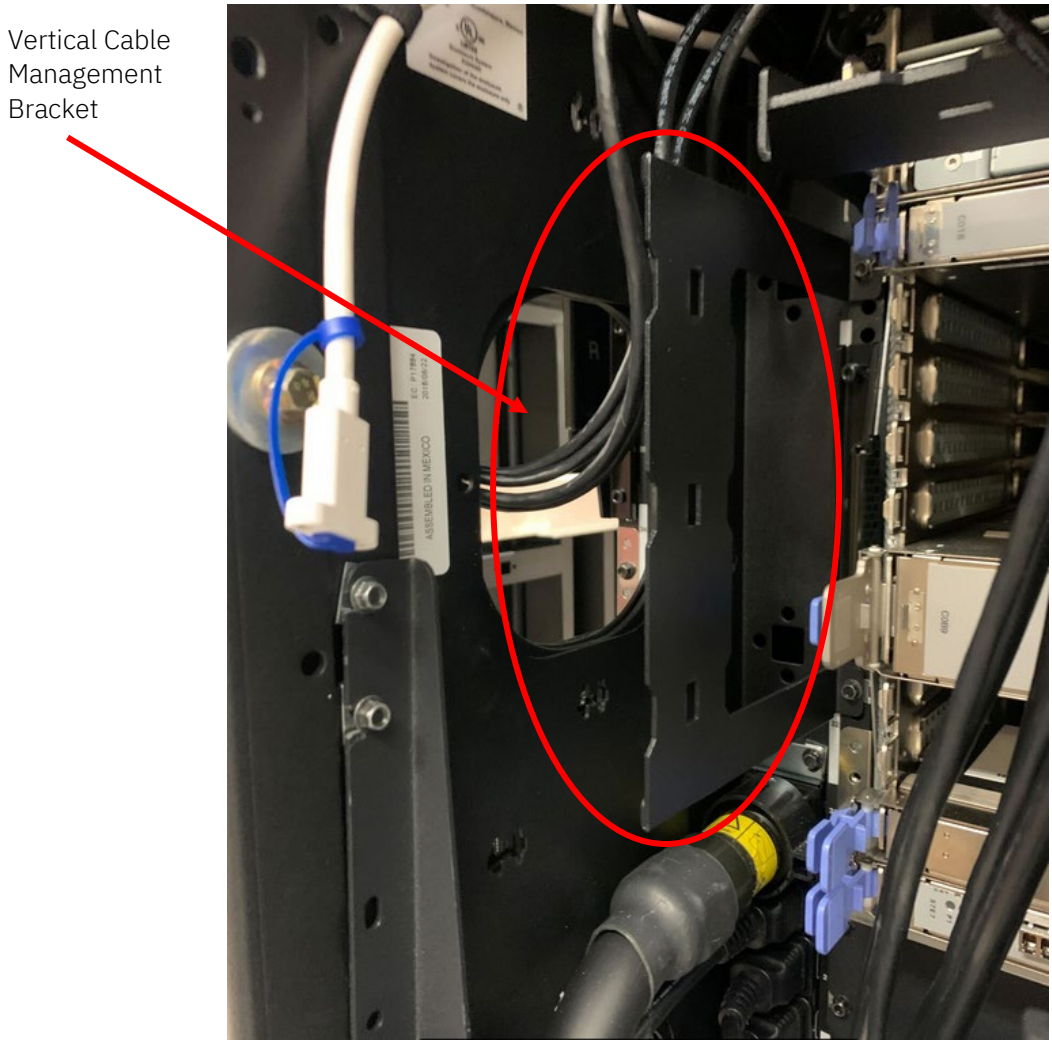


Figure 22: Empty Vertical Cable Management Bracket

Top exit cabling enclosure

This is an optional feature **(FC 7898)** and is ordered to support the top exit egress of cables, added storage of cable slack (if needed), and to ease integration with hot / cold aisle airflow containment systems. Note, the top access cover of the enclosure is reversible to allow cabling to egress towards either the hot or cold aisle.

*Figure 23: Fiber Cables in Top Exit Cabling Enclosure (**FC 7898**)*

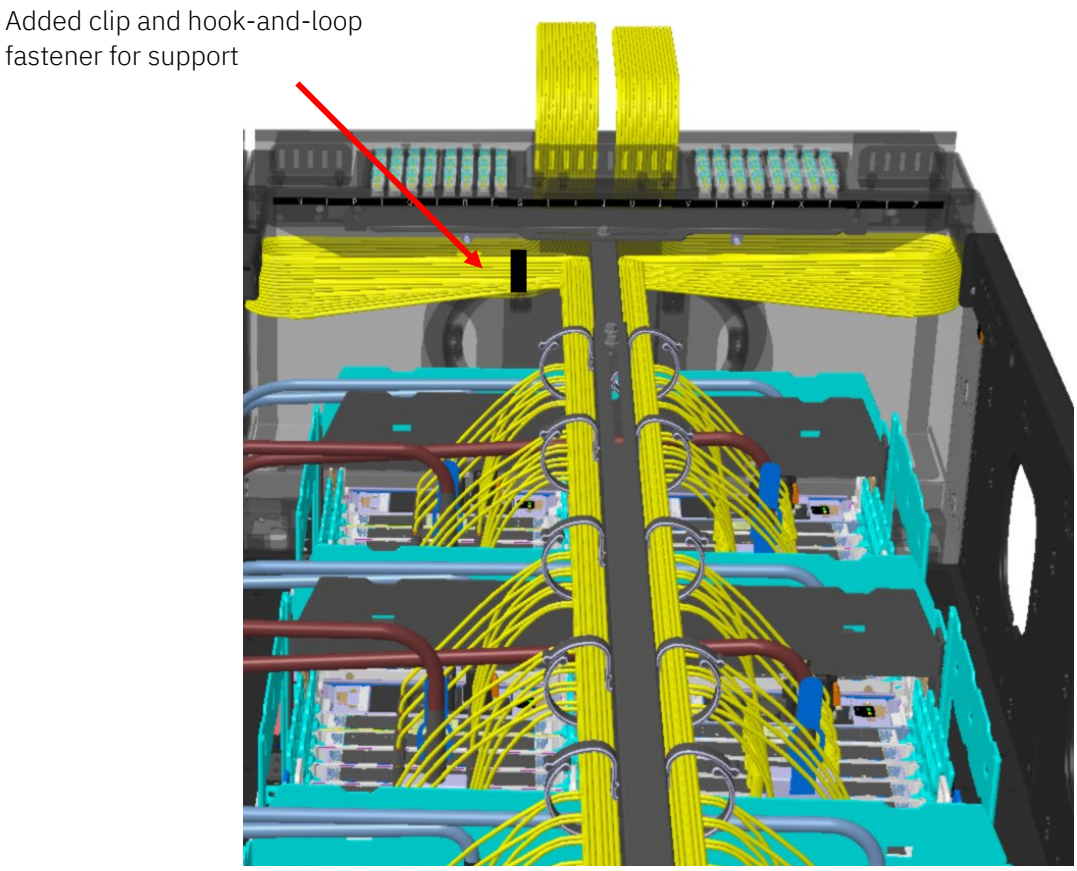


Figure 24: Horizontal Cable Support

Strain Relief Clamps (Bottom Exit Tailgate Hardware)

Strain relief clamps are used to secure any cables that pass through the tailgate. There are two types: one integrated within the bottom exit tailgate assembly for the line cord and a stand-alone clamp for strain relief of I/O, Coupling, and/or Ethernet cabling. Note given design changes with the bottom exit tailgate design (FC 7899), these clamps are new for z16.

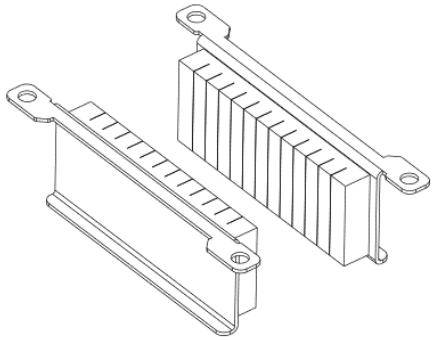


Figure 25: Strain Relief Clamp

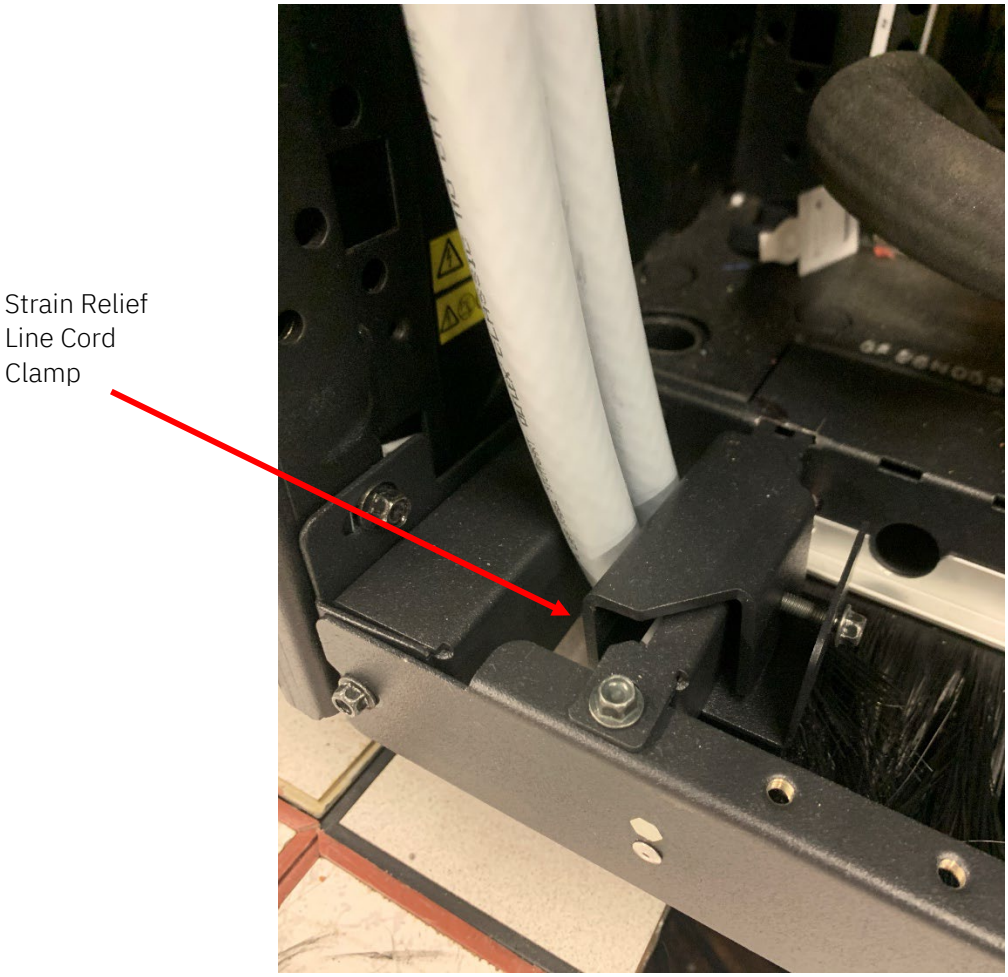


Figure 26: Strain Relief Line Cord Clamp for bottom exiting system

FICON Cabling Spool (Bottom Exit Tailgate Hardware)

The FICON cabling spool is designed to neatly organize excess FICON cable length only when both the bottom exit (FC 7899) and the fiber quick connect brackets to support structured cabling are ordered (*FC 5827*). To ensure adequate cabling service loop, it is recommended that the hoop be placed in its service position prior to wrapping any excess cable length around the spool. Once completed, the spool is to be moved to the regular position on the sides of the spine *(reference Figures 27 & 28).*

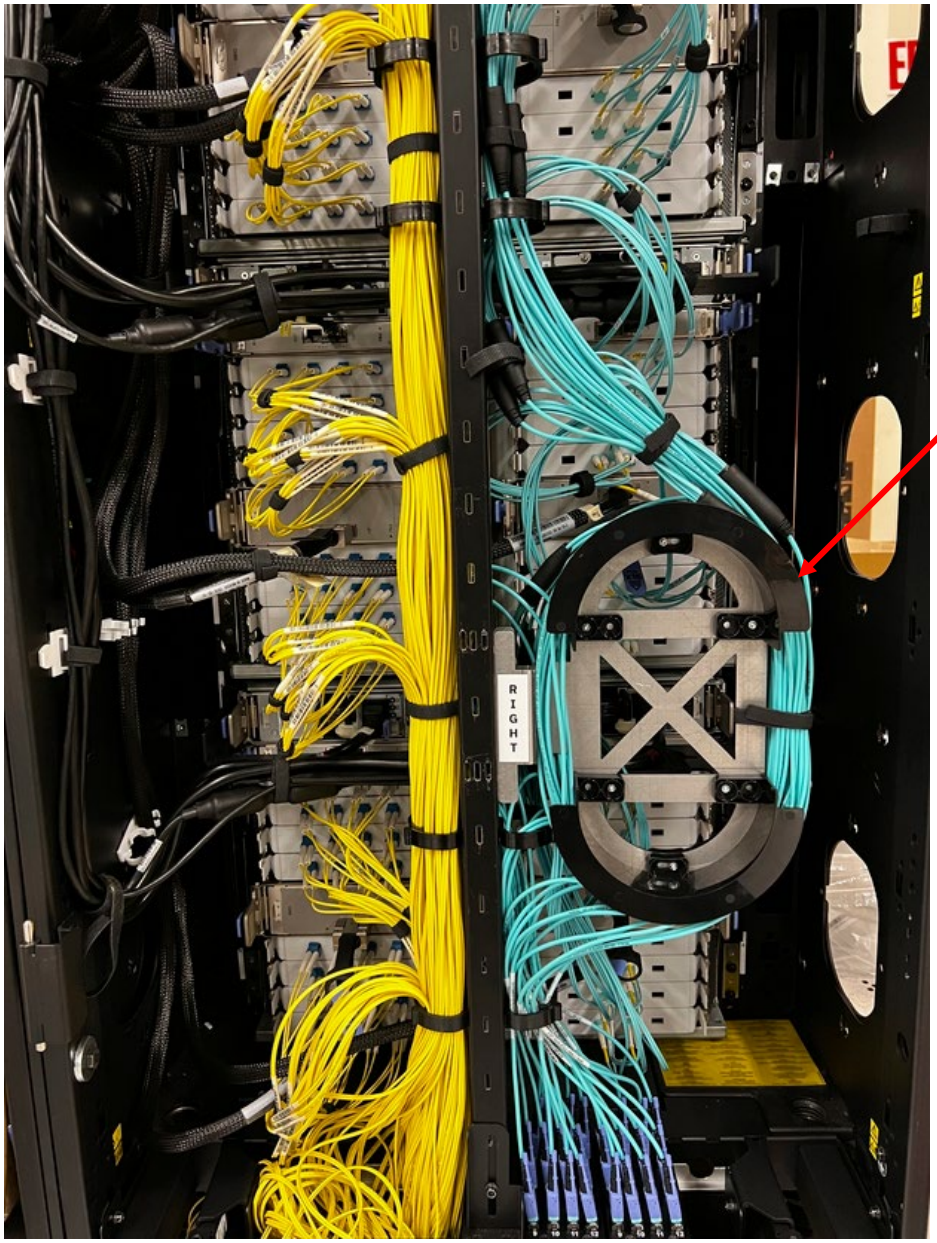


Figure 27: FICON Cabling Spool in its Regular Position

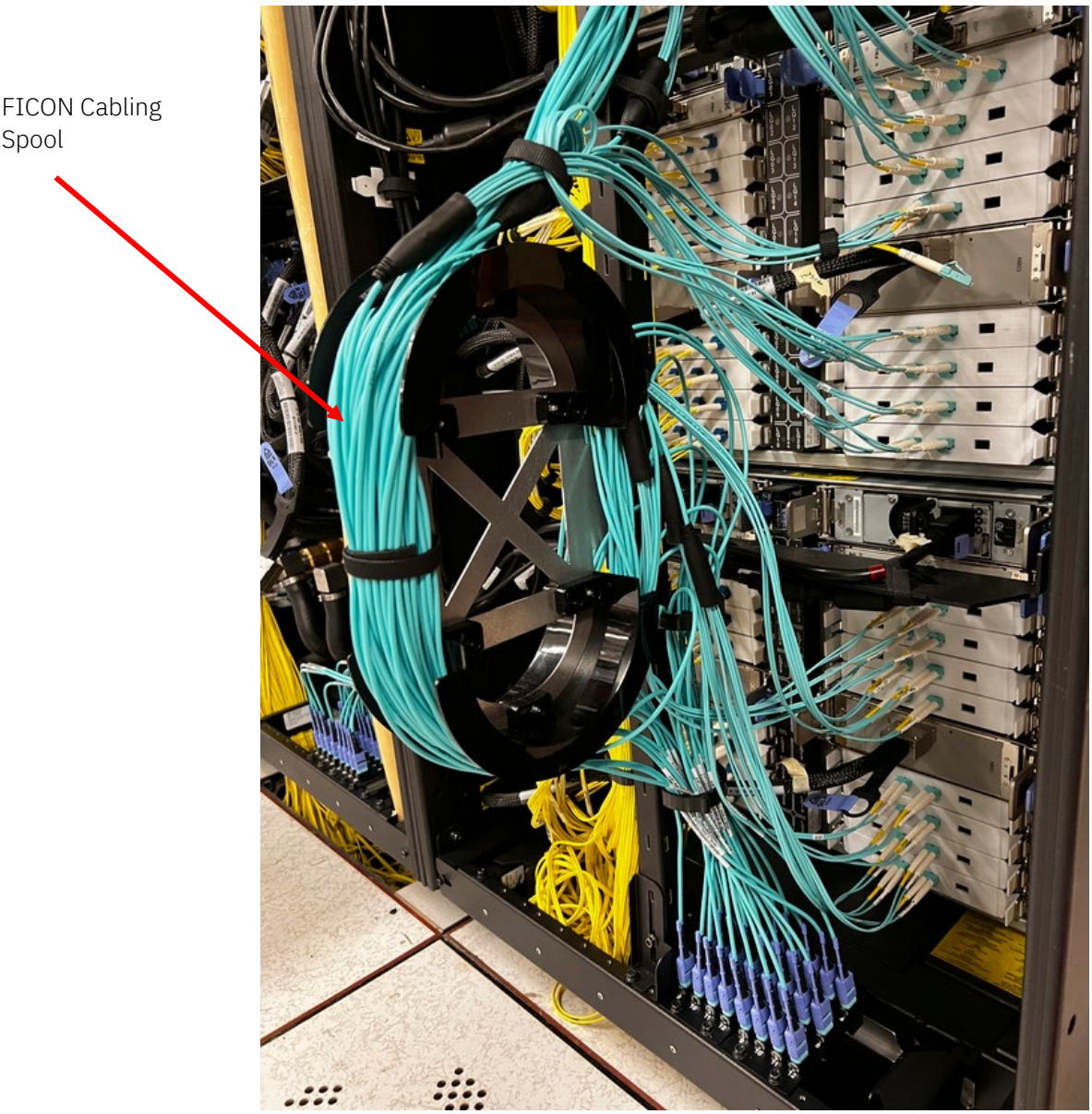


Figure 28: FICON Cabling Spools in its Service Position

For the A- (and B-) frames and if both the bottom exit hardware and Fiber Quick Connect FCs are ordered, the excess FICON fiber can be spooled with a filler plate outside of the frame as shown in Figure 29.

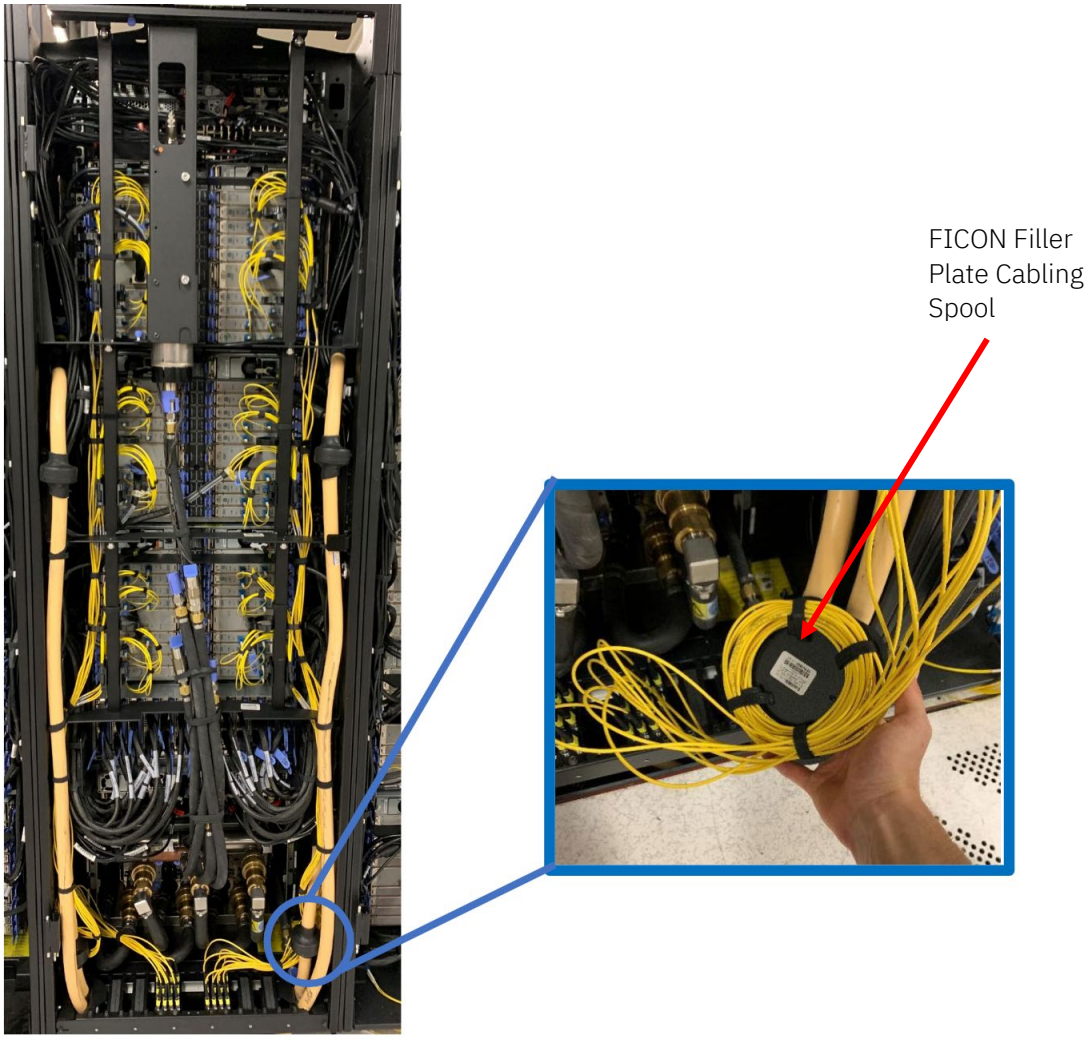


Figure 29: FICON Filler Plate Cabling Spool

Chapter 4. Internal System Cables

For multi-frame system configurations, signal and power cables are routed within a frame and between frames. The interframe cables are coiled and bagged to one side of the frame for shipping. During installation, these cables will need to be routed after the frames are bolted together through designated frame holes (see Figure 30). These frame hole callouts are also referenced in the Installation Manual.

On the free end of the cable, there is a striped or solid location colored flag label for guidance designating where the cable should be plugged. The color on the labels serves as visual aid to distinguish entities from each other. The solid colored flag indicates the primary source and the stripe colored flags indicates the secondary source. Installation individuals should read the provided printed label data to ensure correct plugging location. The following subsections of this chapter are ordered the same way the cables are to be installed.

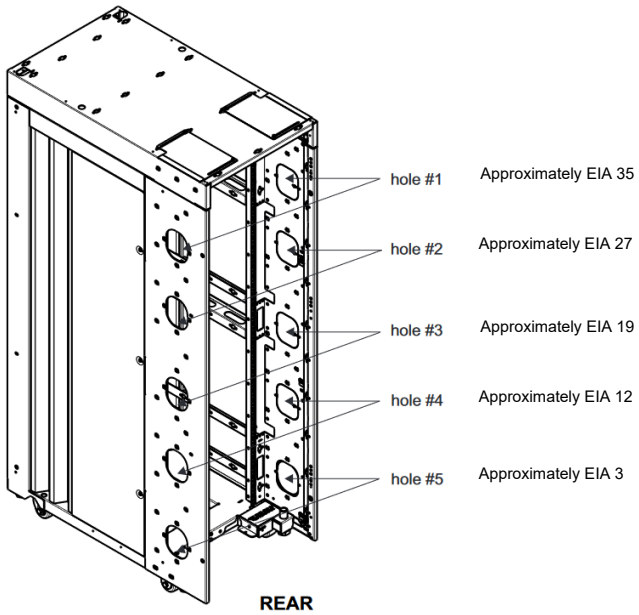


Figure 30: Rear View of Frame with Hole Numbers and Locations

Ethernet Network Cables

Internal system ethernet network cables interconnect the system's internal service processor network. External ethernet cables will be discussed later in this document. The routing schemes for these cables are provided in Figures 31-39 for various system configurations.

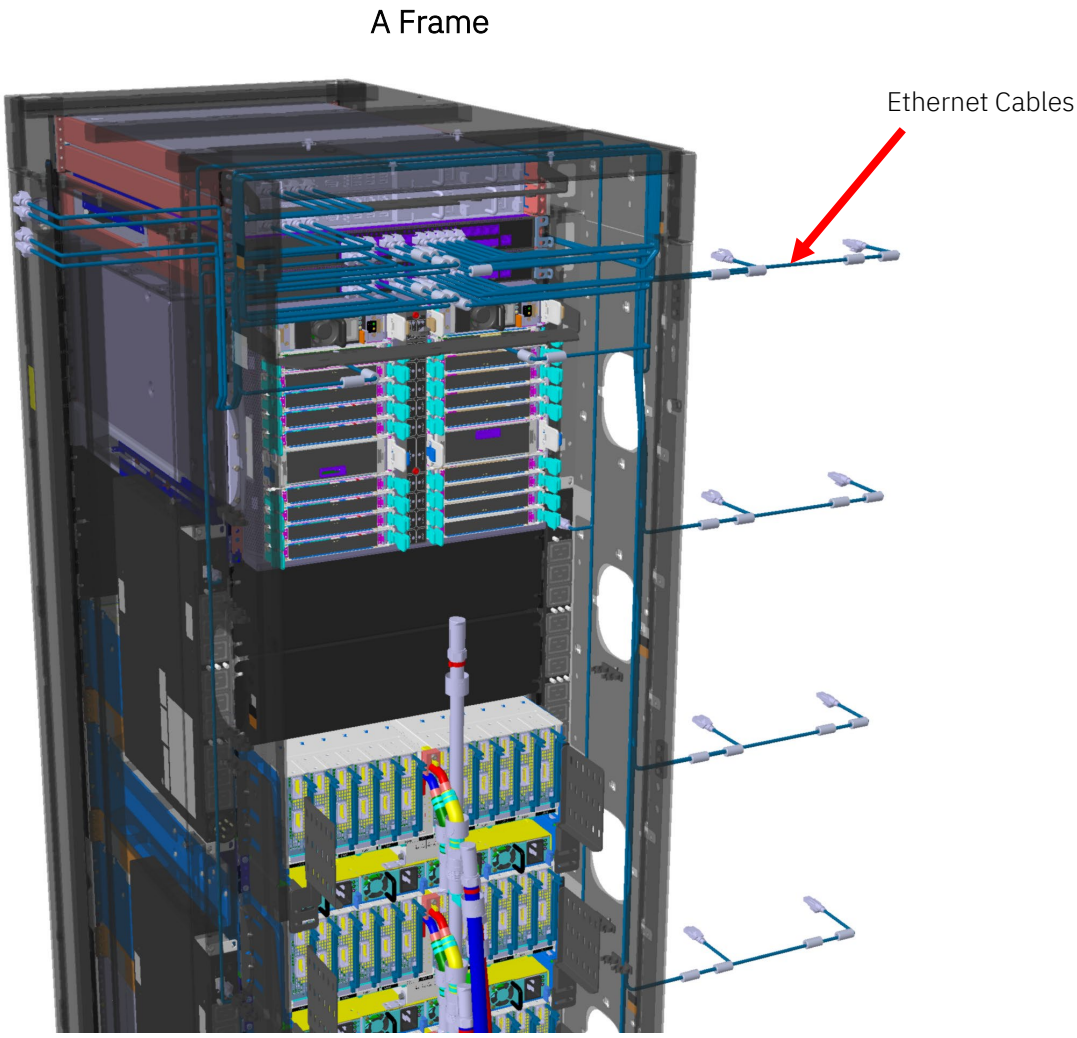


Figure 31: 3D Rendering of Ethernet Cables Being Routed within Semitransparent Frame. The adjacent frames and reservoir are not shown for clarity.

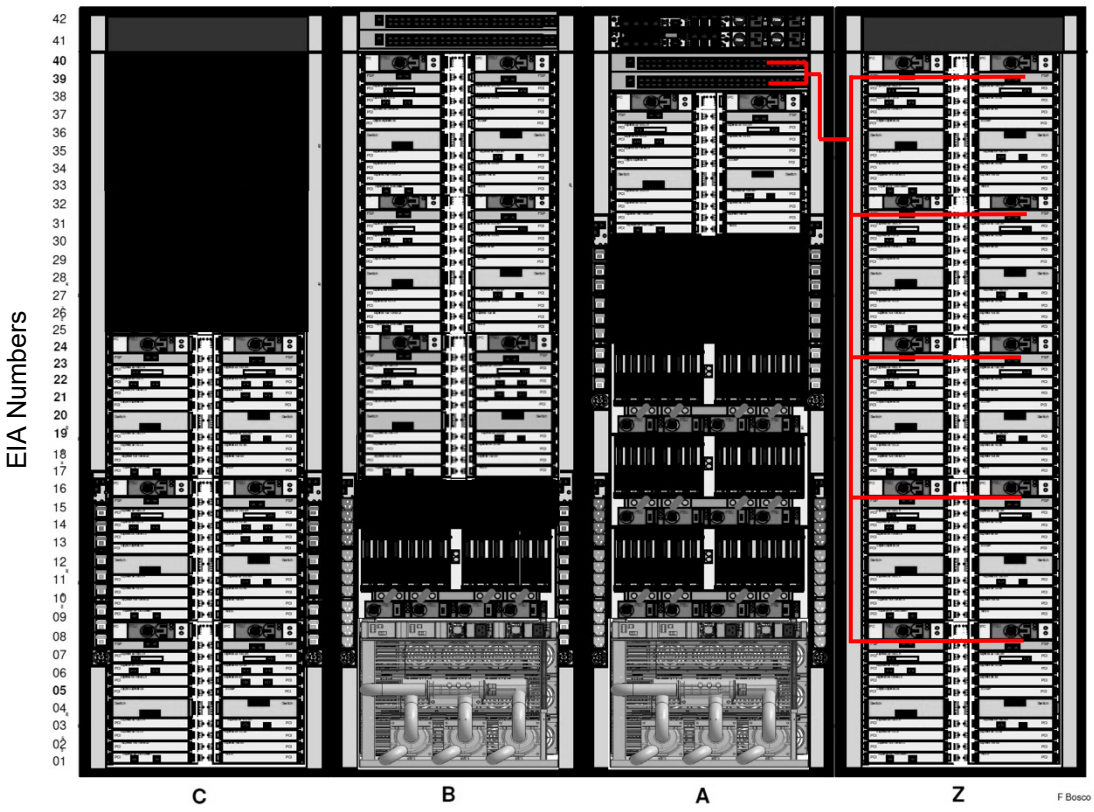


Figure 32: Z to A Frame iPDU Cabling through hole #1

Figure 33: B to A Frame iPDU Cabling through hole #1

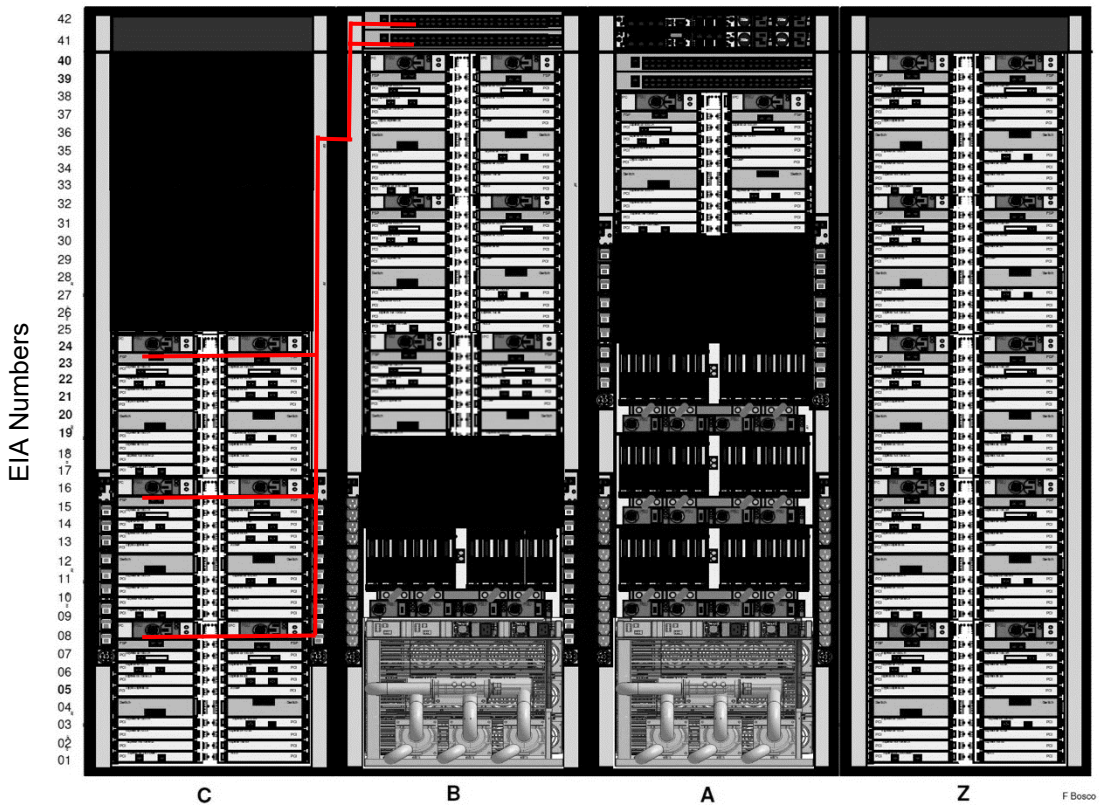


Figure 34: C to B Frame iPDU Cabling through hole #1

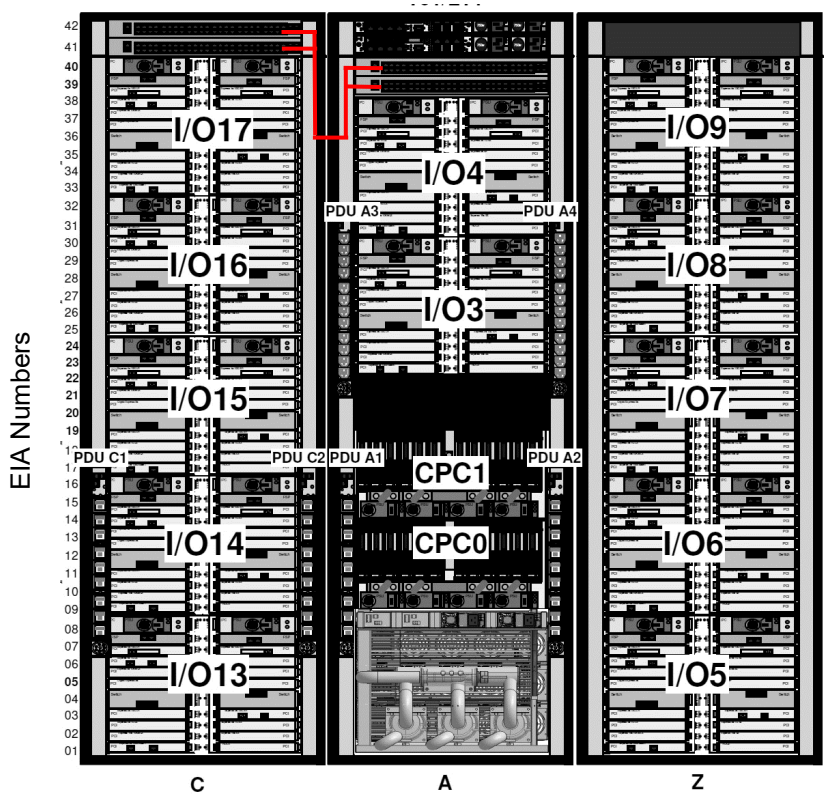


Figure 35: C (without B) to A Frame iPDU Cabling through hole #1

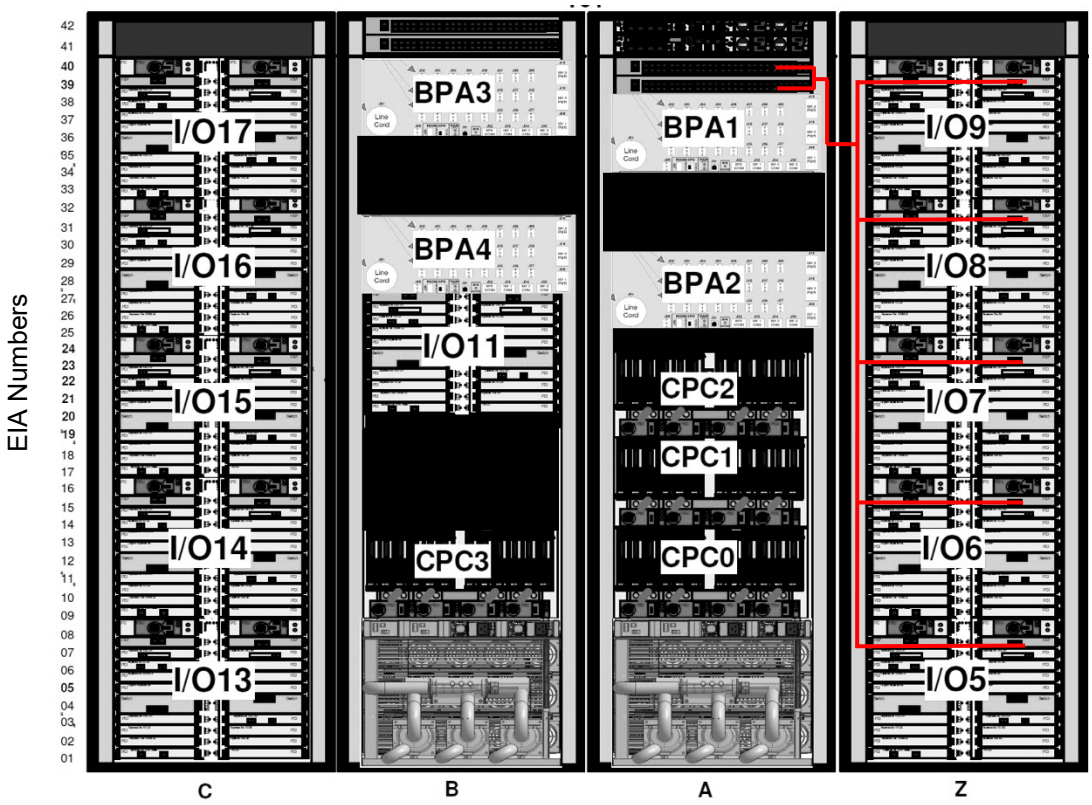


Figure 36: Z to A Frame BPA Cabling through hole #1

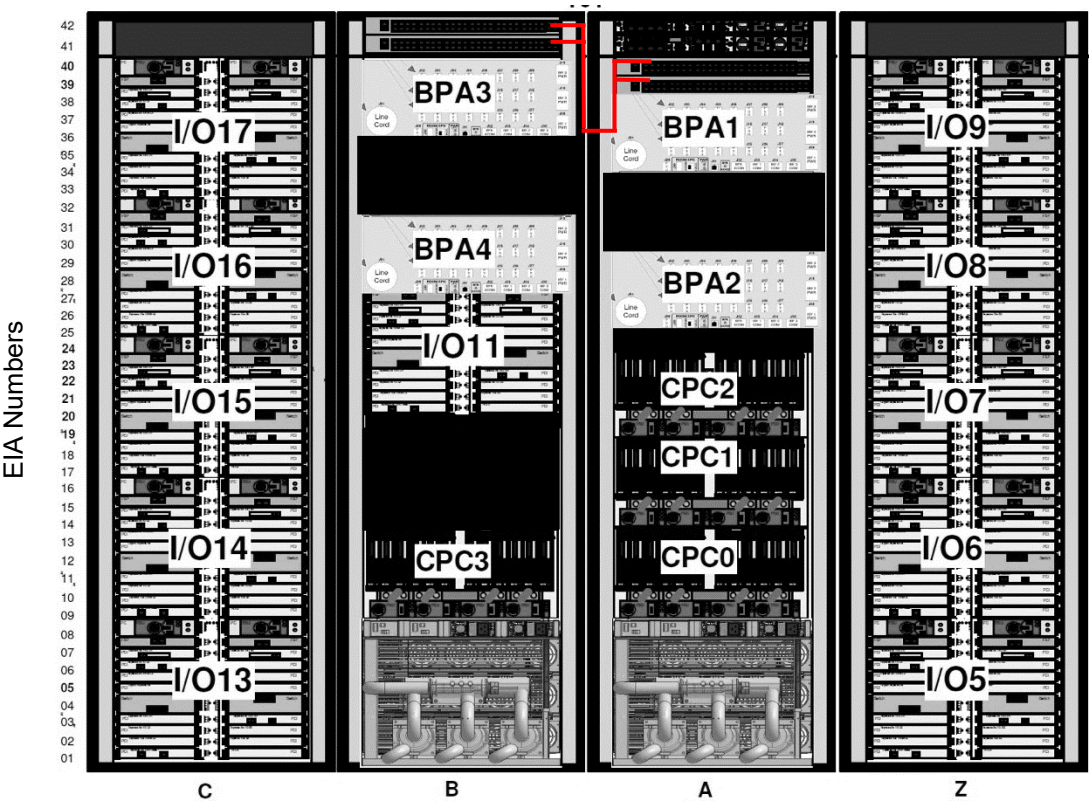


Figure 37: B to A Frame BPA Cabling through hole #1

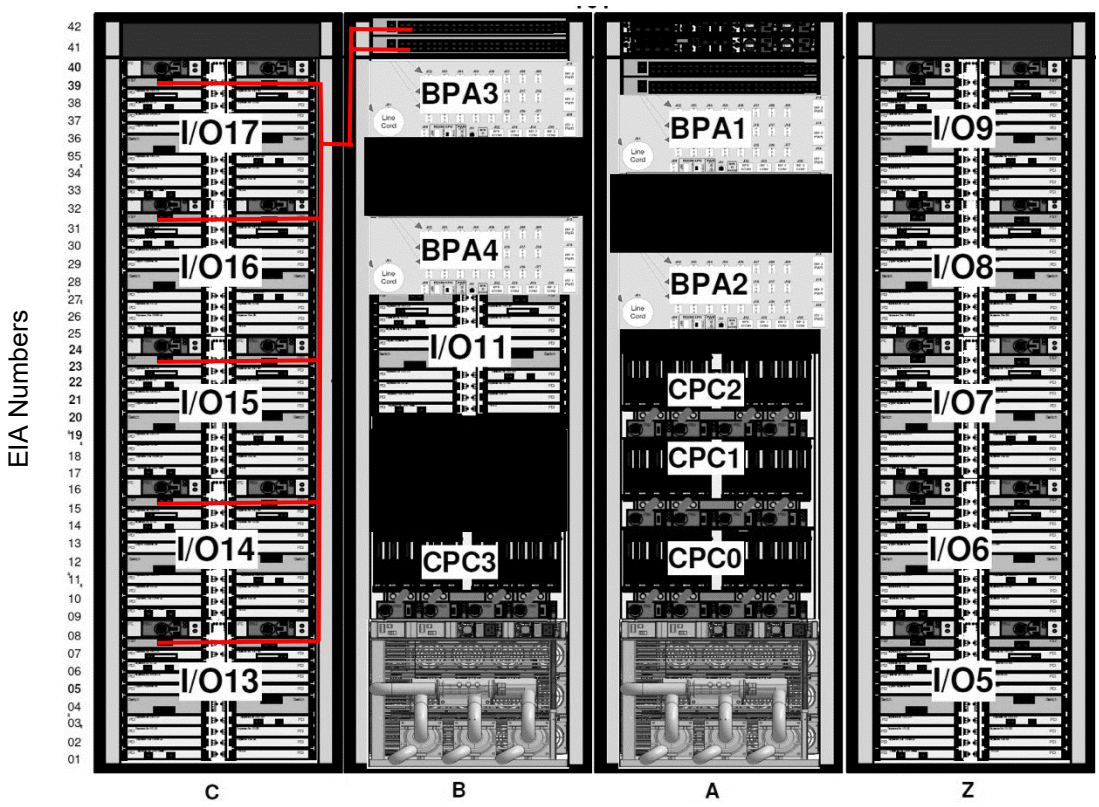


Figure 38: C to B Frame BPA Cabling through hole #1

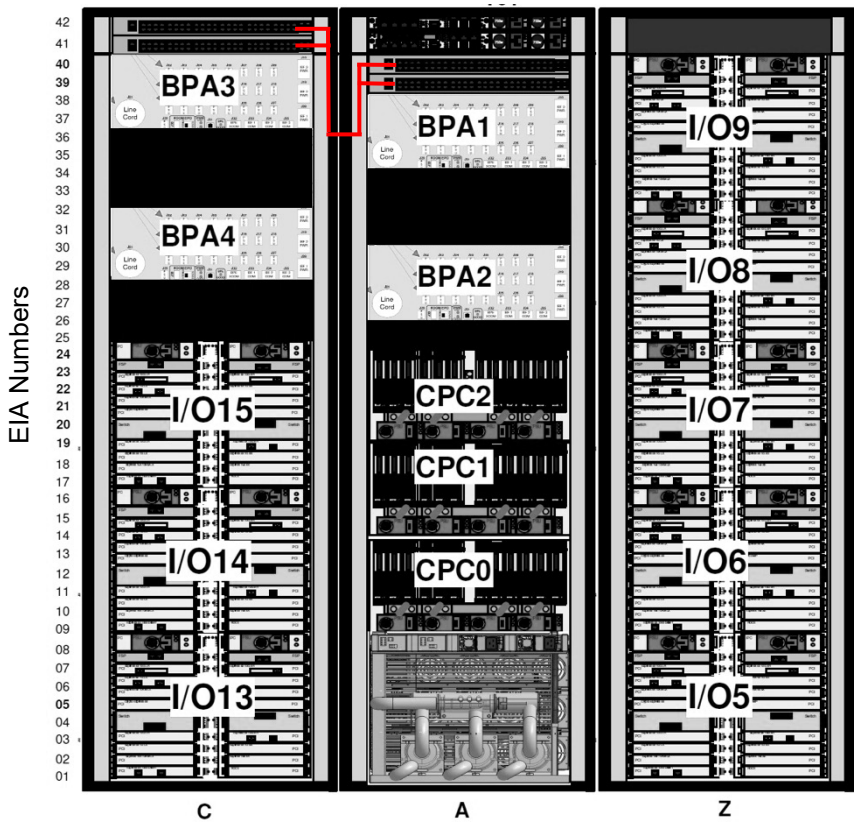


Figure 39: C (without B) to A Frame BPA Cabling through hole #1

Power Supply Cords

Power supply cords (a.k.a., internal power jumpers) are internal system cables used to connect the internal power supply units to the system's power distribution system (i.e., iPDU or bulk power). Note, these cords are point-to-point connections in iPDU power systems and are Y-cable connected to the redundant Bulk Power Assemblies (BPAs) in a Bulk Powered system. The routing schemes are provided for these cables in Figures 40-44 for the maximum configured systems.

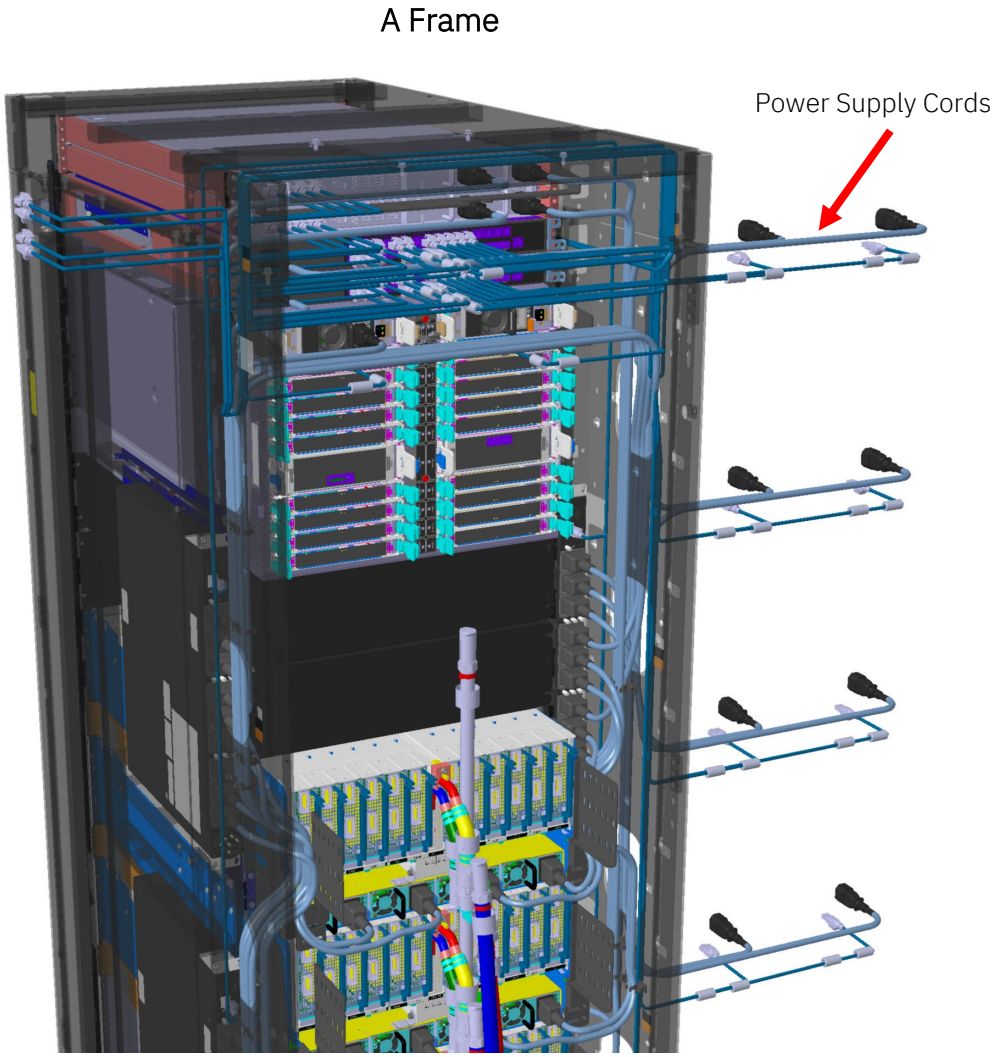


Figure 40: 3D Rendering of Power Supply Cords Being Routed within Semitransparent Frame. The adjacent frames and reservoir are not shown for clarity.

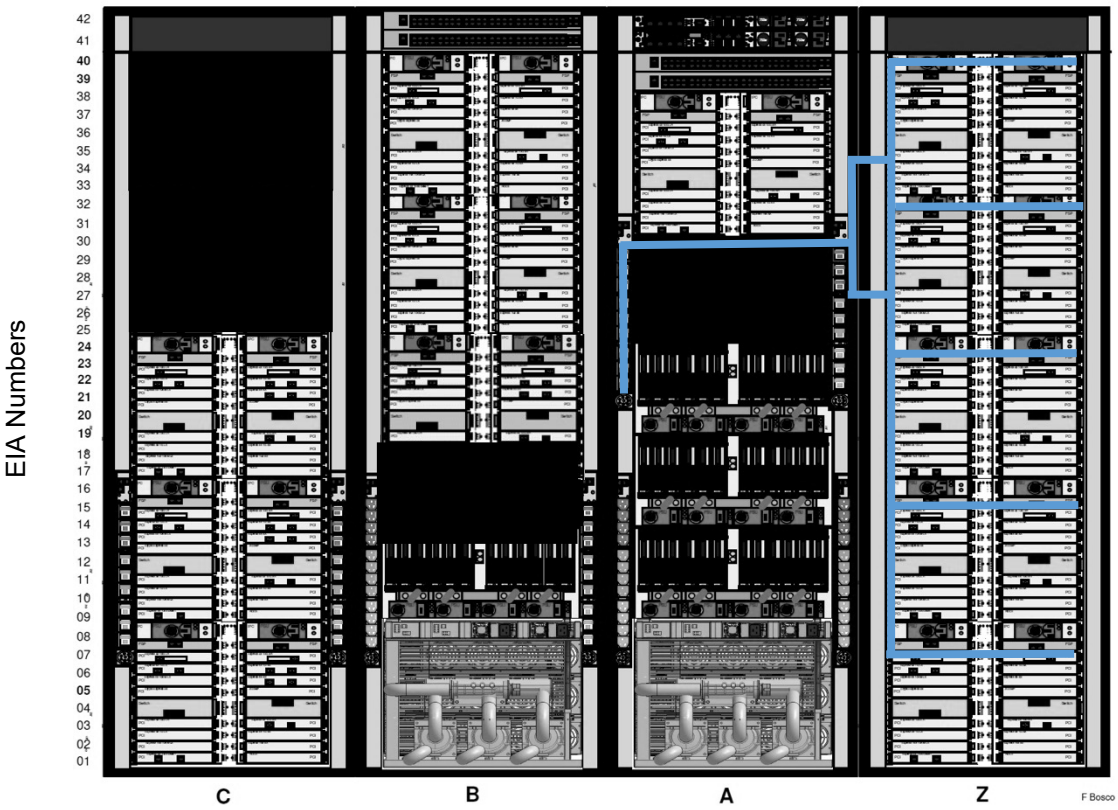


Figure 41: Z to A Frame iPDU Cabling through holes #1 and #2

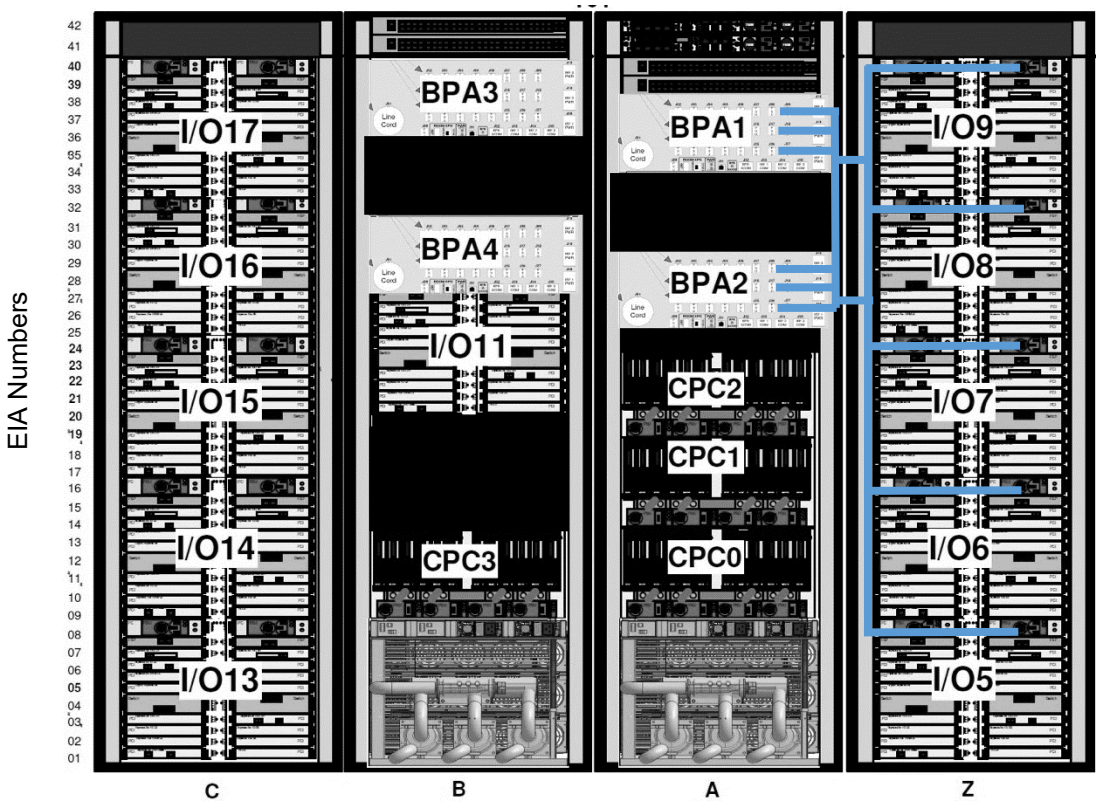


Figure 42: Z to A Frame BPA Cabling through hole #1 and #2

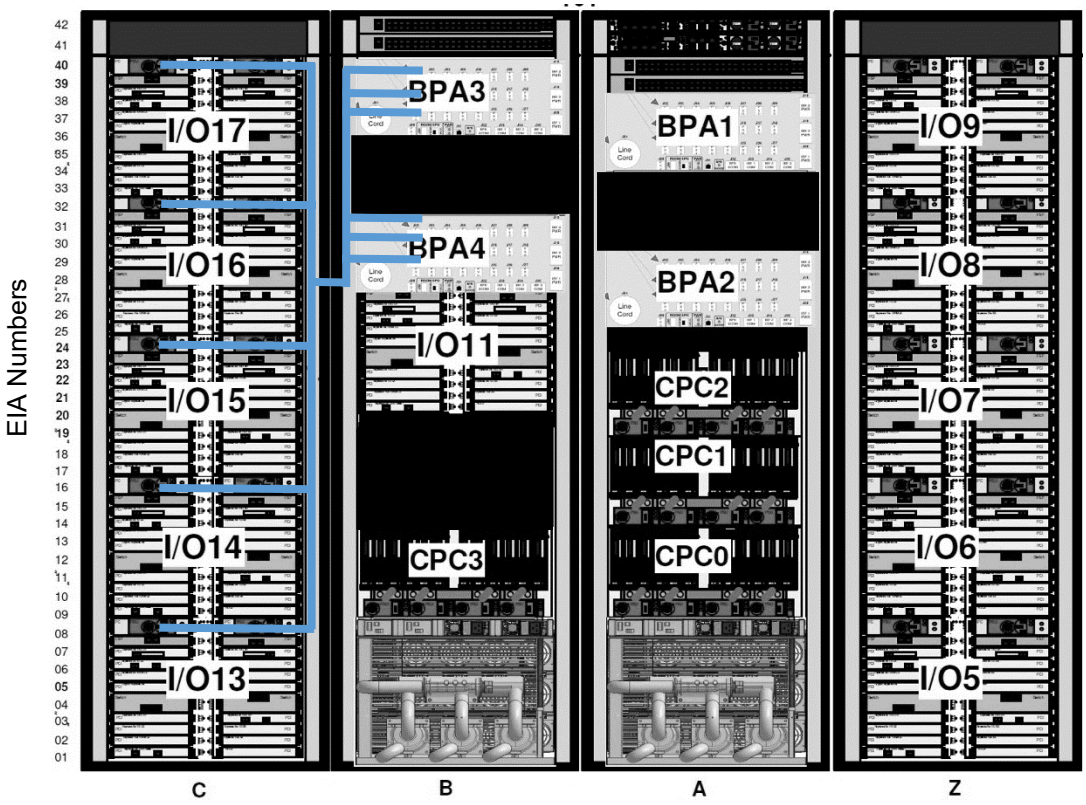


Figure 43: C to B Frame BPA Cabling through hole #2

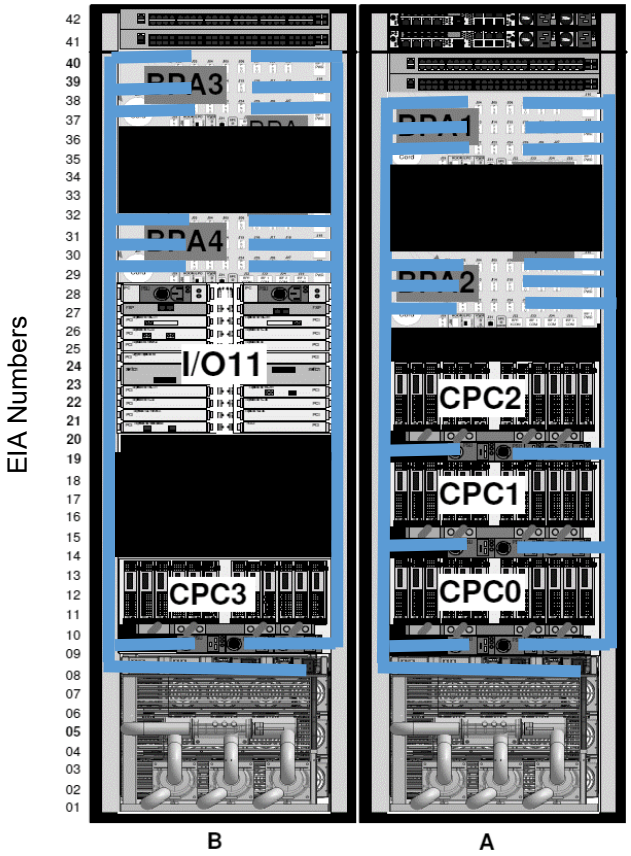


Figure 44: A and B Intra-frame BPA Cabling

SMP Cables

The SMP cables create the processor network by connecting the nodes of the CPC drawer to each other. These cables are fragile, so they must be handled with care.

Figures 45-47 depict the maximum configuration for the SMP cables and how they should be routed. The actual cable count depends on the number of configured CPC drawers, but the cable routing paths always remain the same. The SMP cable is to be routed in a manner such that it doesn't interfere with servicing the left most card as shown in Figure 48.

Note: For iPDU service actions, the hook-and-loop fastener that attaches the SMP cable to the CPC bracket will need to be removed to release the cable so they can be moved out of the way during servicing.

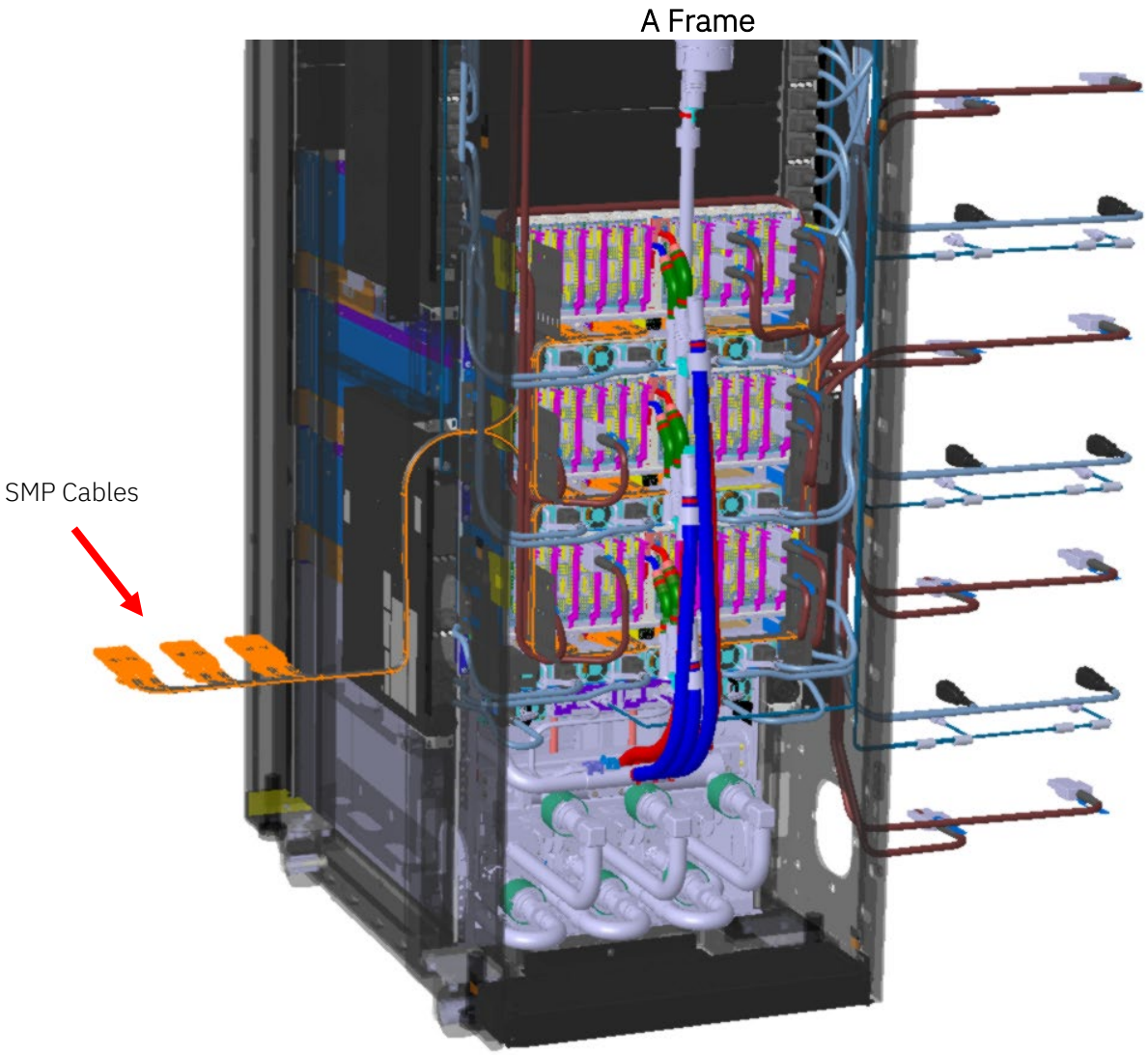


Figure 45: 3D Rendering of SMP Being Routed within Semitransparent Frame. The adjacent frames and reservoir are not shown for clarity.

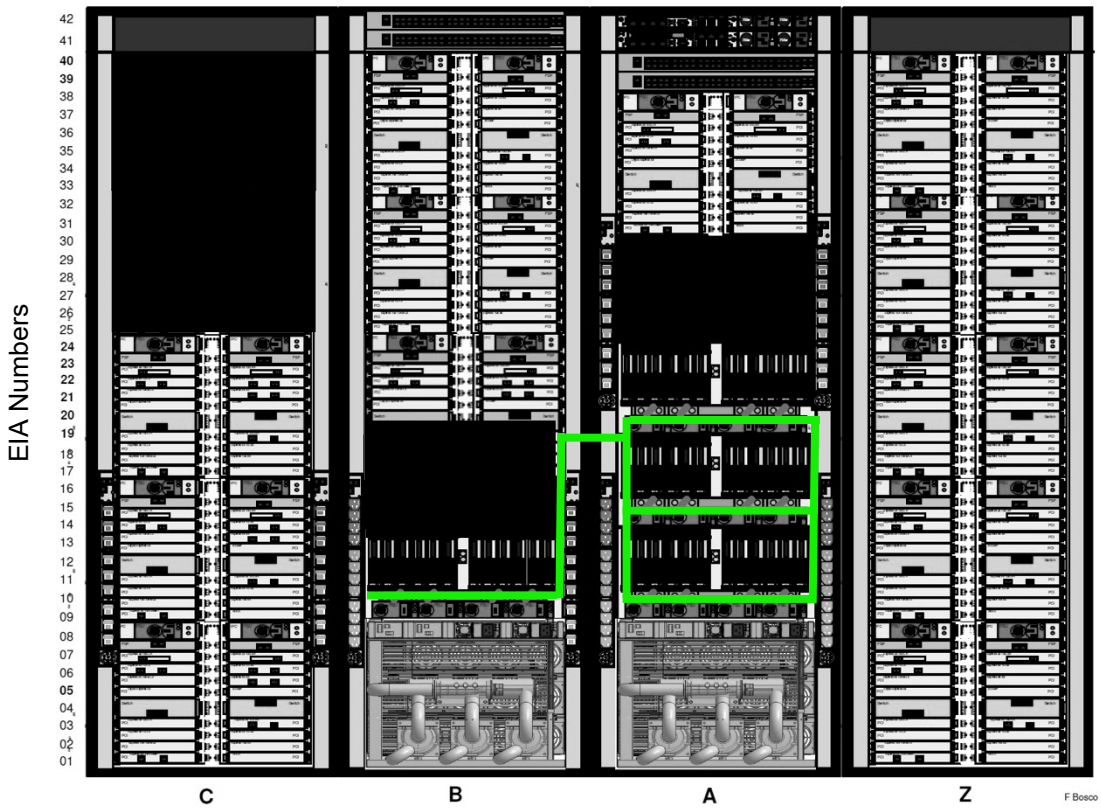


Figure 46: SMP Cabling through hole #3

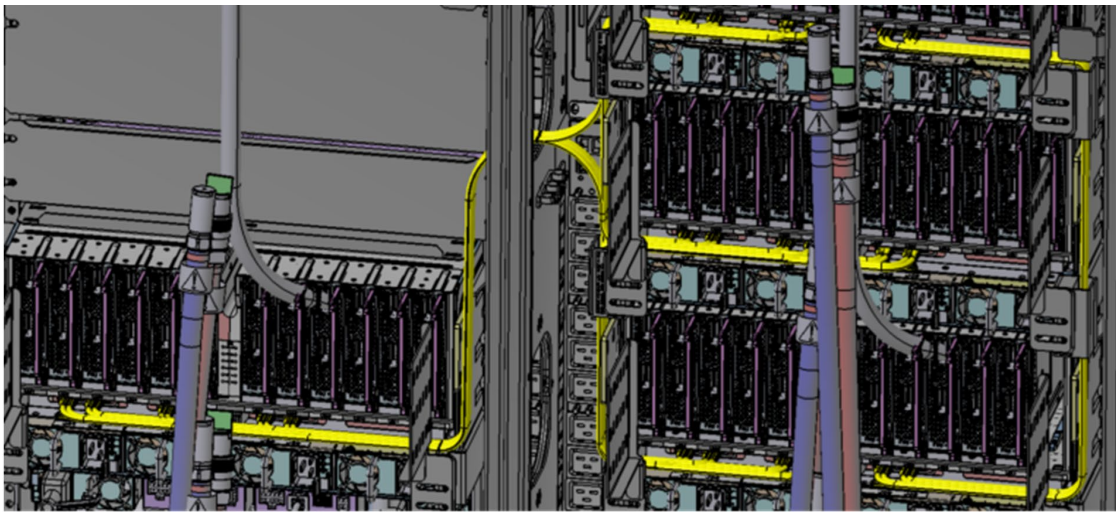
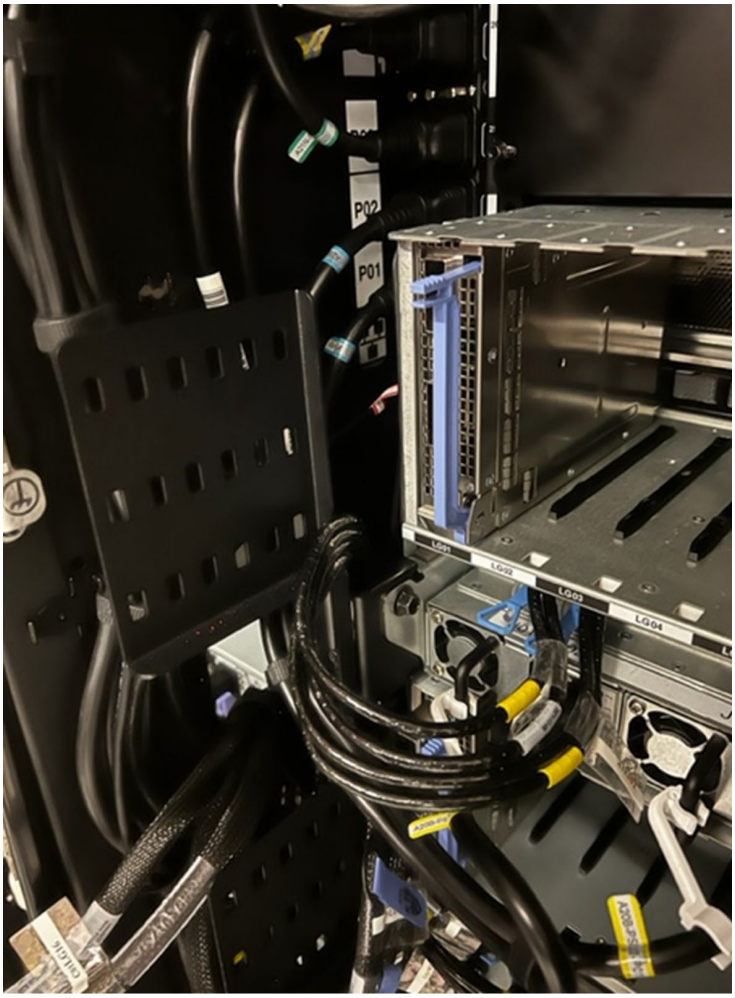


Figure 47: SMP Cabling for CPC Drawers



. *Figure 48: Neatly Routed SMP cable*

PCIe+ I/O Cable

PCIe+ I/O cables connect the CPC drawers to the PCIe+ I/O drawers. The recommended routing of these cables within a frame or to an adjacent frame(s) is provided in Figure 49. In the case of an iPDU system and where these cables are required to route across a frame, these cables must be routed through hole number 3 (ref. Figure 50).

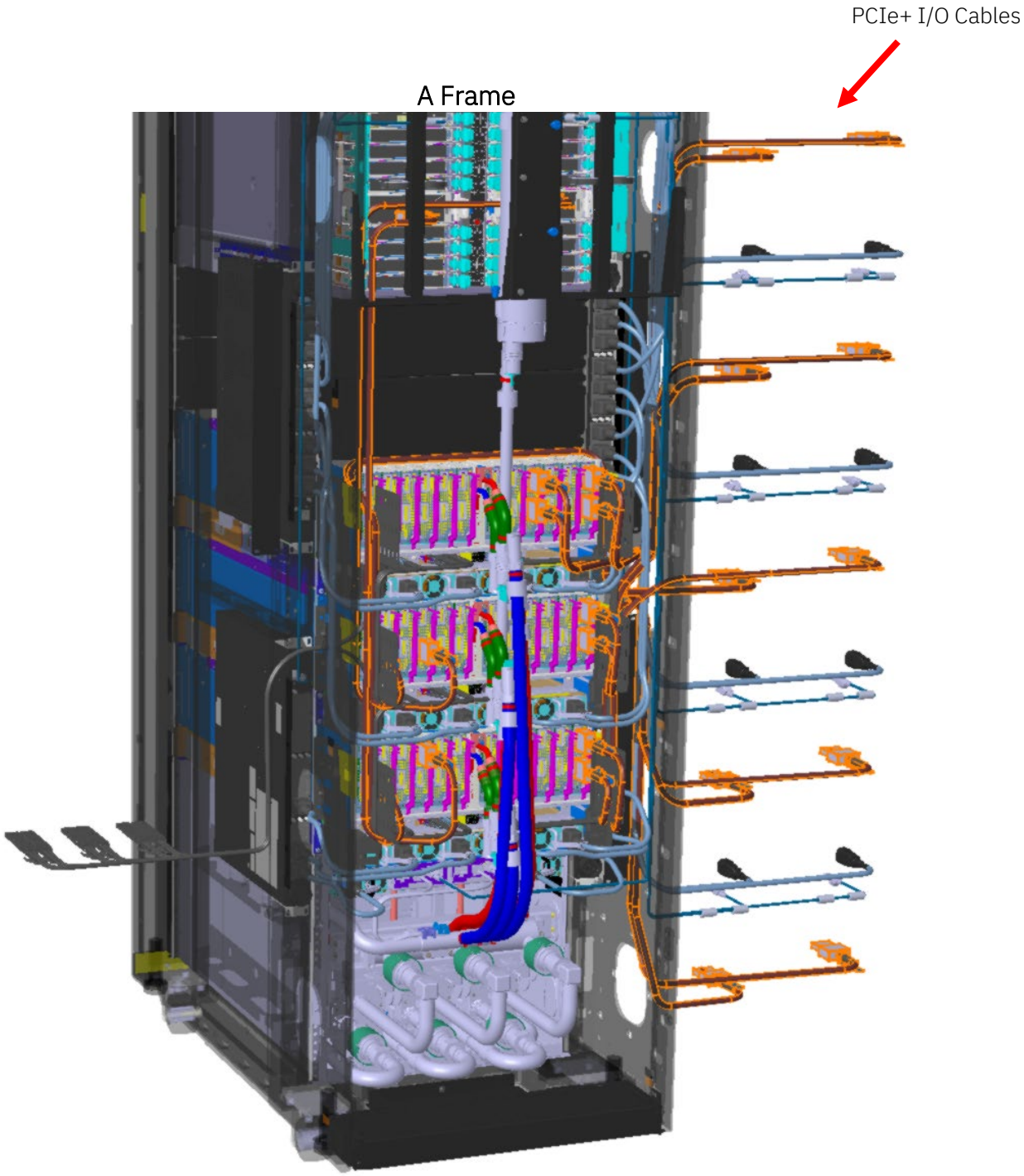


Figure 49: 3D Rendering of PCIe+ I/O *Cables Being Routed within Semitransparent Frame. The adjacent B and Z frames and reservoir are not shown for clarity.*

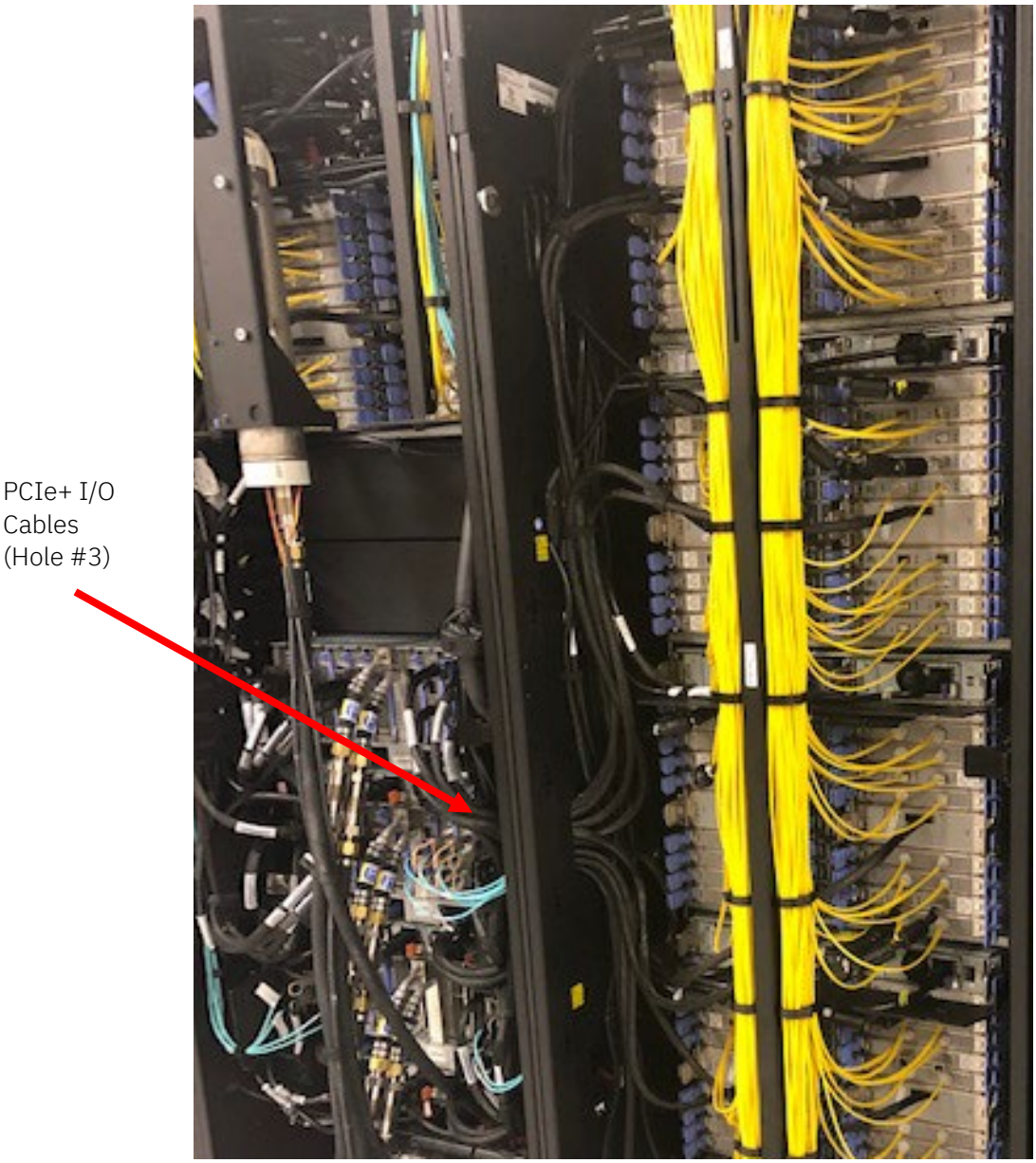


Figure 50: PCIe+ I/O cables *Routed Through Hole #3*

Chapter 5. External System Cables

FICON & FCP Cables

Fiber optic cables that attach to PCIe+ I/O cards can exit through the top or the bottom of the frame. FICON Express, OSA Express, and Coupling connection types are included in this grouping for further details on the connection type options, refer to the IMPP, Chapter 8: I/O Cabling and Connectivity.

Two important notes should be understood when installing fiber optic cables:

1) Follow recommended cleaning and installation procedures for all fiber optic cable products for optimal performance
2) Top exit feature with enclosure (FC 7898) is not required to route fiber optic cables through the top of the machine.

As previously noted, the spine with the hook-and-loop fasteners are included with the system configuration (i.e., factory installed or included as part of a system upgrade) for Z- and C-frames and, is used for cable management and strain relief. These cables will route up or down, parallel to the central channel for both top and bottom exiting systems, respectively. If the Fiber Quick Connect feature (FC 5827) is selected, the cable positions on the bracket should be populated from the center outwards towards the sides of the frame (ref. Figure 52). If Fiber Quick Connect is not selected, then the cables would run through the tailgate or straight out the top of the system for bottom and top exiting cabling schemes, respectively.

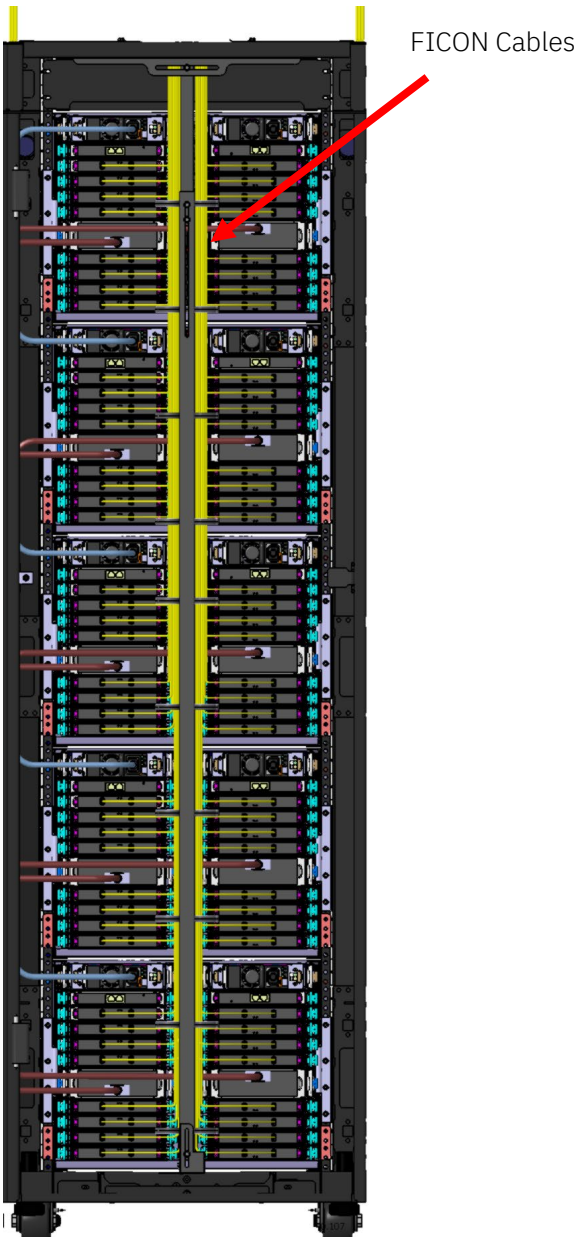


Figure 51: FICON Cables in Spine

If fiber trunking cables are planned, the Fiber Quick Connect brackets shall be ordered (FC 5827). When the Fiber Quick Connect brackets are ordered with the top exit cabling enclosure feature code, the brackets are mounted in the enclosure per Figure 53. When using this FC, to minimize cabling congestion within the frame confines, all excess fiber cabling bulk should be trained upward and wrapped around the organizing spool provided within the box structure mounted on the top of the frame. For bottom exit Fiber Quick Connect systems, vertical cable spools are provided (see Figures 27 and 28) and are attached to the spine. Note, fiber trunk cabling may be dressed differently based on the cabling type selected and the location of its furcation pod(s).

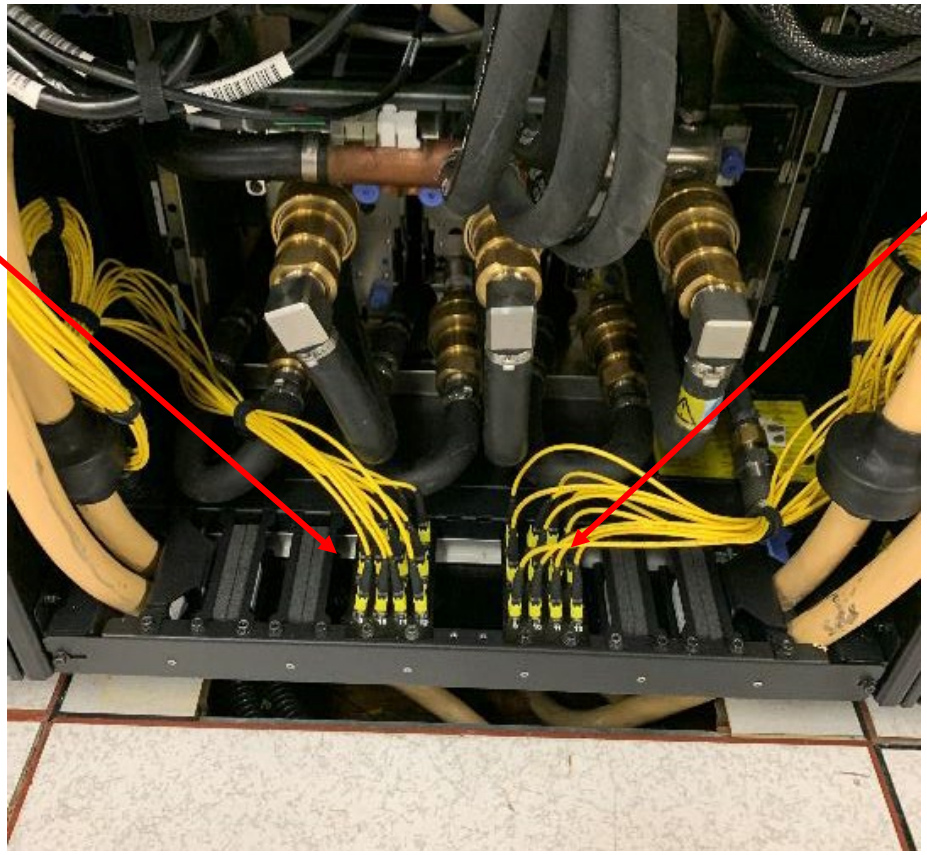


*Figure 52: Fiber Quick Connect on Tailgate (**FCs 7899 and 5827**)*

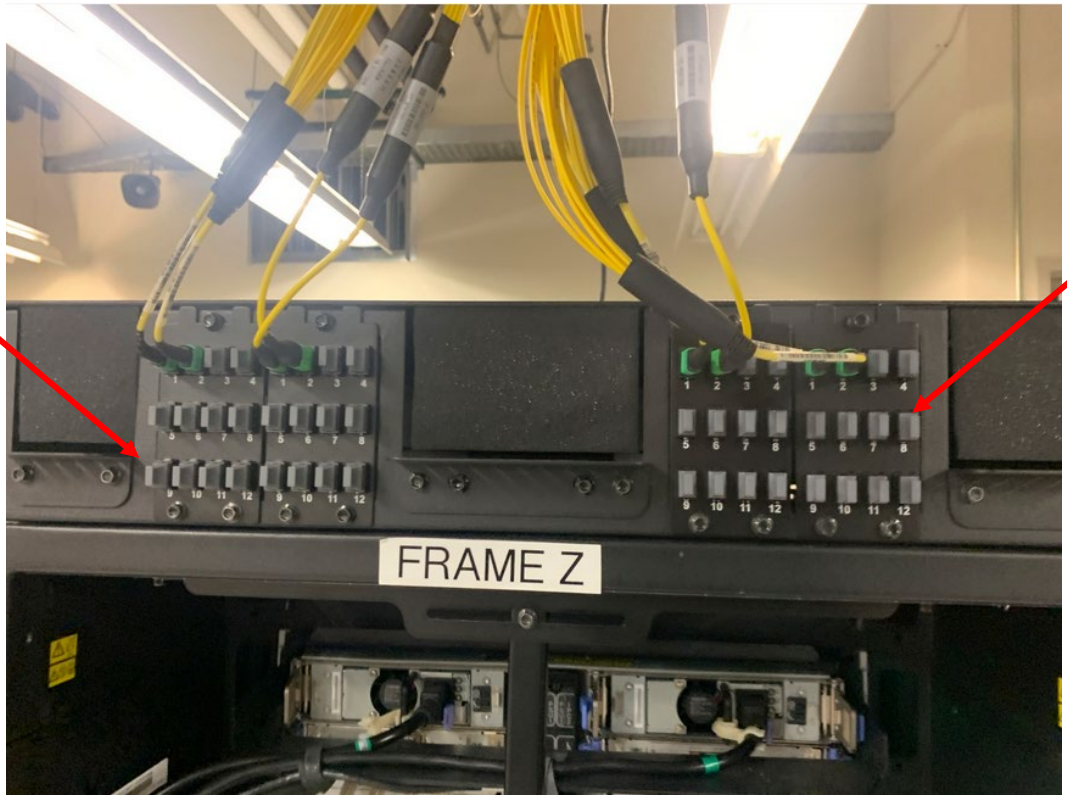


*Figure 53: Fiber Quick Connect in Top Exit Cabling Enclosure (**FC 7898**)*

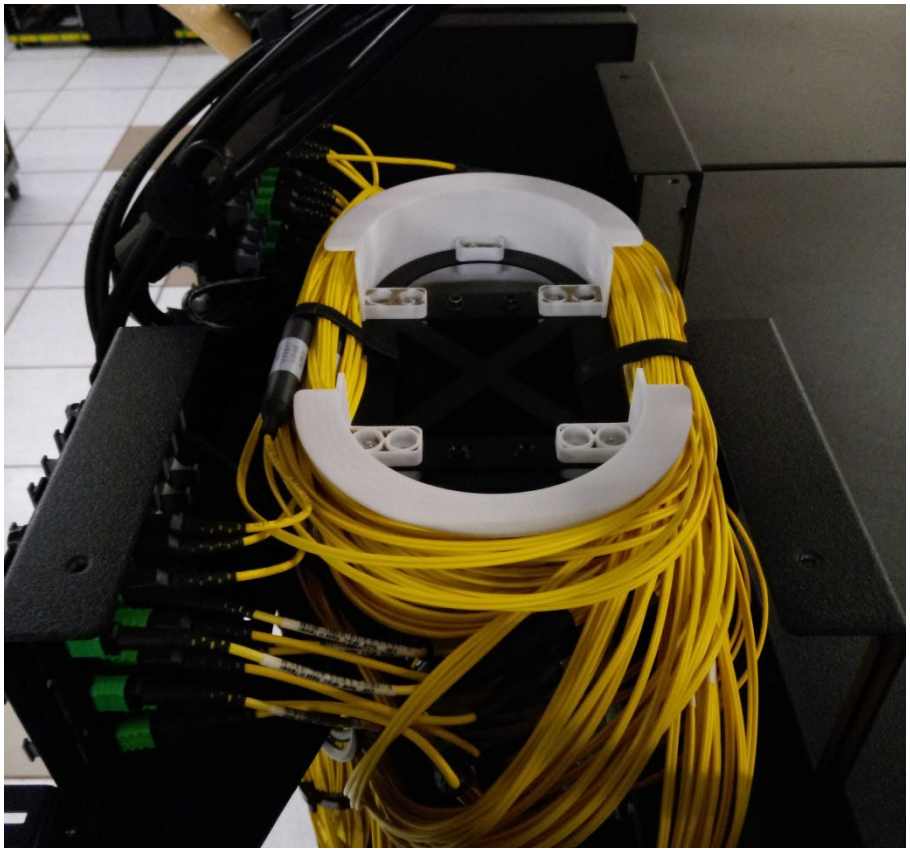


Figure 54: Fiber Cables in Top Exit Cabling Enclosure Including Integrated Cabling Spool

Specific to A- and/or B-frame routing of fiber cables, these should be along the sides of a frame, ensuring these are neatly tucked behind the reservoir bracket and the line cord and secure it with a hook-and-loop fastener. A mini-spine with hook-and-loop fasteners is provided for frames that have at least one CPC drawer installed in an iPDU powered system. The mini-spine is factory installed in the top half of the frame. For this configuration, the fiber optic cables (i.e., FICON, OSA and/ or Coupling) are be routed through the outer loops (Ref. Figures 56 and 57).

Figure 55: Routing Fiber Cables

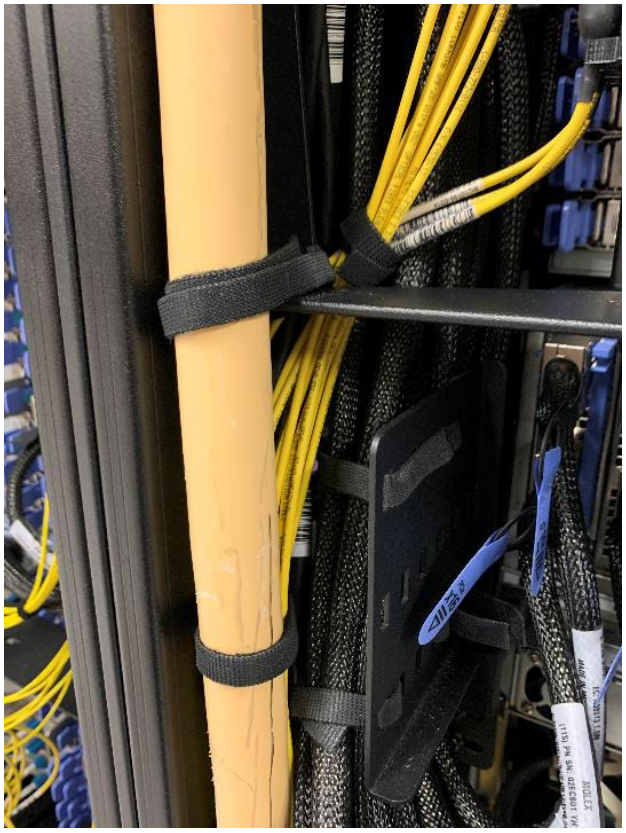


Figure 55.1: Zoomed Image of Routing Fiber Cables

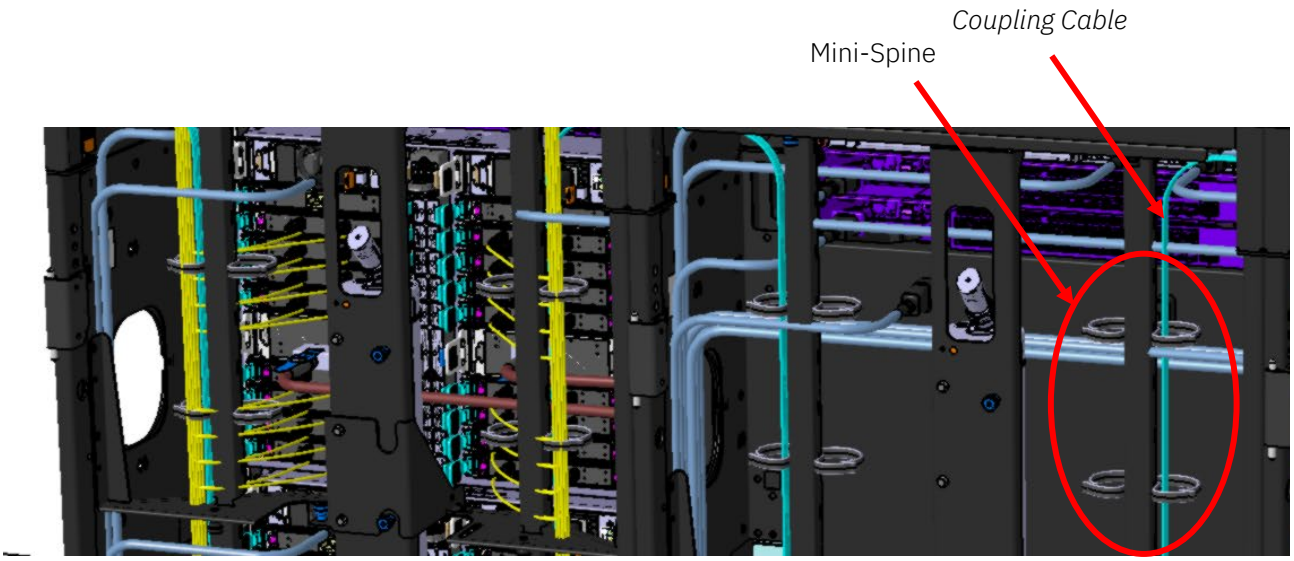


Figure 56: Coupling Cabling in Mini-Spine with Hook-and-Loop Fasteners

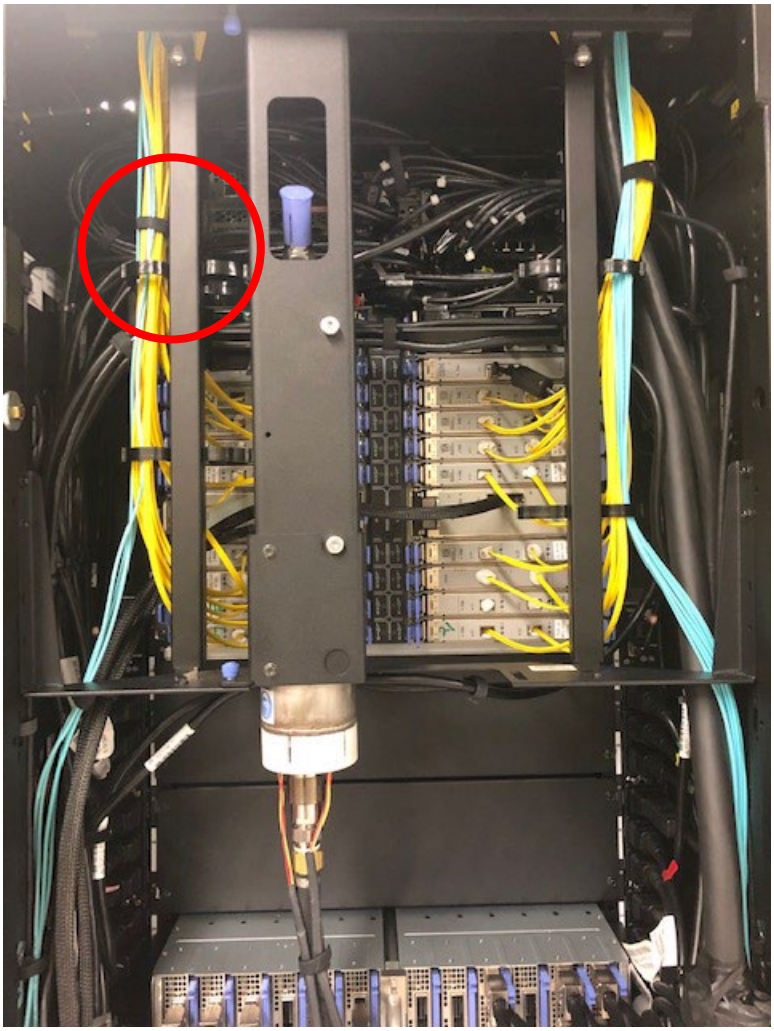


Figure 57: Coupling Cabling in Mini-Spine with Hook-and-Loop Fasteners

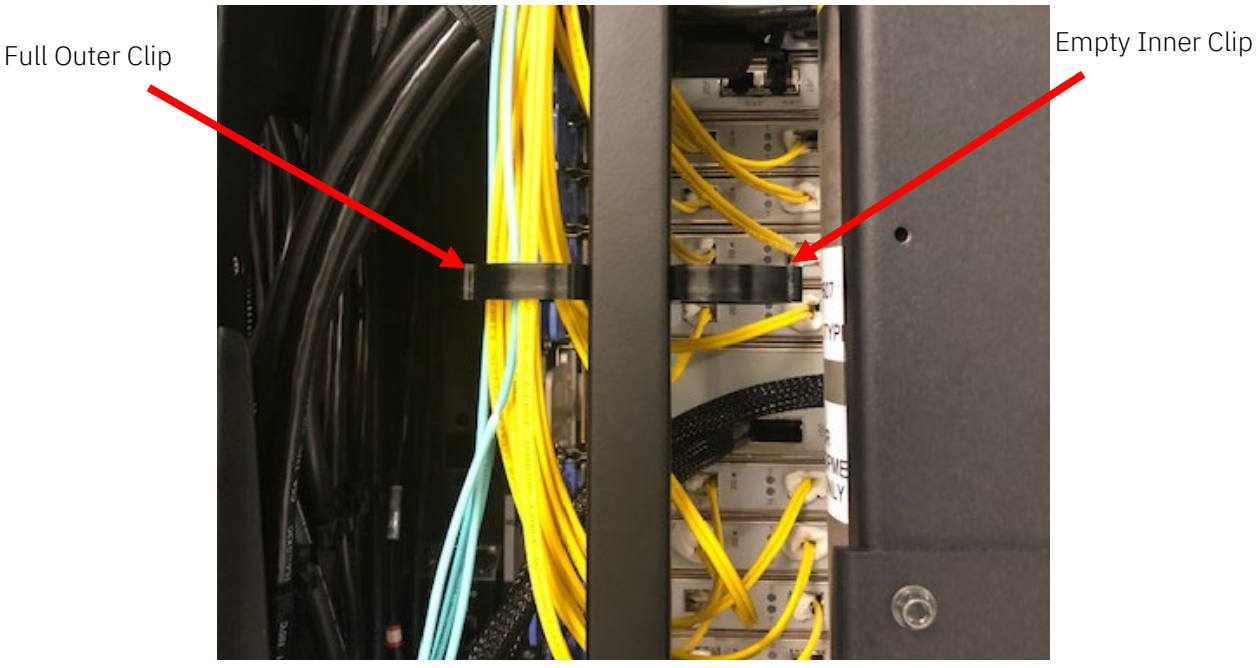


Figure 57.1: Zoomed image of Circled Area in Figure 56

NOTE: The coupling cables originating from CPC drawer(s) should be routed first to the side of the frame and then either up or down within the spine clip depending on the defined system cabling exit scheme (ref Figure 58).

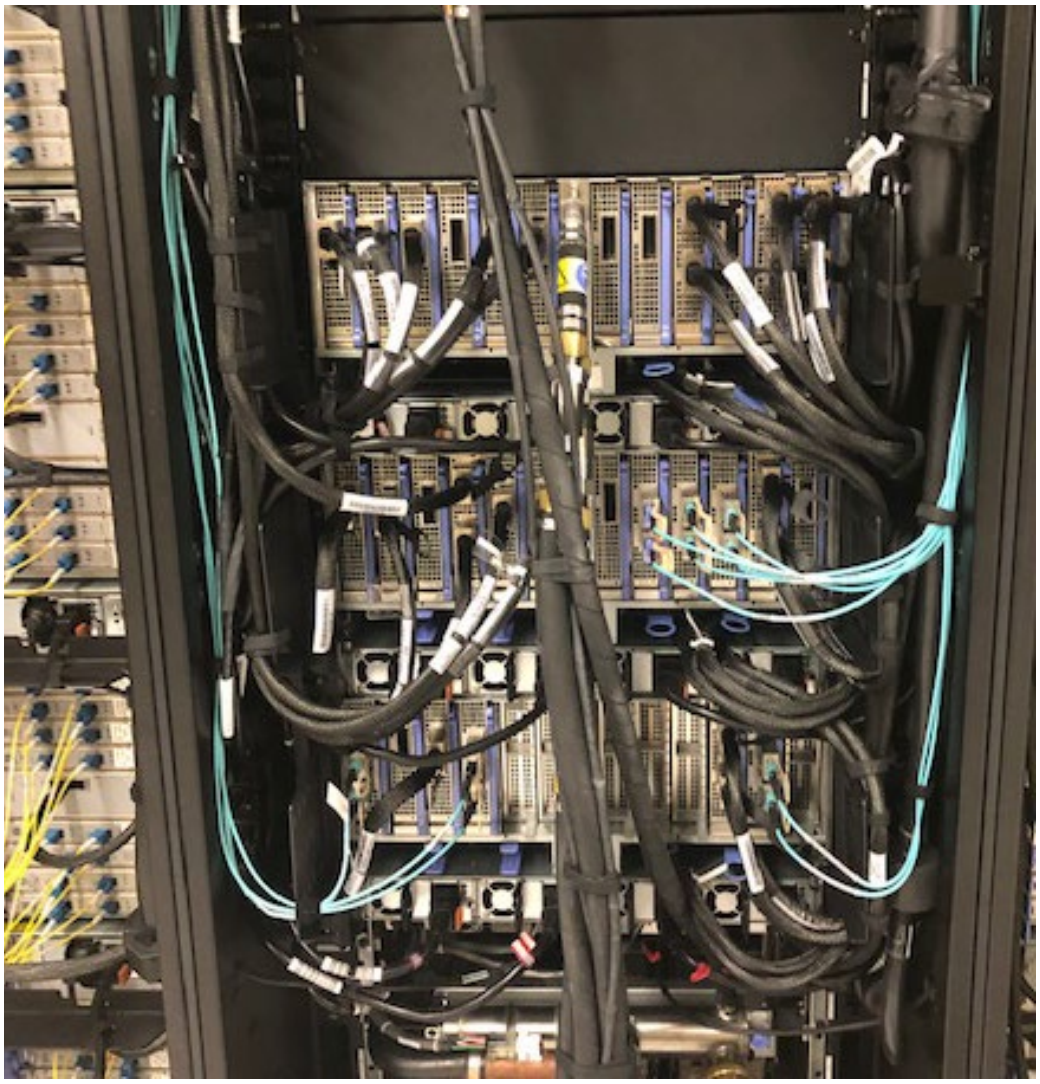


Figure 58: Coupling Cabling in Mini-Spine with Hook-and-Loop Fasteners

Lastly, everything should be terminated, retained, and properly supported with the provided strain relief clamps, cable clamps, and filler plates. This will ensure the cable performs reliably and preserve the integrity of the cables.

OSA Network Cables

Open Systems Adapter-Express (OSA-Express) features enable connectivity to industry-standard local area networks (LANs). These cables may either be copper or fiber optic which are routed through the spine. For A- or B-frames with the mini-spine, the cables should be routed through the outer clips (ref. Figure 59). Configuration information is found in the IMPP and reference information may also be found in the Planning for Fiber Optic Links.

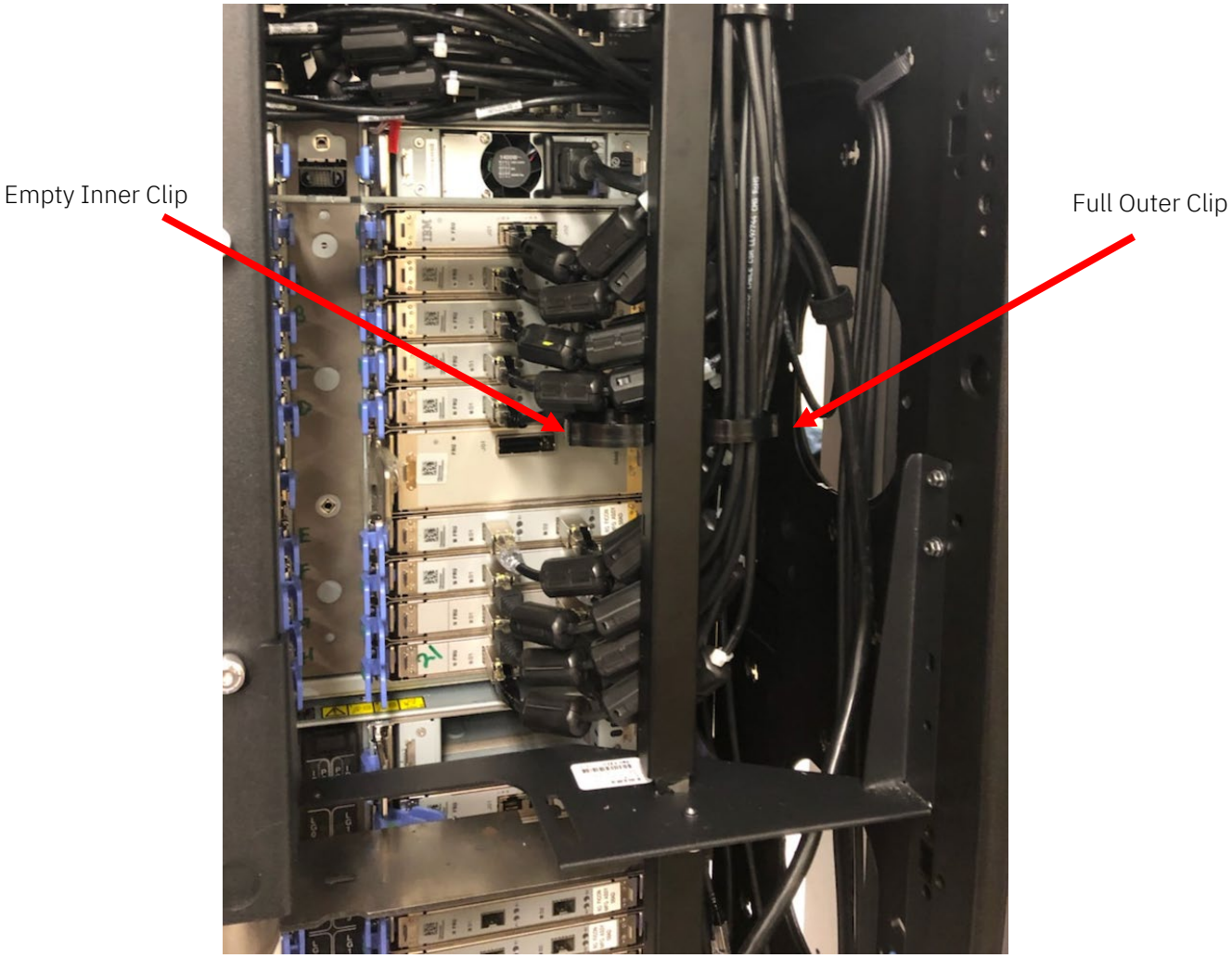


Figure 59: OSA Cables in Mini-Spine

External Ethernet

There are two (2) 50 foot external ethernet cables provided that connect the server to the Hardware Management Console (HMC). These cables are routed from the front to the rear of the system to the left of the server then exit either from the top or the bottom depending on the external cabling configuration.

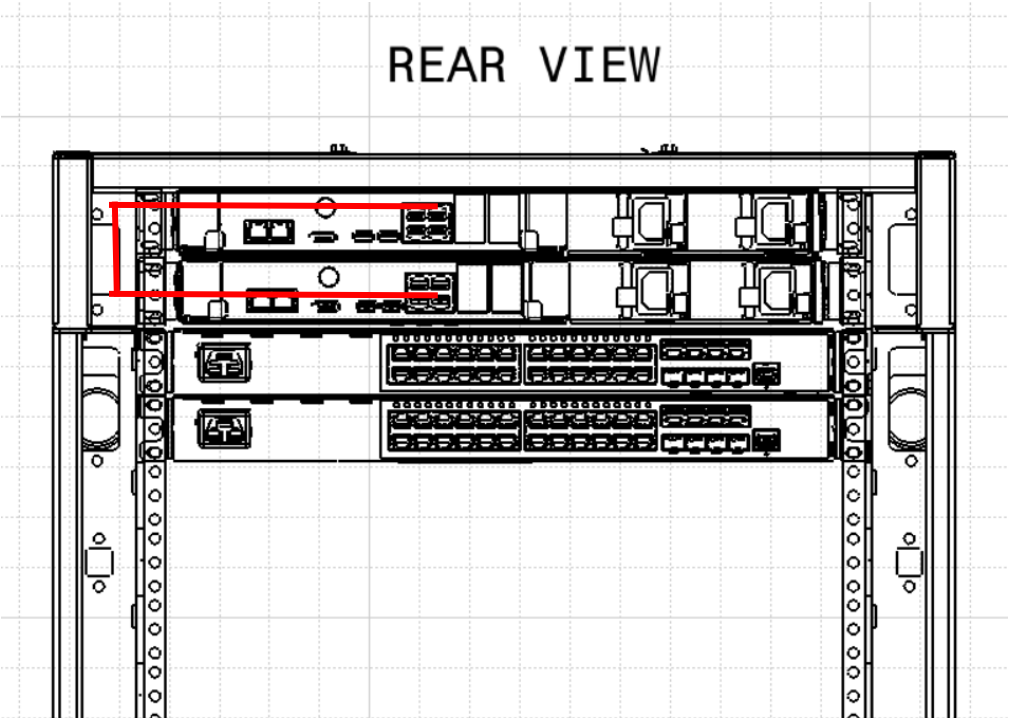


Figure 60: External Ethernet Routing

Time Synchronization

A Server Time Protocol (STP) Coordinated Timing Networks (CTN) has the capability of connecting to its time source a Network Time Protocol (NTP) or a Precision Time Protocol (PTP) time server that has a pulse per second (PPS) output signal. The NTP and PTP timing networks are connected to the oscillator card(s) in the CPC drawer(s) because the NTP or PTP client runs in firmware partition within the CPC drawer. The PPS output of the NTP or PTP time server is connected using a coaxial cable to the front of the CPC drawer located within the “A” frame (reference Figures 61 and 62). When installing the PPS cable, caution must be followed as detailed in the install manual.

The PPS cable should be retained to the BMC card latches using hook-and-loop fasteners. The routing of these cables shall be along the same path as the preinstalled BMC ethernet cables under the plastic cable organizer in front of the frame (ref. Figure 63). After it is routed through the horizontal hole in the upper portion of the frame, it should be routed either up or down out of frame depending on the desired external cabling configuration. If top exiting cabling is being used, the coaxial cable may also be exited from the top through the D hole in the upper portion of the front of the frame (see Figure 64).

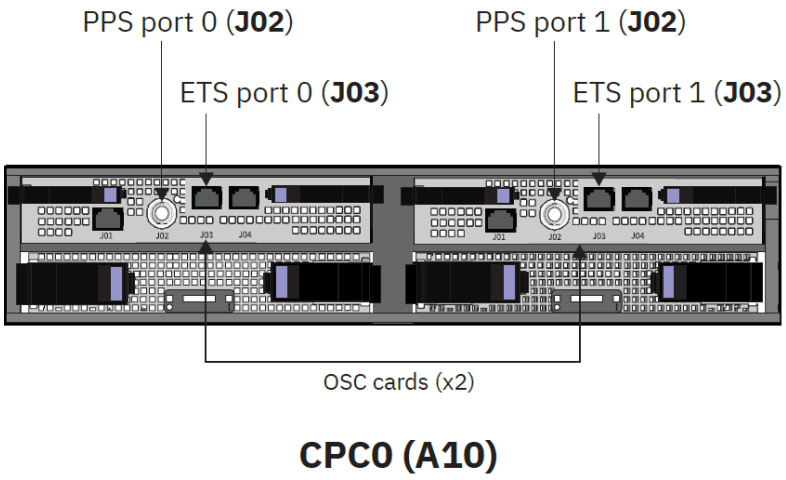


Figure 61: PPS Ports for One (1) "A" Frame CPC drawer

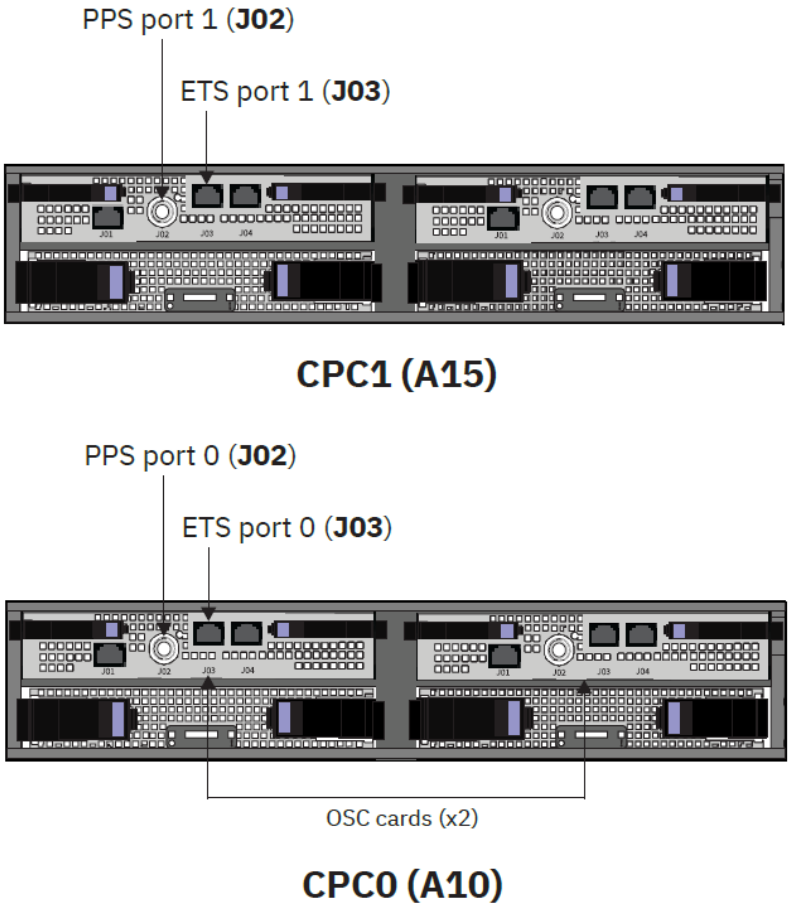


Figure 62: PPS Ports for Two (2) or more "A" Frame CPC drawers *(please update with PTP locations)*

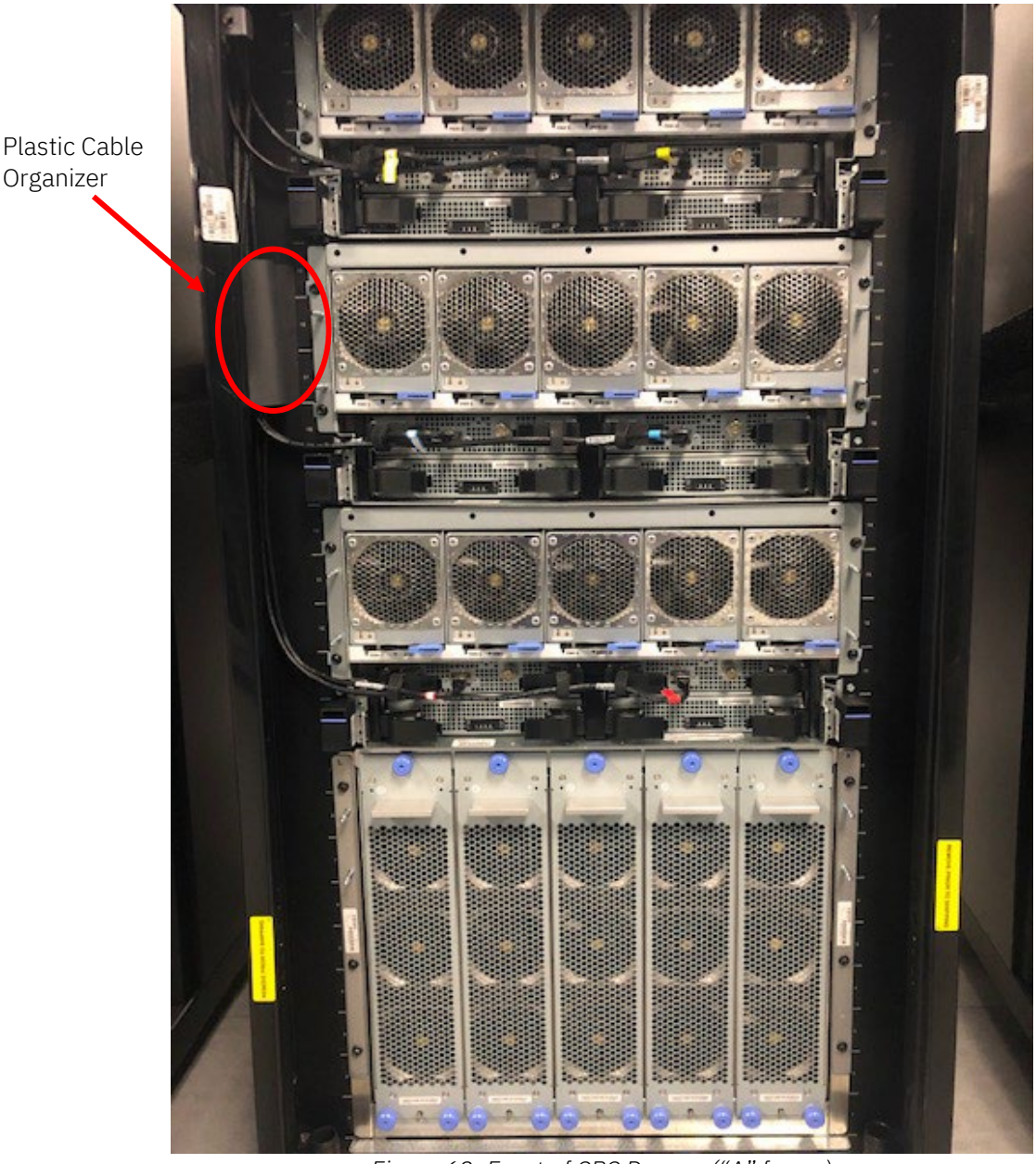


Figure 63: Front of CPC Drawer (“A” frame)

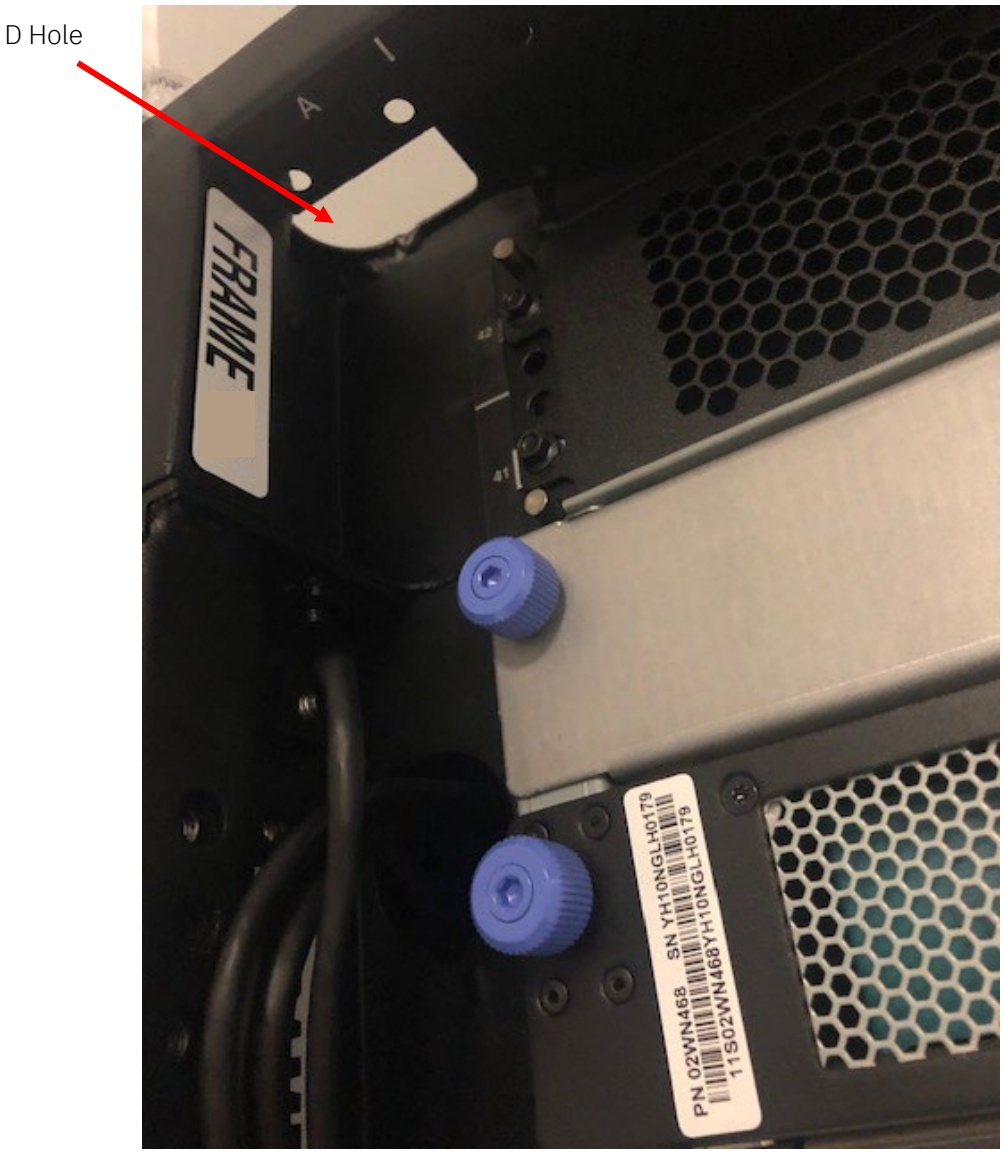


Figure 64: D Hole

Appendix A. Notices

This information was developed for products and services offered in the US.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not grant you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive, MD-NC119
Armonk, NY 10504-1785
US

INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FORA PARTICULAR PURPOSE. Some jurisdictions do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.

IBM may use or distribute any of the information you provide in any way it believes appropriate without incurring any obligation to you.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

Statements regarding IBM's future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to actual people or business enterprise is entirely coincidental.

Trademarks

IBM, the IBM logo, and ibm.com® are trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the web at "Copyright and trademark information" at http://www.ibm.com/legal/copytrade.

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Microsoft and Windows are trademarks of Microsoft Corporation in the United States, other countries, or both.

Class A Notices

The following Class A statements apply to this IBM product. The statement for other IBM products intended for use with this product will appear in their accompanying manuals.

Federal Communications Commission (FCC) Statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Industry Canada Compliance Statement

This Class A digital apparatus complies with Canadian ICES-003.

Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

European Community Compliance Statement

This product is in conformity with the protection requirements of EU Council Directive 2014/30/EU on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

This product has been tested and found to comply with the limits for Class A Information Technology Equipment according to European Standard EN 55032. The limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

European Community contact:
IBM Deutschland GmbH
Technical Regulations, Department M372
IBM-Allee 1, 71139 Ehningen, Germany
Tele: +49 (0) 800 225 5423 or +49 (0) 180 331 3233
email: halloibm@de.ibm.com

Warning: This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

VCCI Statement - Japan

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI-A

The following is a summary of the Japanese VCCI statement above:

This is a Class A product based on the standard of the VCCI Council. If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.

Japan JIS C 61000-3-2 Compliance

（一社）電子情報技術産業協会 高調波電流抑制対策実施要領に基づく定格入力電力値： Knowledge Centerの各製品の仕様ページ参照

For products less than or equal to 20 A per phase, the following statement applies:

高調波電流規格 JIS C 61000-3-2 適合品

For products greater than 20 A, single-phase, the following statements apply:

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
回路分類：６（単相、ＰＦＣ回路付）
換算係数：０

For products greater than 20 A per phase, three-phase, the following statements apply:

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
回路分類　：５（３相、ＰＦＣ回路付）
換算係数　：０

Electromagnetic Interference (EMI) Statement - People's Republic of China

声　明

此为Ａ级产品，在生活环境中，
该产品可能会造成无线电干扰。
在这种情况下，可能需要用户对其
干扰采取切实可行的措施。

Declaration: This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may need to perform practical action.

Electromagnetic Interference (EMI) Statement - Taiwan

警告使用者:
這是甲類的資訊產品，在
居住的環境中使用時，可
能會造成射頻干擾，在這
種情況下，使用者會被要
求採取某些適當的對策。

The following is a summary of the Taiwan EMI statement above:

Warning: This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.

IBM Taiwan Contact Information:

台灣IBM 產品服務聯絡方式：
台灣國際商業機器股份有限公司
台北市松仁路7號3樓
電話：0800-016-888

Electromagnetic Interference (EMI) Statement - Korea

이 기기는 업무용(A급)으로 전자파적합등록을 한 기기이오니
판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의
지역에서 사용하는 것을 목적으로 합니다.

Germany Compliance Statement

Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2014/30/EU zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaaten und hält die Grenzwerte der EN 55032 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der IBM empfohlene Kabel angeschlossen werden. IBM übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung von IBM verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung von IBM gesteckt/eingebaut werden.

EN 55032 Klasse A Geräte müssen mit folgendem Warnhinweis versehen werden:

"Warnung: Dieses ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funk-Störungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen zu ergreifen und dafür aufzukommen."

Deutschland: Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Geräten

Dieses Produkt entspricht dem "Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)". Dies ist die Umsetzung der EU-Richtlinie 2014/30/EU in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC EG Richtlinie 2014/30/EU) für Geräte der Klasse A

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Einhaltung der EMV Vorschriften ist der Hersteller:
International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
Tel: 914-499-1900

Der verantwortliche Ansprechpartner des Herstellers in der EU ist:
IBM Deutschland GmbH
Technical Regulations, Abteilung M372
IBM-Allee 1, 71139 Ehningen, Germany
Tel: +49 (0) 800 225 5423 or +49 (0) 180 331 3233
email: halloibm@de.ibm.com

Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55032 Klasse A.

Electromagnetic Interference (EMI) Statement - Russia

ВНИМАНИЕ! Настоящее изделие относится к классу А.
В жилых помещениях оно может создавать радиопомехи, для снижения которых необходимы дополнительные меры