M/T 9176 Rack Mount
System Cabling Best Practices Guide

Safety Notices

DANGER: The provided equipment that is intended to be installed in a customer-supplied rack can pose weight, mechanical, stability, electrical, and thermal hazards. See the safety instructions of the selected rack for installing this hardware, along with these general guidelines:

- Weight hazard:
  - Heavy equipment. Personal injury or equipment damage might result if mishandled.
- Mechanical hazard:
  - Do not use rack-mounted devices as shelves or workspaces. Do not place objects on top of rack-mounted devices. In addition, do not lean on rack-mounted devices and do not use them to stabilize your body position (for example, when working from a ladder).

    
  - Do not move or relocate a rack with the equipment installed. Remove all hardware from the rack if the rack needs to be moved or relocated. Use professional movers.
- Stability hazard:
  - With hardware installed in a rack, the rack can tip over causing serious personal injury or death.
  - To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack.
  - Always lower the leveling pads on the rack, if a rack has casters.
  - Always install stabilizer or earthquake brackets on the rack, if provided.
  - Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.

    
- Electrical hazard:
  - The rack might have more than one power cord. Be sure to disconnect all power cords when directed to disconnect power during servicing.
  - Connect all devices that are installed in a rack to power devices that are installed in the same rack. Do not plug a power cord from a device that is installed in one rack into a power device that is installed in a different rack.
  - An electrical outlet that is not correctly wired might 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 outlets are correctly wired and grounded to prevent an electrical shock.
  - Consideration must be given to the connection of the equipment to the power supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, see the rating labels that are located on the equipment in the rack to determine the total power requirement of the supply circuit.
- Thermal hazard:
  - Do not install a unit in a rack where the internal rack ambient temperatures exceeds the recommended ambient temperature of the manufacturer for all your rack-mounted devices.

- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced at ventilation openings that can adversely affect thermal performance of the equipment.

- Install and service each drawer according to its installation and service instructions, following the applicable safety notices in the respective documentation. (R001 part 3 of 3)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions:
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are little-to-no empty U-levels between devices installed in the rack cabinet below the 32U level, unless the received configuration specifically allowed it.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 mm wide (30 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- If a rack has casters, ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - If a rack has casters, lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet or in an earthquake environment bolt the rack to the floor.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also, if a rack has casters, lower the leveling pads to raise the casters off of the pallet and bolt the rack cabinet to the pallet. (R002)

CAUTION:

- Rack is not intended to serve as an enclosure and does not provide any degrees of protection required of enclosures.
- It is intended that equipment installed within this rack will have its own enclosure. (R005)

Cabling information is provided to customers for reference only. Only IBM service may plug and route cables to IBM equipment.

Contents

References:

1) Installation and Maintenance Physical Planning (IMPP) Guide
2) Planning for Fiber Optic Links Guide

Chapter 1. Introduction

This cabling best practices document was created to help the reader plan, install and retain cables for the 9176 Rack Mount system 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/or provided with the system while external cables are those provided by the client (i.e. power line cords, I/O, coupling, external communications network attach, etc.) and that egress from the system.

This document 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, 9176 Rack Mount Visio ® files are available on-line through IBM Documents.

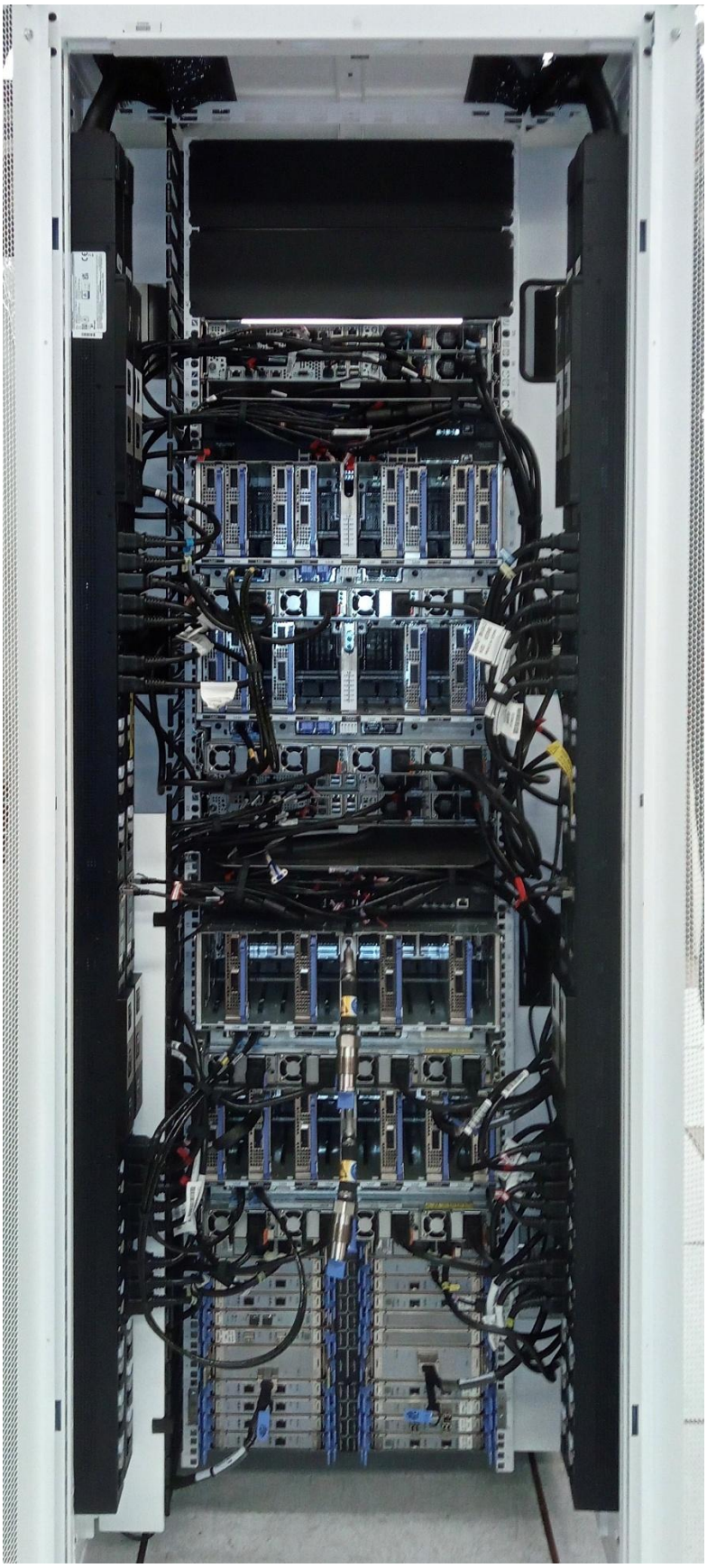

Figure 1: Reference Example of Full-System Cable Routing
(Note that system racks and therefore ideal cable routing may vary)

Chapter 2. Cable Support Recommendations

Clips

The system comes equipped with clips attached to the power supply units. It is intended to retain the power supply cords.

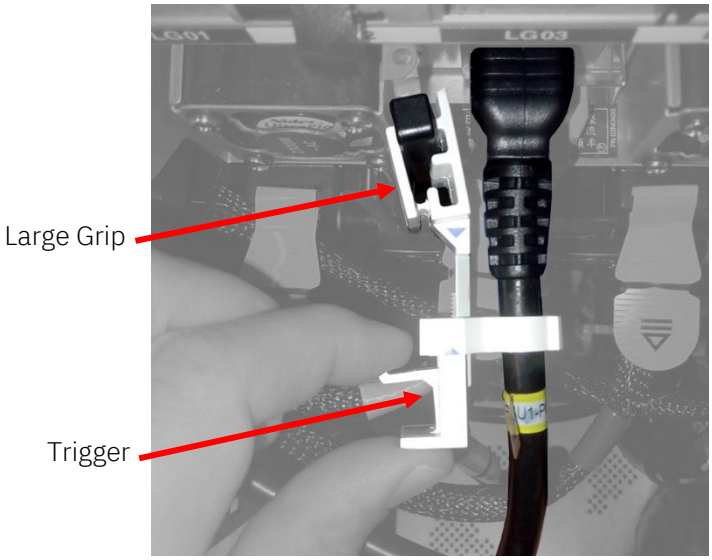

Figure 2: Large PSU Clip Being Adjusted

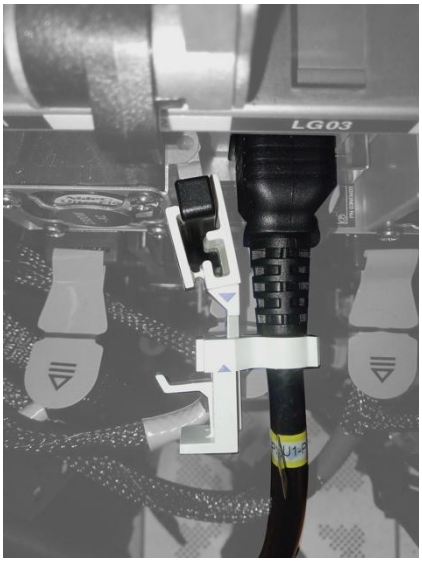

Figure 3: Large PSU Clip Fully Installed

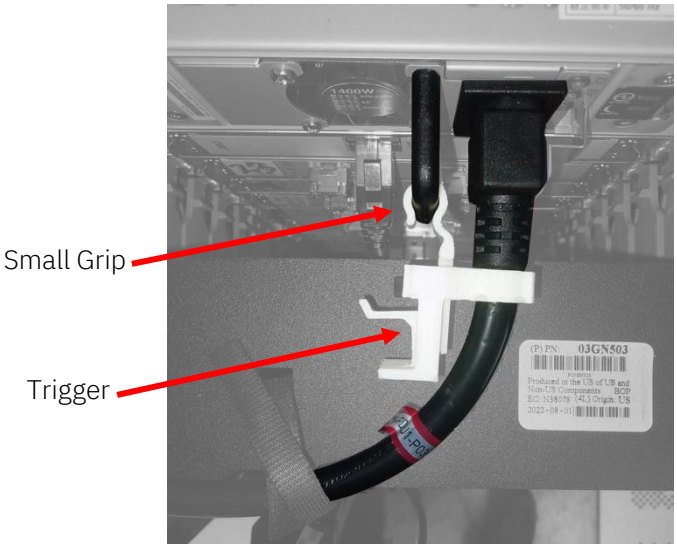

Figure 4: Small PSU Clip Fully Installed

Figure 5: Large and Small Grips

Hook-and-Loop Fastener

Hook-and-loop fasteners are used to properly route and retain cables in place, while maintaining bend radii and strain relief. Figure 6 shows what hook-and-loop fasteners look like.

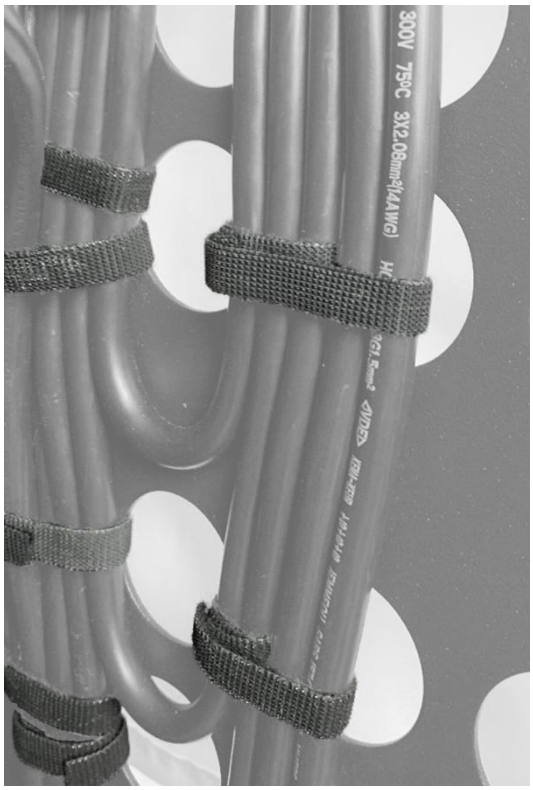

Figure 6: Hook-and-Loop Fastener

Figures 6-10 are examples on how to best route and retain the cables. Client frames may vary as well as pre-existing cables and/or features. In general, it is best to take a layered approach to installing cables starting with power, then signal, and finally optical. These cables are to be routed at install before plugging to prevent any unplugging issues. Cables that impede system serviceability is strongly discouraged. Therefore, cables on the right should be routed to the right, and cables on the left are to be routed left. The bend radius is to be maintained throughout the routing process. The IMPP goes into further details about servicing systems.

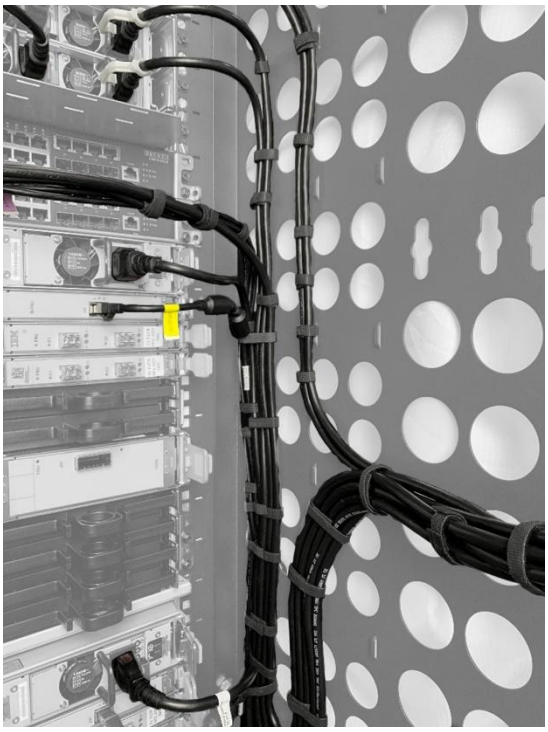

Figure 7: Example Frame Cable Routing

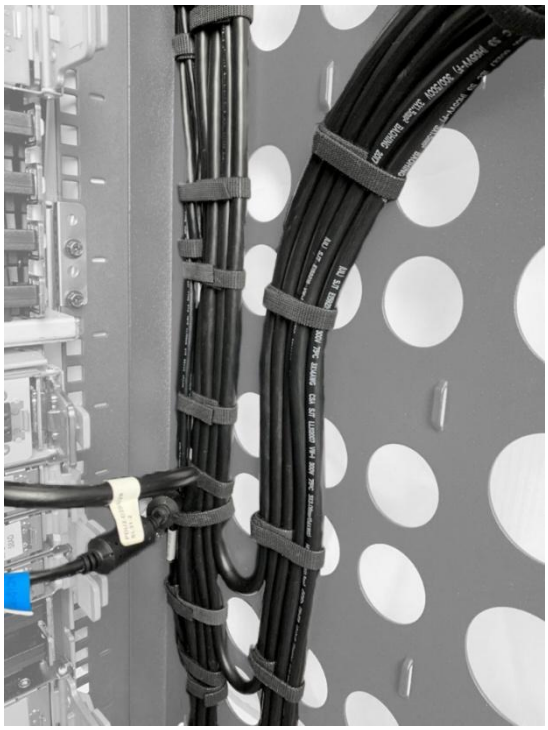

Figure 8: Example Frame Cable Routing

Figure 9: Example Frame Cable Routing Ensuring Serviceability

Figure 10: Example Frame Cable Routing Ensuring Serviceability

Chapter 3. Internal System Cables

On each end of the internal power jumpers and ethernet cables, there is a striped or solid-colored location flag label designating where the cables should be plugged. The color on the label serves as a visual aid to distinguish entities from each other. The solid-colored flag indicates the primary source, and the striped-colored flag indicates the secondary source. Installation personnel shall use the provided printed label data to ensure correct cable plugging locations are used.

The following subsections of this chapter are listed in the prioritized installation order:

1) Ethernet Network Cables
2) Power Jumpers
3) SMP Cables
4) PCIe+ I/O Cables

Note: Line cords are recommended to be installed after all internal system cables have been installed, routed and strain-relieved.

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. Ethernet cables plugged to elements on the left-side of the rack should be routed along the left-side of the rack and vice versa for elements on the right-side of the rack. Some ethernet cables will have two (2) ferrite cores, and others will not.

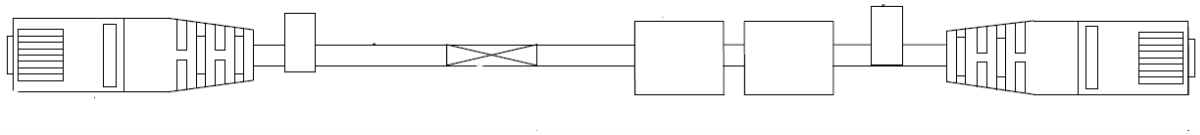

Figure 11: 2D Drawing of an Ethernet Cable

Power Jumpers

Power jumpers are internal system cables used to connect the power supply units to the customer's power distribution system (i.e., PDU).

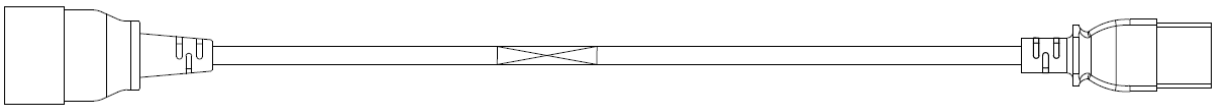

Figure 12: 2D Drawing of a Power Jumper

The customer can choose the best power jumper length for their rack. To assist with the selection process, a cable matrix was developed to identify edge cases. It takes into consideration frames up to 50U, vertical (0U) PDUs approximately 6U in length, and horizontal (1U and 2U) PDUs. If the customer has a vertical PDU that spans the height of the rack, then the cable length should be chosen based on section that the port is in. Even though there are many possible configurations, the cable matrix can be used as a guide to find the best length for given areas. The following diagram is used to depict the relative PDU positions used in the cable matrix.

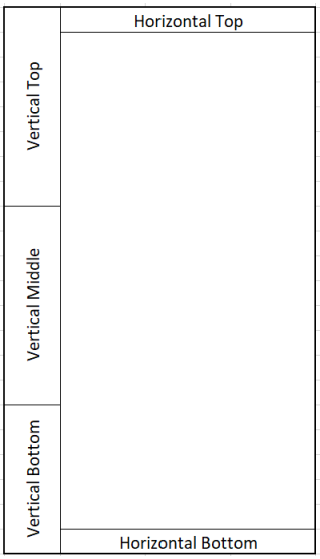

Figure 13: Relative PDU Positions for the Cable Matrix

With this background, before using the cable length planning matrix in Figure 14, customers should use the IBM Systems Environmental Estimator (SEE). With configuration details, this tool provides number of power jumper cords and current draw per power jumper. This can be used to verify that customer PDUs are sufficient and aid in completion of the PDU port planning worksheet.

Upon using the SEE, follow these steps to pick appropriate cable length for application:

- Read the cable matrix left to right.
- Choose an IBM component.
- Select the EIA location where it will be placed.
- Consult the matrix as shown in Figure 14 to find appropriate cable lengths.

	IBM Component	EIA Location	Horizontal PDU Bottom	Horizontal PDU Top	Vertical PDU Bottom	Vertical PDU Middle	Vertical PDU Top
Support Elements	SE 1 & SE 2	1-12U	2	3	1	1	2
		13-25U	3	3	1	1	2
		26-38U	3	3	2	1	1
		39-50U	3	2	3	2	1
Switches	SW 1 & SW 2	1-12U	2	3	1	1	3
		13-25U	3	3	1	1	2
		26-38U	3	3	2	1	1
		39-50U	3	2	3	2	1
CPCs	CPC 0	1-12U	2	3	1	1	3
		13-25U	3	3	1	1	2
		26-38U	3	3	2	1	1
		39-50U	3	2	3	2	1
	CPC 1	1-12U	2	3	1	1	3
		13-25U	3	3	1	1	2
		26-38U	3	3	2	1	1
		39-50U	3	2	3	2	1
IO Drawers	IO 1	1-12U	2	3	1	1	3
		13-25U	2	3	1	1	2
		26-38U	3	3	2	1	1
		39-50U	3	2	3	2	1
	IO 2	1-12U	n/a	n/a	n/a	n/a	n/a
		13-25U	3	3	1	1	2
		26-38U	3	3	2	1	1
		39-50U	3	3	3	2	1
	IO 3	1-12U	n/a	n/a	n/a	n/a	n/a
		13-25U	3	3	1	1	2
		26-38U	3	3	2	1	1
		39-50U	3	3	3	2	1

Figure 14: Cable Matrix For Length Identification

SMP Cables

SMP cables create the processor network by connecting the nodes of the CPC drawer.

Note: For PDU service actions, the hook-and-loop fastener that retains the SMP cable will need to be removed to release the cable, so they can be moved out of the way during servicing. DO NOT unplug the cable, but gently move it aside to make clearance for service activities.

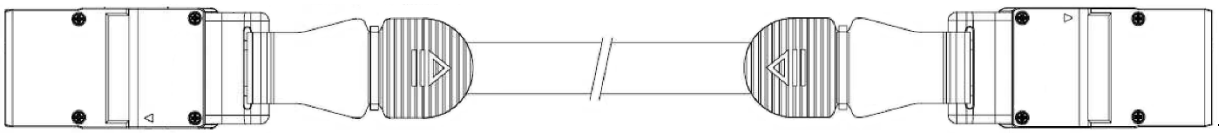

Figure 15: 2D Drawing of an SMP10 Cable

PCIe+ I/O Cables

PCIe+ I/O cables connect the CPC drawers to the PCIe+ I/O drawers.

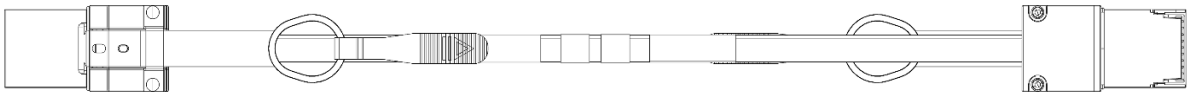

Figure 16: 2D Drawing of a PCIe+ I/O Cable

Chapter 4. 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, FCP, 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 and Fiber Optic Cabling Guide. When installing fiber optic cables, it is important to follow the recommended cleaning and installation procedures for optimal performance.

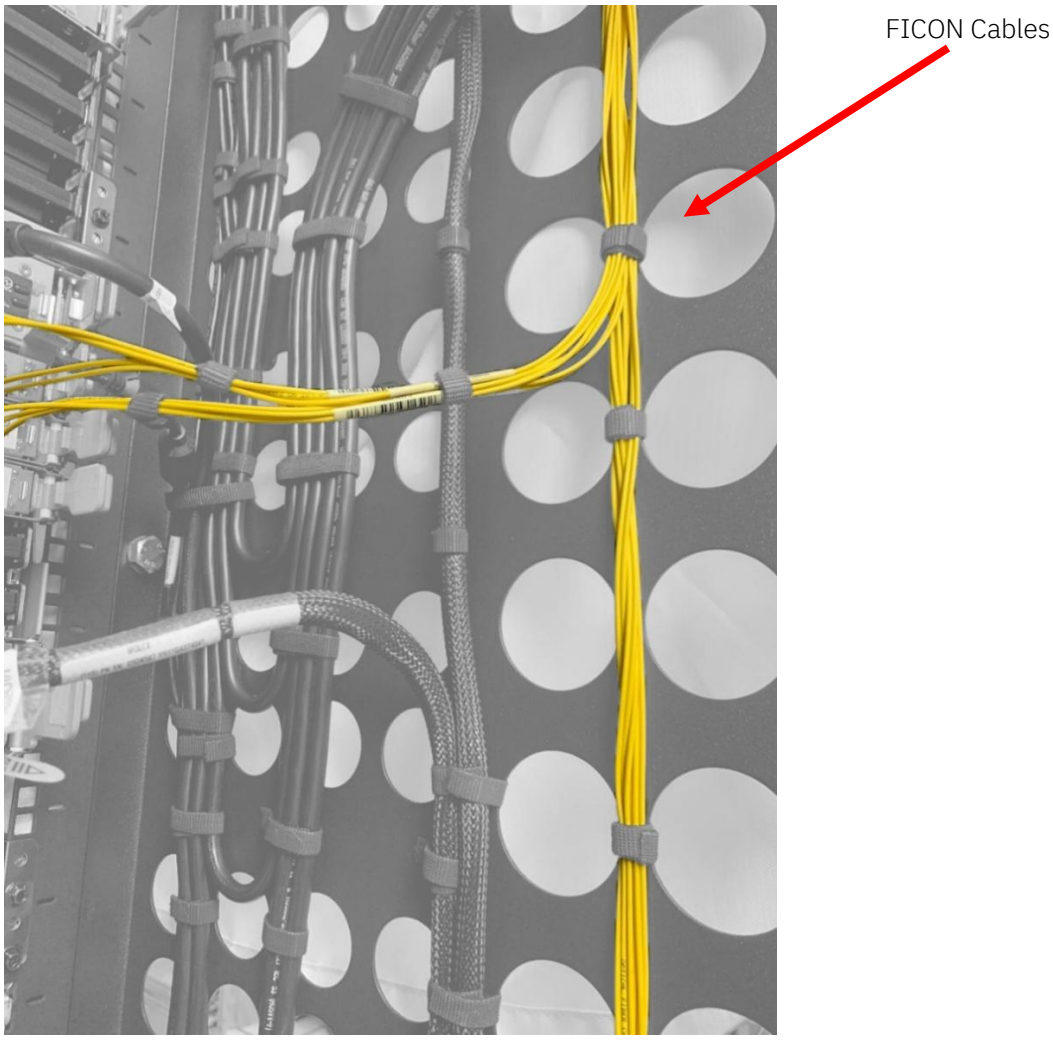

Figure 17: Example of FICON Routing

OSA Network Cables

Open Systems Adapter-Express (OSA-Express) features enable connectivity to industry-standard local area networks (LANs). These cables may either be fiber optic or copper (carry-forward FC only). They are to be routed on the outer most layer of cable types. This is done to ensure the integrity of the cable as they are the most fragile. Configuration information is found in the IMPP, and reference information is found in the Planning for Fiber Optic Links.

External Ethernet (HMC)

If a Hardware Management Console (HMC) is ordered, the customer must supply the necessary Ethernet cables to connect the remote HMC to the IBM Z system's Support Element (SE). These cables are routed either through the top or bottom of the system depending on the frame configuration.

System Time Synchronization

A Server Time Protocol (STP) Coordinated Timing Network (CTN) has the capability of connecting to an External Time Source (ETS) via either a Network Time Protocol (NTP) or a Precision Time Protocol (PTP). This capability requires at least an ETS ethernet cable connection but may additionally include a pulse-per-second (PPS) signal via coaxial cable to augment the timing accuracy. The ETS and PPS cables are both connected to the oscillator (OSC) cards at the front of the CPC drawer(s) (Figure 19 and 20), assuming the client network operates in a firmware partition within the CPC drawer.

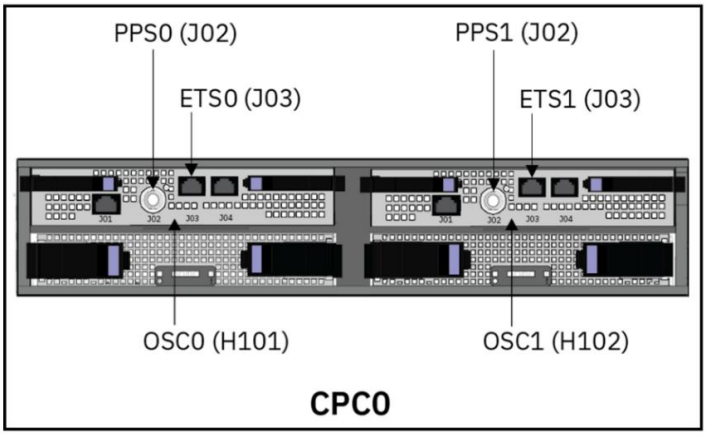

Figure 19: PPS Ports for One (1) CPC drawer

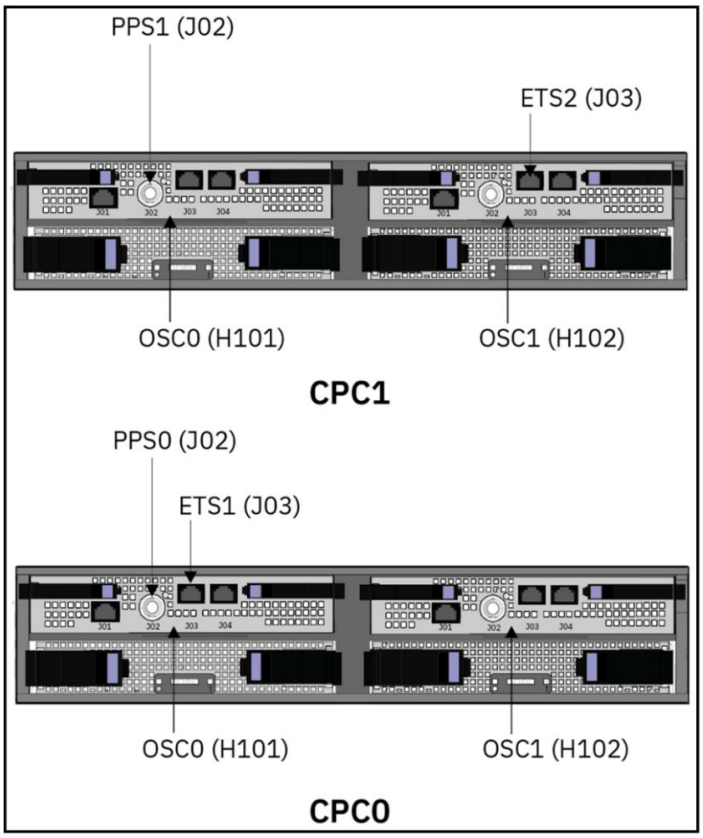

Figure 20: PPS Ports for Two (2) CPC drawers

When installing the PPS coaxial cable, caution must be followed as detailed in the Install Manual. The PPS cable shall use a 90-degree BNC connector (included in the Ship Group) that has a bare grounded outer barrel. The warning provided below shall be followed when plugging or unplugging the coaxial cable (also reference the procedure provided in the system's Install Manual).

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)

Figure 21: Grounding Warning

The ETS and PPS cables should be retained to the OSC card latches using hook-and-loop fasteners. Cables routed on the left side of the frame shall only plug to the left oscillator card. Cables routed on the right side of the frame shall only plug to the right oscillator card (Figure 22).

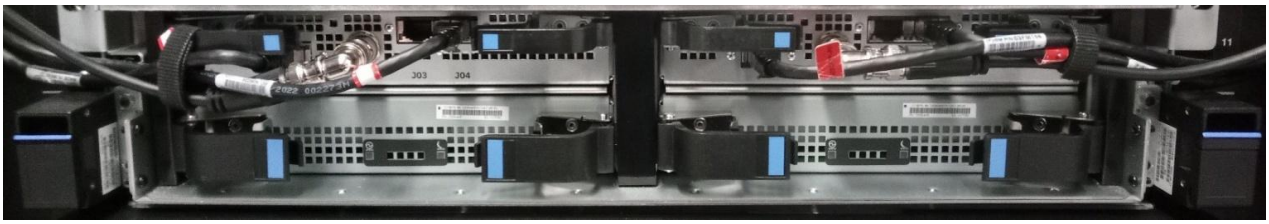

Figure 22: Front of CPC Drawer

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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

Japan Voluntary Control Council for Interference (VCCI) Notice

この装置は、クラスA機器です。 この装置を住宅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

Korea Notice

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

People's Republic of China Notice

警告:在居住环境中,运行此设备可能会造成无线电干扰。

Russia Notice

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

Kingdom of Saudi Arabia Notice

قد يتسبب هذا المنتج في حدوث تداخل إذا تم استخدامه في المناطق السكنية.

ويجب تجنب هذا الاستخدام ما لم يتخذ المستخدم تدابير خاصة لتقليل الانبعاثات الكهرومغناطيسية لمنع التداخل مع استقبال البث الإذاعي والتلفزيوني.

تحذير: هذا الجهاز متوافق مع الفئة أ من SASO CISPR 32

في البيئة السكنية، قد يتسبب هذا الجهاز في حدوث تداخل لاسلكي.

Taiwan Notice

CNS 13438:

警告使用者：此為甲類資訊技術設備，於居住環境中使用時，可能會造成射頻擾動，在此種情況下，使用者會被要求採取某些適當的對策。

CNS 15936:

警告：為避免電磁干擾，本產品不應安裝或使用於住宅環境。

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

United States Federal Communications Commission (FCC) Notice

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. Proper cables and connectors are available from IBM-authorized dealers. 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.

Responsible Party:
International Business Machines Corporation
New Orchard Road
Armonk, NY 10504
Contact for FCC compliance information only: fccinfo@us.ibm.com

United Kingdom Notice

This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.