



GigaIO™

FabreX™ System (Gen 4)

Deployment Guide

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1 Revision History

Rev.	Date	Description
1.01	07 Jan 2022	<ul style="list-style-type: none">▪ Updated "Related Documentation" section for the latest releases.▪ Updated the "FabreX System Component Overview" chapter to add the GigaIO Storage Pooling Appliance for Gen 4.▪ Updated the "Installing FabreX Components and Supported Hardware" chapter to add the GigaIO Storage Pooling Appliance for Gen 4.▪ Updated "Installing the FabreX Server Package" subsections to include Ubuntu installation instructions and also added AMD-based servers to iommu kernel arguments.▪ Updated "The host_list.json file" section to include FabreX software changes.
1.00	11 Oct 2021	Initial release.

2 About this Deployment Guide

This deployment guide is intended for users who are responsible for installing and configuring GigalO™ FabreX™ System components and software.

2.1 Related Documentation

Documentation available for FabreX™ Software (FXS), associated software tools, and hardware resources may be found on the [GigalO Support Portal](#) site (login and password are required to access). The Support Portal's [Documentation](#) site includes the following items.

Table 1. Related Documentation

Document Name	Description
GigalO™ 24-Port FabreX™ Switch User's Manual: Models RS4024/RS3024	24 Port, 1U, PCIe Switch installation and management interface instructions
GigalO™ 4-Port FabreX™ Network Adapter Card User's Manual: Models FA4004/FA3004	Details installation instructions and operational configurations
GigalO™ Storage Pooling Appliance User's Manual: Model RB4248	24 x16 slots, 2U, PCIe Gen 4 Storage Pooling Appliance (SPA) installation and management interface instructions
GigalO™ Accelerator Pooling Appliance User's Manual: Model RB4082	8 x16 slots, 5U, PCIe Gen 4 Accelerator Pooling Appliance (APA) installation and management interface instructions
GigalO™ FabreX™ Software (FXS) User's Manual	FabreX software installation, utilities and configuration tools for Composer, Leader and Maestro software solutions
GigalO™ Redfish® API, Release 2.4.0, User's Manual	FabreX-customized RESTful interface commands that conform to the DMTF Redfish® standard
GigalO™ FabreX™ Fabric Manager Developer Guide	FabreX software how-to guide on performing device discovery using composition examples from the GigalO Redfish API
Software Release Notes - FabreX™	The latest FabreX software changes, fixes, updates, and workarounds. FabreX is a PCIe-based fabric solution providing composability of IO resources and host-to-host communication

For registration and login, visit the [GigalO Support Portal](#). For other support assistance, email support@gigaio.com or call 1 (760) 487-8395.

2.2 Advisories

Displayed throughout this guide are advisories that offer helpful information or alert you to the risk of hardware damage or personal injury.

 **Info:** Offers the reader helpful tips, suggestions, or references to related material.

 **Tip:** Identifies information critical to equipment deployment.

 **Caution:** Tells the reader to be careful. It is a situation that could result in equipment damage or loss of data. Do not attempt to service this system except as explained in this deployment guide.

 **Warning:** Tells the reader about a potentially dangerous situation that could result in personal injury or damage to equipment.
Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard safety practices to prevent accidents.

2.3 Safety Guidelines

Before you begin installation process, review these safety guidelines to avoid injuring yourself or damaging the equipment.

Also, before configuring, maintaining, or replacing equipment, review the regulatory compliance and safety information warnings.

2.3.1 General Precautions

Observe the following general precautions for using and working with your product:

- Observe and follow service markings. Do not service any GigaIO product except as explained in your product documentation. Opening or removing covers that are marked with the triangular symbol with a lightning bolt might expose you to electrical shock. Components inside these compartments should be serviced only by an authorized service technician.
- If any of the following conditions occur, unplug the product from the electrical outlet and contact your authorized service provider:
 - The power cable or plug is damaged.
 - An object has fallen into the product.
 - The product has been exposed to water.
 - The product has been dropped or damaged.
 - The product does not operate correctly when you follow the operating instructions.
- Do not restrict air flow to the product's fans and vents.
- Never open the product to expose internal components. Opening the product voids the warranty.
- Do not service fans or power supplies without following the procedures described in this guide.
- Do not expose the product to heat or moisture exceeding the environmental limits for operation listed in the [General Specifications](#).

- Do not push any objects into the openings of your product. Doing so can cause fire or electric shock by shorting out interior components.
- Use the product only with other equipment approved by GigaIO.
- Use the correct external power source. Operate the product only from the type of power source indicated on the electrical ratings label. If you are not sure of the type of power source required, consult your service representative or local power company.
- Use only approved power cables. If you have not been provided with a power cable for your product or for any AC-powered option intended for your product, purchase a power cable that is approved for use in your country. The power cable must be rated for the product and for the voltage and current marked on the product's electrical ratings label. The voltage and current rating of the cable should be greater than the ratings marked on the product.
- To help prevent electric shock, plug the product and power cables into properly grounded electrical outlets. These cables are equipped with three-prong plugs to help ensure proper grounding. Do not use adapter plugs or remove the grounding prong from a cable. If you must use an extension cord, use a three-wire cord with properly grounded plugs.
- Observe extension cord and power strip ratings. Make sure that the total ampere rating of all products plugged into the extension cord or power strip does not exceed 80 percent of the extension cord or power strip ampere ratings limit.
- To help protect your product from sudden, transient increases and decreases in electrical power, use a surge suppressor, line conditioner, or uninterruptible power supply (UPS).
- Position cables and power cords carefully; route cables and the power cord and plug so that they cannot be stepped on or tripped over. Be sure that nothing rests or hangs on your product cables or power cord.
- Do not modify power cables or plugs. Consult a licensed electrician or your power company for site modifications. Always follow your local or national wiring rules.

2.3.2 Safety with Equipment

The following guidelines will help ensure your safety and protect the equipment. However, this list does not include all potentially hazardous situations, so be alert.

 Read the installation instructions before connecting the system to a power source.

- Always disconnect all power cords and interface cables before moving this product.
- Never assume that power is disconnected from a circuit; always check.
- Keep the product chassis area clear and dust-free before and after installation.
- Keep tools and components away from walk areas where you or others could fall over them.
- Do not work alone if potentially hazardous conditions exist.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.
- Do not wear loose clothing that might get caught in the product chassis.
- Wear safety glasses and ear protection when working under conditions that might be hazardous to your eyes and ears.

2.3.3 Safety with Electricity

The following guidelines will help ensure your safety and protect the equipment. However, this list does not include all potentially hazardous situations, so be alert.

⚠ This unit is intended for installation in restricted access areas accessible only through the use of a special tool, lock and key, or other means of security.

⚠ To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telephone-network voltage (TNV) circuits. LAN ports contain SELV circuits, and WAN ports contain TNV circuits. Some LAN and WAN ports both use RJ-45 connectors. Use caution when connecting cables.

⚠ Do not touch or remove the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is off and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected.

⚠ Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.

⚠ Before working on a chassis or working near power supplies, unplug the power cord on AC units; disconnect the power at the circuit breaker on DC units.

⚠ Do not work on the system or connect or disconnect cables during periods of lightning activity.

⚠ This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.

⚠ When installing or replacing the unit, the ground connection must always be made first and disconnected last.

Use the following guidelines when working on equipment powered by electricity:

- Locate the room's emergency power-off switch. Then, if an electrical accident occurs, you can quickly turn off the power.
- Disconnect all power before doing the following:
 - Working on or near power supplies
 - Installing or removing the product
 - Performing hardware upgrades
- Never install equipment that appears damaged.

- Carefully examine your work area for possible hazards, such as moist floors, ungrounded power extension cables, and missing safety grounds.
- Never assume that power is disconnected from a circuit; always check.
- Never perform any action that creates a potential hazard to people or makes the equipment unsafe.
- Never work alone when potentially hazardous conditions exist.
- If an electrical accident occurs, proceed as follows:
 - Use caution, and do not become a victim yourself.
 - Disconnect all power to the product.
 - If possible, send another person to get medical aid. Otherwise, determine the condition of the victim, and then call for help.
 - Determine whether the person needs rescue breathing, external cardiac compression, or other medical attention; then take appropriate action.

In addition, use the following guidelines when working with any equipment that is disconnected from a power source but still connected to network cabling:

- Never install network wiring during a lightning storm.
- Never install network plugs or jacks in wet locations.
- Never touch uninsulated network wires or terminals unless the network line is disconnected at the network interface.
- Use caution when installing or modifying network lines.

 **WARNING!** DO NOT REMOVE FabreX Switch COVER. OPENING THE COVER VOIDS WARRANTY. OPENING THE COVER EXPOSES POTENTIALLY DANGEROUS SITUATIONS THAT COULD RESULT IN PERSONAL INJURY OR DAMAGE TO EQUIPMENT.

2.3.4 Electrostatic Discharge Damage Prevention

Electrostatic discharge (ESD) can damage equipment and impair electrical circuitry. ESD can occur when electronic printed circuit cards are improperly handled and can cause complete or intermittent failures. Always follow ESD-prevention procedures when removing and replacing modules:

- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the anti-static packing material until you are ready to install the component in your product. Just before unwrapping the antistatic packaging, be sure to discharge static electricity from your body.
- When transporting a sensitive component, first place it in an antistatic container or packaging.
- Handle all sensitive components in a static-safe area. If possible, use anti-static floor pads and workbench pads.
- Ensure that the product is electrically connected to earth ground.
- Wear an ESD-preventive wrist strap, ensuring that it makes good skin contact. Connect the clip to an unpainted surface of the product to channel unwanted ESD voltages safely to ground. To guard against ESD damage and shocks, the wrist strap and cord must operate effectively.
- If no wrist strap is available, ground yourself by touching a metal part of the product.

 For the safety of your equipment periodically check the resistance value of the anti-static wrist strap. It should be between 1 and 10 Mohm.

2.3.5 Lifting Guidelines

- Before you install the product, ensure that your site is properly prepared so you can avoid having to move the product later to accommodate power sources and network connections.
- The FabreX Switch weighs approximately 15 to 25 pounds (6.8 to 11.3 kilograms). The product is not intended to be moved frequently. Whenever you lift the product or any heavy object, follow these guidelines:
 - Always disconnect all external cables before lifting or moving the product.
 - Ensure that your footing is solid, and balance the weight of the object between your feet.
 - Lift the product slowly; never move suddenly or twist your body as you lift.
 - Keep your back straight and lift with your legs, not your back. If you must bend down to lift the product, bend at the knees, not at the waist, to reduce the strain on your lower back muscles.
 - Lift the product from the bottom; grasp the underside of the product exterior with both hands.

2.4 Glossary

Table 2 . Glossary of Terms

Term	Definition
AOC	Active Optical Cable. PCIe fiber cable assembly.
APA	GigaIO Accelerator Pooling Appliance (formerly Add-in Card Resource Box)
CMI	Cable Management Interface. The 2-wire management interface for communication between subsystems. Details can be found in the PCI-SIG Express External Cabling Specification 3.x.
CMI Controller	CMI communications may be managed by a processor on the FabreX Network Adapter Card or by a processor at the opposing cable end.
composition-only mode	Composition mode is the ability to move PCIe resources (GPUs, accelerator cards, NVMe™ drives) from one host to another, meaning no host-to-host PCIe communication (like MPI, NVMe-oF, GDR, or IP over NTB).
Crosslink	A link between two Upstream ports or two Downstream ports, where the ports go through a process to determine which will act as the USP and which will act as the DSP. The crosslink is a physical layer option that works around the need for a defined upstream/downstream direction in the link training process. Another crosslink used is non-transparent endpoint (NT EP) to NT EP, where the crosslink is two USPs.
DAC	Direct Attached Cable. A common reference to copper cables versus active optical cables (AOC).
DSP	Downstream port is the port facing toward PCIe leaf segments (upstream port or endpoint).
EP	Endpoint. See Endpoint.

Term	Definition
Endpoint	<p>A device that resides at the bottom of the branches of the tree topology and implements a single Upstream Port toward the Root. For GigaIO FabreX, it is a device that connects to a fabric port without a Root Complex and Host Bridge. Endpoint is a device that doesn't extend the PCIe tree. PCI-SIG defines an "Endpoint" as "A Function that has a Type 00h Configuration Space header."</p> <p>Examples include GPU cards, NVMe drives, network adapters, RAID controller cards, PCIe switch cards, and so on.</p>
FabreX	A software defined PCIe network fabric developed by GigaIO, which consists of various hardware and software components.
FPGA	Field Programmable Gate Array are semiconductor devices built around an array of programmable logic blocks and a hierarchy of reconfigurable interconnects.
FXS	FabreX Software (formerly FabreX OS) is a software engine that drives the performance and dynamic composability of GigaIO software-defined infrastructure (SDI) for enterprise data centers and high-performance computing environments.
GDR	GPUDirect® RDMA enables a GPU application to be run over multiple servers with GPUs attached to them.
GUID	Global Unique IDentity is the complete model-dash number and serial number used to define the FabreX Switch.
HBA	Host Bus Adapter. When the FabreX Card is configured in Host Mode and installed in the host server.
HPC	High Performance Computing is the use of parallel processing for running advanced application programs efficiently, reliably and quickly.
Host Mode	See HBA
IO Switch	A switch with only an upstream port or a downstream port in every partition, which only connects to Edge Switches, hosts, I/O devices, and I/O expanders.
IPN	Internal port number is a 'logical' representation of one, two, or four physical switch ports used by FabreX Management Tools and Redfish for configuring downstream ports.
Lane	A "lane" is a PCI Express® term defined as "A set of differential signal pairs, a differential pair for transmission and a differential pair for reception."
Link	A communication link between Upstream and Downstream ports consisting of a set number of PCIe lanes (x1, x2, x4, x8, x16).
LTR	A Logical Topology Record is a file that has the names for server hosts and designate which switch and port each host connects.

Term	Definition
Mini-SAS HD	A SAS 3.0 connector type for either copper or optical cables. When used to describe a cable, it implies there are no side-band connections and therefore does not support CMI for PCIe.
MMIO	Memory Mapped I/O
MPICH	Message-Passing Interface CHameleon is a high performance and widely portable implementation of the MPI standard. GigaIO currently uses the MPICH 3.3 release.
Non-blocking	Internal bandwidth that can handle all the port bandwidths, at the same time, at full capacity.
NVMe-oF	Non-Volatile Memory over Fabrics uses a message-based model to communicate between the host computer and system over a network.
PCIe cable	A cable, with side-band connections for CMI, designed to meet the PCI-SIG External Cabling Specification 3.0.
Port	There are 24 PCIe cable ports on the FabreX Switch and four on the FabreX Network Adapter card. Each port consists of four lanes of PCIe Gen 4. Each port can be used to connect x4, x8 or x16 lanes of PCIe and serves as a receptacle for an x4 PCIe cable with a Mini-SAS HD connector.
Root Complex	A root complex device connects the processor and memory subsystem to the PCI Express switch fabric composed of one or more switch devices.
SDI	Software-defined infrastructure operates independently of hardware and is programmatically extensible.
SPA	GigaIO Storage Pooling Appliance (formerly U.2 Resource Box)
Switch Port	Physical connectors numbered 1-24 on the switch. Each switch port represents a x4 PCIe Gen 4 link. The switch ports can be grouped into x4, x8, or x16 PCIe for Gen 4 links.
TBA	Target Bus Adapter. When the FabreX Card is configured in Target Mode and installed in a downstream I/O expansion platform.
USP	Upstream port is the port facing toward the PCIe Root.

3 General Specifications

Table 3. FabreX Switch (Model RS4024) Specifications

Dimensions	17.4" (44.2 cm) Width x 1.75" (4.5 cm) Height x 15.3" (38 cm) depth
Width & Height	19" rack-mountable chassis, 1U
Management	Open systems FabreX Software (FXS) with DMTF Redfish [®] Composable APIs
Protocol	Industry standard PCI Express protocol
Architecture	Fully disaggregated with dynamic composability
Port Side	<p>24 Ports of x4 PCIe Gen 4 Links Ports configurable to attach to PCIe Endpoint:</p> <ul style="list-style-type: none"> ▪ With Root Complex Processor (RCP) ▪ Without RCP <p>2 one-Gigabit Ethernet (GbE) Ports 2 USB 2.0 Ports DisplayPort[®] (DP) LEDs for Stack Bifurcation, Link Status, and Activity for every port Power Switch with status indication Audio Alarm</p>
Power Side	IEC-320-C13 power receptacle; 100 to 240 VAC, 50 to 60 Hz; 75 Watts typical, 100 Watts Max.
Management CPU	Intel Atom [®]
Latency	24 Ports Non-Blocking port to port latency of less than 110 ns for PCIe Gen 4
Environmental	<p>Operating Temperature: 0°C to 45°C (32°F to 113°F) Storage Temperature: -25°C to 70°C (-13°F to 158°F) Relative Humidity: 5% to 95% (non-condensing)</p>
Safety and Compliance	<p>(RS4024 pending)</p> <ul style="list-style-type: none"> ▪ CE Mark / UL / CSA / CB ▪ Compliance with EN-60950-1 (2005-13), EN-55022 (2010), EN-55024 (2010), EN-61000-6-2 (2005), Class A. ▪ FCC Class A ▪ RoHS ▪ WEEE compliant
Weight (net)	15 lb. (6.80 kg) with dual power supplies
Fail Over	N+1 with Multi-Switch configurations

Scalable	Topologies – Star, Mesh or Tree with Multi-switch configurations. See Support Portal for supported Topologies.
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Table 4. FabreX Network Adapter Card (Model FA4004) Specifications

PCI Specification	Meets PCI Express Base Specification (Rev. 4.0), CEM Specification (Rev. 3.0), and External Cabling Specification R3.0 (Version 1.0).
Dimensions	Low profile, half-height PCIe card 68.9 mm x 167.65 mm
Ports	4 x4 PCIe Gen 4 ports supporting x16, x8, or x4 configurations
Indicators	Four (4) LED status indicators for status. External port numbers 1 through 4 marked on the bracket.
Host & Target	Configurable card for both transparent host and target modes.
Connectors & Cables	PCIe x16 edge connector for installation in x16 slots PCIe connectors, four Mini-SAS HD (SFF-8644) with side-band Copper cables up to 3 meters Cable Management Interface (CMI) on cable ports Active Optical Cable (AOC) up to 100 meters
Power	15 Watts typical, 20 Watts Max. (Max. = all 4 ports with Active Optical Cable)
PCIe Bracket	Half height & full height brackets included
Environmental	Operating temperature: 0°C to 50°C (32°F to 122°F) Air Flow: 10 LFM Relative humidity: 5% to 95% (non-condensing)
Regulatory	Agency Certifications (pending for FA4004): <ul style="list-style-type: none"> ▪ CE Mark ▪ EN55032 ▪ EN55024 Class A ▪ FCC 15 Subpart B Class A ▪ RoHS ▪ WEEE

Table 5. Storage Pooling Appliance (Model RB4248) Gen 4 Specifications

PCI Express Bus Specification	Meets PCI Express Base Specification (Rev. 4.0)
Enclosure	2U rack-mounted NVMe storage enclosure that supports 24 NVMe SSDs.
Dimensions	17.5" W x 21" D (446 x 540mm)
Weight (net)	58.4 lbs. (26.5 kg), with rack rails and 24 drive carriers (no drives installed)
NVMe Drive	<p>Front access NVMe drive Up to 24 2.5" (U.2) PCIe Gen 4 NVMe SSDs Dual-ported, x2 + x2 PCIe lanes per SSD</p> <ul style="list-style-type: none"> ▪ Samsung PM1733 <p>Individual power control</p>
Canister	<p>1+1 redundant Eight 4X ports (SFF-8644) for external connectivity RJ45 Management Port (for BMC connectivity) USB Type-C Debug port</p>
Cables	Connect to FabreX Switches and Adapter Cards using PCIe Gen 4 Copper or Active Optical Cable
Power	<p>900W, 1+1 redundant Hot-pluggable from rear of chassis System input: 89 to 264V AC input, auto ranging 47~63HZ High efficiency (80Plus Platinum Level) Integrated fans for PSU and Canister cooling controlled by internal microcontroller N+1 fan failure support</p>
Environmental	<p>1°C to 35°C; relative humidity 10% to 90%, 0 to 10,000 feet above sea level Storage: -40 to 85°C; relative humidity 5% to 96%, 0 to 50,000 feet above sea level Ambient Temperature: 5°C to 40°C Maximum Temperature Gradient: 20°C per hour Ambient Non-Operating: -40°C to 60°C</p> <p>Ambient Operating (non-condensing) Relative Humidity: 8% to 85% Ambient Non-operating (non-condensing) Relative Humidity: 8% to 95%</p>
Regulatory	<p>Agency Certifications (pending for RB4248):</p> <ul style="list-style-type: none"> ▪ EMC: FCC Part 15 Subpart B Class A. ICES-003 ▪ Class A. EN 55032 Class A, EN 61000-3-2, ▪ EN 61000-3-3, EN 300386, EN 55024, EN 55035, ▪ EN 61000-4-3, EN 61000-4-4, IEC 61000-4-5, ▪ IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11, VCCI-CISPR32, VCCI-32-1

Table 6. Accelerator Pooling Appliance (Model RB4082) Specifications

PCI Express Bus Specification	Meets PCI Express Base Specification (Rev. 4.0)
Dimensions	5U: 8.6" (21.9 cm) H x 17.12" (43.5 cm) W x 18.35" (46.63 cm) D
Weight (net)	62 lbs. (28 kg), with target adapters, power cables and rack rails (no add-in cards installed)
Enclosure	<p>Two Drawers; four (4) PCIe 4.0 x16 double width, full-height, GPU length, per drawer. Supports 8 double-wide, passive accelerators, 250 Watts each. Qualified accelerators include Nvidia A100, RTX6000/8000 and Xilinx U250.</p> <p>Bottom Riser Cage: Two (2) PCIe 4.0 x16 low-profile, half-length slots for upstream connections only.</p> <p>Top Riser Cage: Two (2) PCIe 4.0 x16 low-profile, half-length slots for either additional add-in cards, or for two (2) additional PCIe 4.0 x16 upstream connections (optional).</p>
BMC/mCPU	Aspeed AST2500
Status Display	16 x 2 matrix LCD Display status and key information
Cables	Connect to the FabreX Switches and Adapter Cards with copper cables; 0.5, 1.0, 2.0 or 3.0 meters in length. Four per x16 upstream connections.
Cooling	Six 120 x 38 mm fans; hot-swappable with high-reliability
Power	<p>Standard (total power): 2000 Watts with 100 to 120 VAC source, and 3200 Watts with 200 to 240 VAC source, at 47 to 63 Hz.</p> <p>Optional (2+2) redundant (total power): 4000 Watts with 100 to 120 VAC source, and 6400 Watts with 200 to 240 VAC source, at 47 to 63 Hz.</p> <p>Auxiliary Accelerator Power Connections: 8, 8-pin male EPS12V connectors, 4 per drawer. Supports +12V power requirements of approved (300W) accelerators, such as Nvidia A100 and RTX 6000/8000.</p>
Environmental	<p>Operating Temperature: 0°C ~ 35°C (50°F ~ 95°F)</p> <p>Non-operating Temperature: -20°C to 70°C (-4°F to 158°F)</p> <p>Operating Relative Humidity: 10% to 90% (non-condensing)</p> <p>Non-operating Relative Humidity: 0% to 95% (non-condensing)</p>
Regulatory	<p>Agency Certifications:</p> <ul style="list-style-type: none"> ▪ AS/NZS CISPR32, class A ▪ EN 55032, class A, EN 55024, EN 61000-3-2, and EN 61000-3-3 ▪ FCC Part15B, class A ▪ RoHS Directive 2011/65/EU

Table 7 . FabreX Cable Gen 4 Specifications

Cables	Copper cables in lengths of 0.5, 1.0, 2.0, and 3.0 meters
	Cable Management Interface (CMI) support
	Active Optical Cable (AOC) up to 10 meters, no CMI
Configurations	x4, x8, or x16
Connectors	PCIe connectors (SFF-8644)

Table 8 . FabreX Switch Gen 4 Bandwidth Specifications

Lane	24 Ports Gen 4 Non-Blocking (Gbits/sec)	
	Half-Duplex	Full-Duplex
x4	64 Gb/s	128 Gb/s
x8	128 Gb/s	256 Gb/s
x16	256 Gb/s	512 Gb/s
Throughput ¹	1,536 Gb/s	3,072 Gb/s

1-Aggregate bandwidth though all ports.

4 System Requirements

The following table lists the requirements necessary to support the FabreX System on a host server.

Table 9 . System Requirements

Requirement	Description
Processor	Intel Xeon E5-2603 1.6 MHz or higher
Memory	64GB DDR4, or more if need by other devices installed in host
Storage space	50 GB free space available
Ethernet	10/100/1000 MB Ethernet port
PCIe	One open PCIe x16, Gen 4, card slot for one HHL PCIe Network Adapter Card
FabreX Software	Version 2.4.x
Operating System	CentOS 7 or Ubuntu Released Versions Visit Software Releases on the GigaIO Service Desk for the latest customer release notes listing changes and updates to supported operating system distributions and kernels.

5 Server Compatibility

5.1 Basic Functionality

For servers connecting FabreX equipment to compose IO resources (NVMe, GPU, FPGA, and/or accelerators cards), the only requirement is a x86 based server with the ability to enumerate the target devices. The BIOS should support the amount of desired IO resources to be connected. As the number of supported devices may vary from server to server, upon request GigaIO representatives can provide a tool to help quantify the server's PCIe characteristics.

5.2 Characterized Systems

The following table lists a subset of servers characterized by GigaIO labs, along with the enumeration limits calculated based on I/O space.

i Note that where listed, SPA is the GigaIO Storage Pooling Appliance (formerly U.2 Resource Box), and APA is the Accelerator Pooling Appliance (formerly AIC or Add-in Card Resource Box).
Due to how each server allocates I/O space, along with differences in resource requirements, actual results may vary slightly from the theoretical maximum.

Table 10 . Server Characteristics Example

Server	I/O Space	Enumeration Limits
Intel® S2600WF0 Intel® Xeon® Gold 5115 CPU @ 2.40GHz	64-bit MMIO Size: 1024 GB 32-bit MMIO Size: 216 MB IO Space Available: 8 KB Total PCI Bus Count: 35 Available Buses for NVMe and GPU devices: 27	Max SPA (up to 24 NVMe Drives): 1 Max APA (up to 8 GPUs each): 1 <ul style="list-style-type: none"> ▪ Max GPUs (limited by 32-bit MMIO Space): 6 ▪ Max GPUs that require IO Space: 2
SUPERMICRO SYS-5019P-M Intel® Xeon® Gold 5115. 2.40GHz (Skylake)	64bit MMIO Size: 1024 GB 32-bit MMIO Size: 432 MB IO Space Available: 16 KB Total PCI Bus Count: 78 Available Buses for NVMe and GPU devices: 58	Max SPA (up to 24 NVMe Drives): 2 Max APA (up to 8 GPUs each): 2 <ul style="list-style-type: none"> ▪ Max GPUs (limited by 32-bit MMIO Space): 13 ▪ Max GPUs that require IO Space: 4
SUPERMICRO 1019GP-TT-OTO-20 Intel® Xeon® Silver 4110 CPU @ 2.10GHz	64-bit MMIO Size: 1024 GB 32-bit MMIO Size: 432 MB IO Space Available: 16 KB Total PCI Bus Count: 78 Available Buses for NVMe and GPU devices: 69	Max SPA (up to 24 NVMe Drives): 2 Max APA (up to 8 GPUs each): 2 <ul style="list-style-type: none"> ▪ Max GPUs (limited by 32-bit MMIO Space): 13 ▪ Max GPUs that require IO Space: 4

Server	I/O Space	Enumeration Limits
SUPERMICRO 1019GP-TT-OTO-20 Intel® Xeon® Silver 4208 CPU @ 2.10GHz	64-bit MMIO Size: 1024 GB 32-bit MMIO Size: 432 MB IO Space Available: 16 KB Total PCI Bus Count: 78 Available Buses for NVME and GPU devices: 69	Max SPA (up to 24 NVME Drives): 2 Max APA (up to 8 GPUs each): 2 <ul style="list-style-type: none"> Max GPUs (limited by 32-bit MMIO Space): 13 Max GPUs that require IO Space: 4
Lenovo® Thinkserver® RD350 (70D6) Intel® Xeon® CPU E5-2640 v4 @ 2.40GHz	64-bit MMIO Size: 256 GB 32-bit MMIO Size: 1727 MB IO Space Available: 63 KB Total PCI Bus Count: 256 Available Buses for NVME and GPU devices: 247	Max SPA (up to 24 NVME Drives): 9 Max APA (up to 8 GPUs each): 7 <ul style="list-style-type: none"> Max. GPUs (limited by 32-bit MMIO Space): 53 Max GPUs that require IO Space: 15
HPE ProLiant DL380 Gen9 Intel® Xeon® CPU E5-2640 v4 @ 2.40GHz	64-bit MMIO Size: 128 GB 32-bit MMIO Size: 1727 MB IO Space Available: 63 KB Total PCI Bus Count: 256 Available Buses for NVME and GPU devices: 247	Max SPA (up to 24 NVME Drives): 9 Max APA (up to 8 GPUs each): 7 <ul style="list-style-type: none"> Max GPUs (limited by 32-bit MMIO Space): 53 Max GPUs that require IO Space: 15

5.3 Advanced Features

The advanced features include MPI/HPC, NVMe-oF, and GDR (GPU Direct RDMA) applications. For these features, the server needs to support the following:

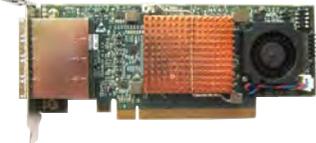
- IOMMU enable / Intel VT for Directed I.O (VT-d) enabled

For best results it is recommended to use the following Memory Mapped I/O (MMIO) settings. To locate where to set these values in the BIOS, see the server documentation from the manufacturer.

- Memory Mapped I/O (MMIO) above 4 GB enabled
- Memory Mapped I/O (MMIO) memory base = 56 TB
- Memory Mapped I/O (MMIO) High Size = 1024 GB
- Memory Mapped Configuration (MMCFG) Base = 2 GB

6 FabreX System Component Overview

Table 11 . GigaIO FabreX System Components

Component	Description
<p>FabreX Switch</p> <p>Power side</p>  <p>Port side</p> 	<p>1U rack component containing several PCIe switches to which external PCIe devices connect</p> <p>Fits in a standard 19" rack</p> <p>Variable length rack slides/fixed ear support from back panel</p> <p>Dual/redundant hot swap PSUs and removable fan tray</p>
<p>FabreX Network Adapter Card</p> 	<p>Half height, half length (HHHL) card enables cable connections from Host to the FabreX Switch</p> <p>The number of FabreX Cards supplied depends on the configuration</p> <p>Each Host requires one FabreX Card</p>
<p>GigaIO Storage Pooling Appliance (Gen 4)</p> 	<p>2U Storage Pooling Appliance (formerly, the U.2 Resource Box)</p> <p>Supports PCIe Gen 4 on 24 dual-ported U.2 NVMe SSD drives</p> <p>More than 350TB capacity</p> <p>Dual/redundant hot swap PSUs</p>
<p>GigaIO Accelerator Pooling Appliance</p> 	<p>5U Accelerator Pooling Appliance (formerly Add-in Card Resource Box)</p> <p>Up to 8 double-wide PCIe slots (4 per drawer) to support GPUs, FPGAs, NVMe, or other accelerator cards</p> <p>Riser Cages:</p> <ul style="list-style-type: none"> ▪ Bottom: Two (2) PCIe 4.0 x16 low-profile, half-length slots for upstream connections only. ▪ Top: Two (2) PCIe 4.0 x16 low-profile, half-length slots for either additional add-in cards, or for two (2) additional PCIe 4.0 x16 upstream connections (optional). <p>Two (standard) or four (optional 2+2) PSUs</p> <p>LCD with 16 x 2 matrix for status and key information</p> <p>Eight 5-inch: 8-pin male to 8-pin male auxiliary power cables</p> <p>Six 120 x 38 mm hot-swap fans</p>

Component	Description
<p>FabreX Cable (PCIe Gen 4, SFF-8644)</p> 	<p>Connects supported hardware to the FabreX Switch The number of cables supplied and how they are connected depends on the configuration.</p>

6.1 FabreX Switch

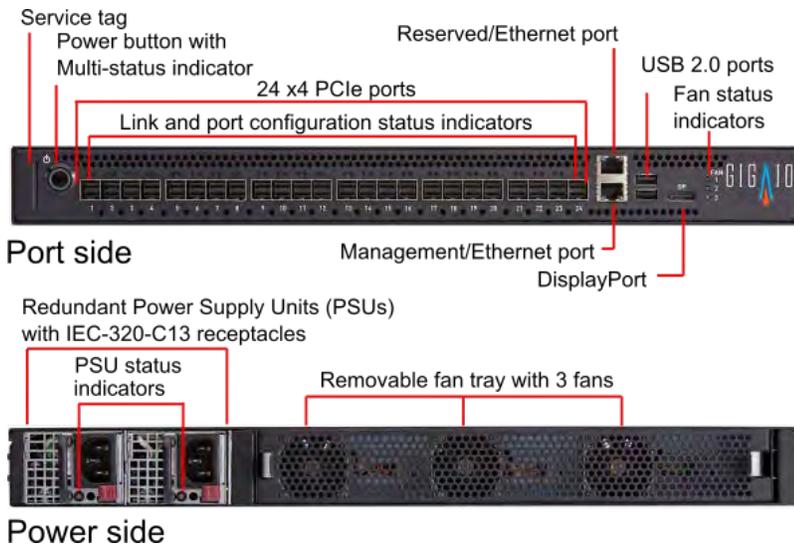


Figure 1 . FabreX Switch Port Side and Power Side panel components

i Connectors on the FabreX Switch port side support a standard USB keyboard and mouse, as well as a DisplayPort video connector. LAN ports enable access, switch management, and software upgrades.

PCIe Lane Width and Ports

The 24 PCIe Gen 4 (model RS4024) ports shown in the figure are physically arranged on the Port Side of the FabreX Switch. Each connector socket represents a single by-four (x4) port.

- Each port represents four PCIe lanes, meaning a port minimally offers a by-four (x4) PCIe connection.
- Adjacent ports grouped into 4 ports (1-4, 5-8, 9-12, 13-16, 17-20, 21-24) provide x16 PCIe connections.
- Adjacent ports grouped as 2 ports (1-2, 3-4, ..., 21-22, 23-24) provide x8 PCIe connections.

6.2 FabreX Network Adapter Card

The FabreX Network Adapter Card (or FabreX Card) is a PCIe host bus adapter card contains four ports and four status indicators. Model FA4004, supporting PCIe Gen 4, has one bank of four DIP Switches to set modes of operation. By default, the card is configured for Host Mode. Check the DIP switch settings for Host Mode (switches 1/2 On and 3/4 Off) prior to installation.

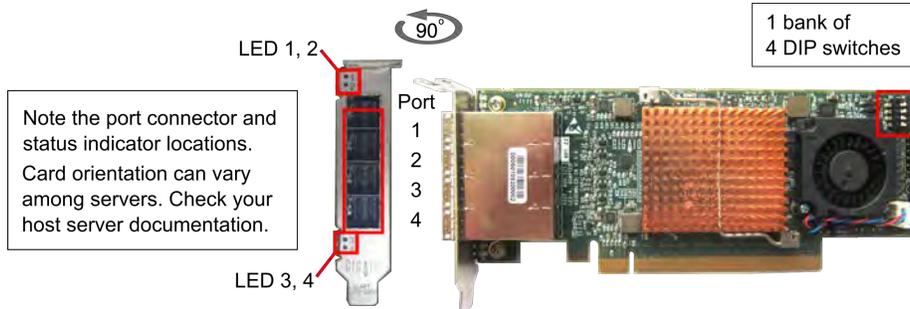


Figure 2 . FabreX Network Adapter Card Components

6.3 GigaIO Storage Pooling Appliance Gen 4

The GigaIO Storage Pooling Appliance for PCIe Gen 4 has two switch canisters, each with eight ports that number from 1 to 8.

- ✔ Note how each port location is numbered in the following figure.

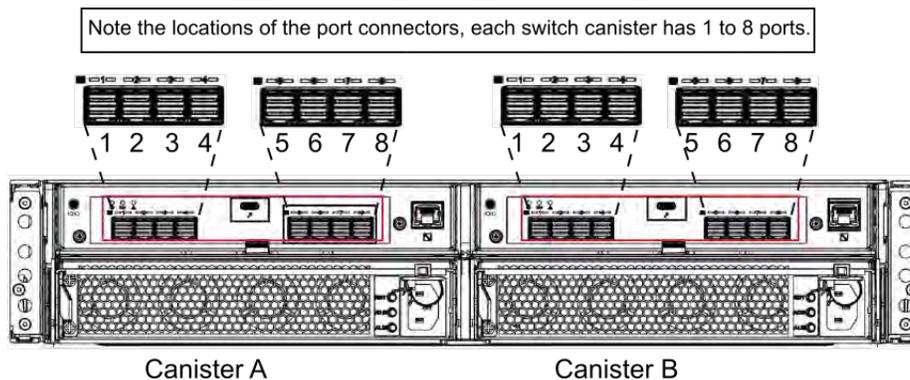


Figure 3 . SPA Gen 4 Port Order

Reference cabling between the FabreX Switch and the Storage Pooling Appliance (SPA) are shown in the following illustrations. The FabreX Switch should use the following partition configuration. For details on these and other partition configurations, see the *GigaIO™ Storage Pooling Appliance User's Manual: Model RB4248*.

- ✔ Use cables of the same length (0.5, 1.0, 2.0, or 3.0 meters) when connecting a device. For example, if connecting four cables (x16) make sure the cable length for each connection is the same. The x16 lane connection must use four cables of the same length

- ❗ The FabreX Switch should be loaded with a topology that supports the following partition configuration example. For instance, the 1S-2x4-1 or 1S-2x4-X1 topology listed on GigaIO Support Portal [Topologies](#) page.

6.3.1 Storage Pooling Appliance Gen 4 Partition Configuration

There are two partitions to the configuration. Each partition contains one x16 USP and 12 SSDs. The PCIe cabling is shown color-coded for easy reference.

- ✅ Use cables of the same length cables when connecting to a device.

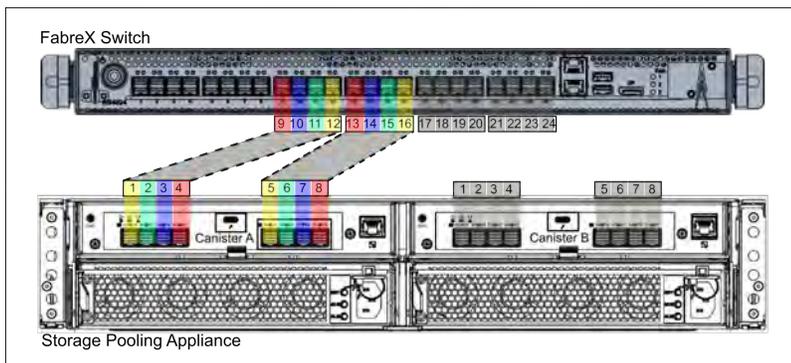


Figure 4 . SPA Gen 4 Reference Cabling for Partition Configuration

6.4 GigaIO Accelerator Pooling Appliance

The GigaIO Accelerator Pooling Appliance is available with two or four cards. Upstream x16 connections are provided using either FabreX PCIe Adapter cards in Target Mode, or Target Re-timer cards. The riser cage left (**1:H1** and **1:H2**) and right (**2:H1** and **2:H2**) halves interconnect to drawer **1** and **2**, respectively. The bottom riser cage is used exclusively for upstream x16 PCIe connections to GigaIO FabreX switch(es). The top riser cage's two x16 slots can be used for any half-height, half-length PCIe resource, such as single-wide accelerator or high-performance storage (NVMe) cards, or two additional FabreX cards for a total of four (4) upstream x16 PCIe connections.

GigaIO PCIe cables connect ports from these cards to the FabreX switch in a top down, 1 through 4 order, where port 1 is at the top of the card and port 4 is at the bottom of the card, as indicated on the FabreX adapter cards' PCIe bracket, or as shown on the port numbering label attached to the lid of the RB4082 APA.

- ❗ The following figure shows the PCIe cards and port connector locations for a four-card configuration.

- ✅ Use cables of the same length cables when connecting to a device.

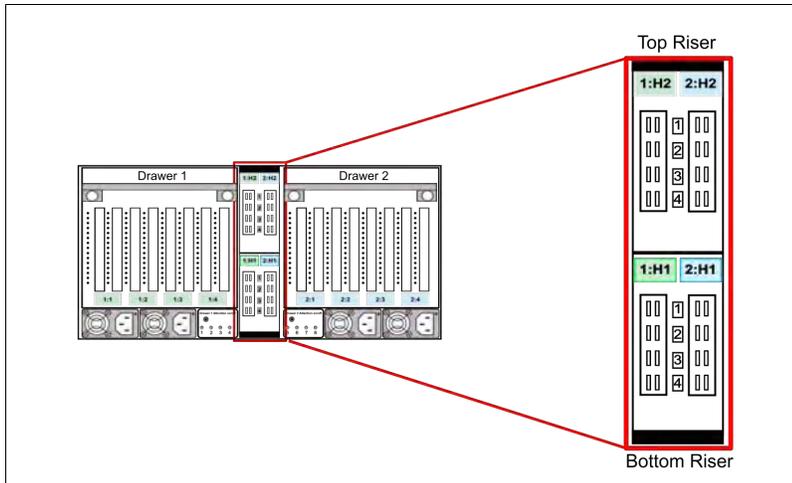


Figure 5 . GigaIO Accelerator Pooling Appliance PCIe Cards and Port Connectors

6.5 Sample Topology

The following figure shows FabreX System components in a sample topology, including a PCIe Gen 4 FabreX Switch with four host servers, one Storage Pooling Appliance, and one Accelerator Pooling Appliance. For supported configurations, visit [Topologies](#) on the GigaIO Service Desk.

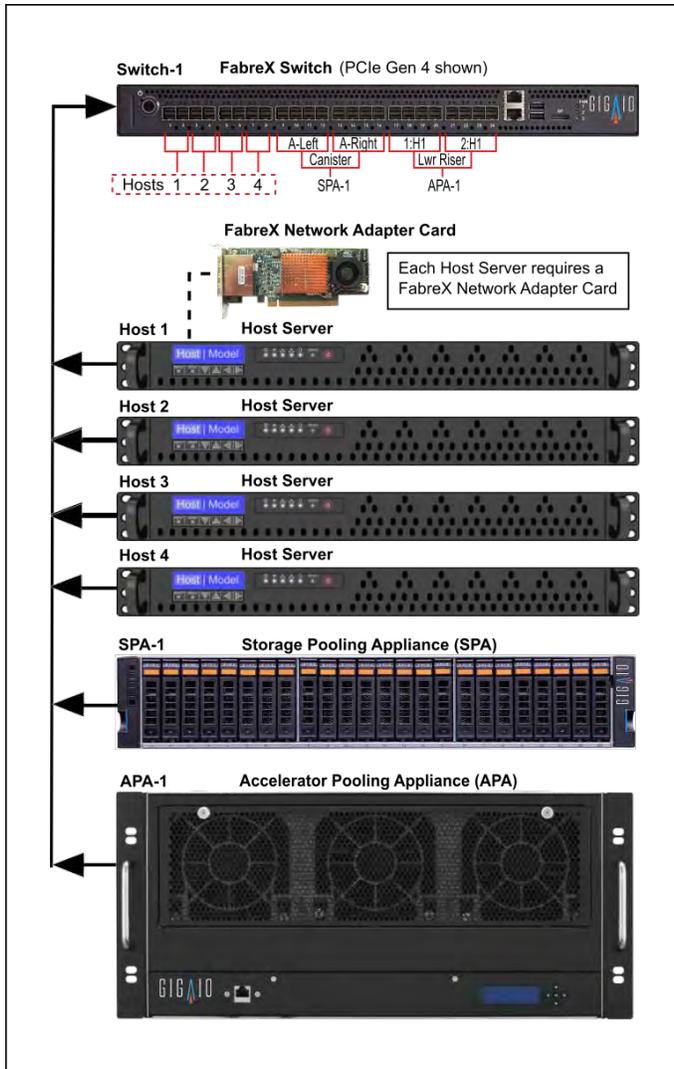


Figure 6 . FabreX System and Supported Hardware

7 Installing FabreX Components and Supported Hardware

7.1 Installing FabreX Cards in a Host Server

To install the FabreX Cards in a Host Server, use the following instructions.

- ⚠ Before handling FabreX Cards, make sure you are properly grounded to avoid static discharge that may damage the card. Follow standard ESD safety procedures.

- Using the following figure, ensure that the DIP switches on the FabreX Card (Model FA4004) are set to Host Mode.

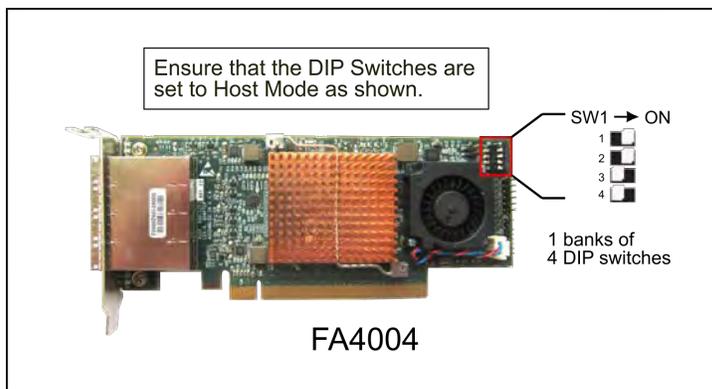


Figure 7 . FabreX Card DIP Switch Settings

- Follow the manufacturer's instructions for the host server when installing a FabreX Card into an open PCIe x16 slot. Use even pressure on the card edge until the card is secure in its slot. Install the bracket screw to hold the card in place.

7.2 Installing Hardware into the Rack

Before installing hardware into a rack, consider that there are a variety of standard topologies available. See [Topologies](#) on the GigaIO Service Desk. The GigaCell x8 topology previously shown demonstrates how each of the available components are installed and connected. These same steps apply to any topology constructed, except for cable connections made to the FabreX Switch. Be sure to check the topology before starting to know the necessary cable connections to the switch.

It is important to understand cable connections between the FabreX Switch and the hosts (or IO appliances) must be in the proper port-order for all PCIe lanes to link. In most cases it is a one-to-one relationship based on the switch's connection topology. In the following example, x16 Switch Stack 1 (ports 1 to 4) connects to the host's (ports 1 to 4). A link failure may result if the connections are reversed (ports 1 to 4 to ports 4 to 1), mixed, or swapped.

For a topology with two x8 connections at Switch Stack 1, Switch port group 1 and 2 will connect to host or appliance target ports 1 and 2. Switch Stack 1, port group 3 and 4, connect to ports 1 and 2 of the next sequential host or appliance's ports.

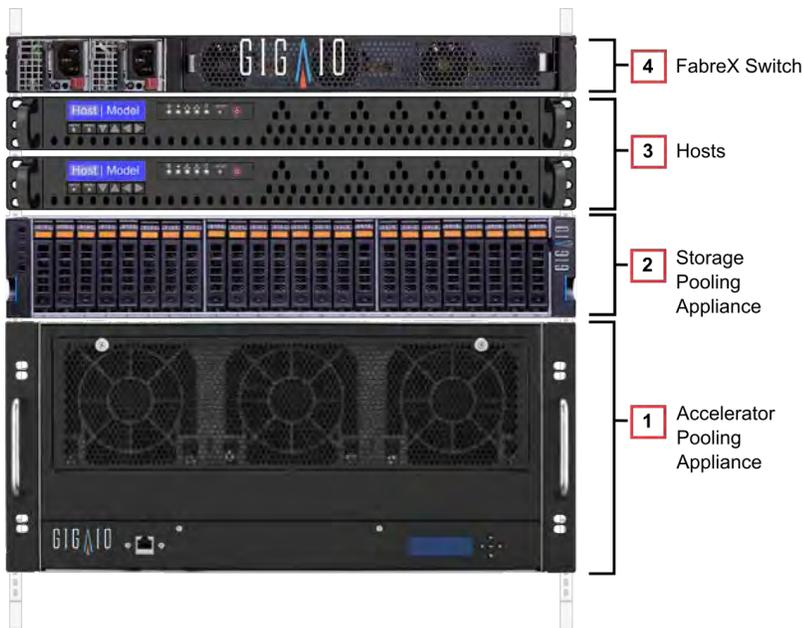


Figure 8 . FabreX System Rack Component Installation

Within the 19-inch rack, install the components in position in the following order:

1. **Accelerator Pooling Appliance (APA)**
2. **Storage Pooling Appliance (SPA)**
3. **Hosts**
4. **FabreX Switch**

7.3 Connecting Hardware PCIe Cables to the FabreX Switch

7.3.1 Prerequisites

The following table lists the number of cables needed for each lane width and the PCIe Gen 4 reference bandwidth in gigabits per second for half-duplex and full-duplex connections,

Table 12 . FabreX Switch Gen 4 Cabling Requirements

Lane	Cable Quantity	Gen 4 (Gbits/sec)	
		Half-Duplex	Full-Duplex
x4	1	64 Gb/s	128 Gb/s
x8	2	128 Gb/s	256 Gb/s
x16	4	256 Gb/s	512 Gb/s

When connecting IO resources and Host Servers to the FabreX Switch, connect the devices in the following order:

1. **Hosts**
2. **Storage Pooling Appliance**
3. **Accelerator Pooling Appliance**

7.3.2 Step 1: Connecting Hosts to the FabreX Switch

Use the following figure to connect Hosts to the FabreX Switch.

i When you are connecting x16 PCIe links, ensure that the Switch Ports used to connect are from the same group of four on the switch. The following example connects Host-1 to Switch Ports 1 to 4 and Host-2 to Switch Ports 5 to 8.

✓ Use cables of the same length cables when connecting a device.

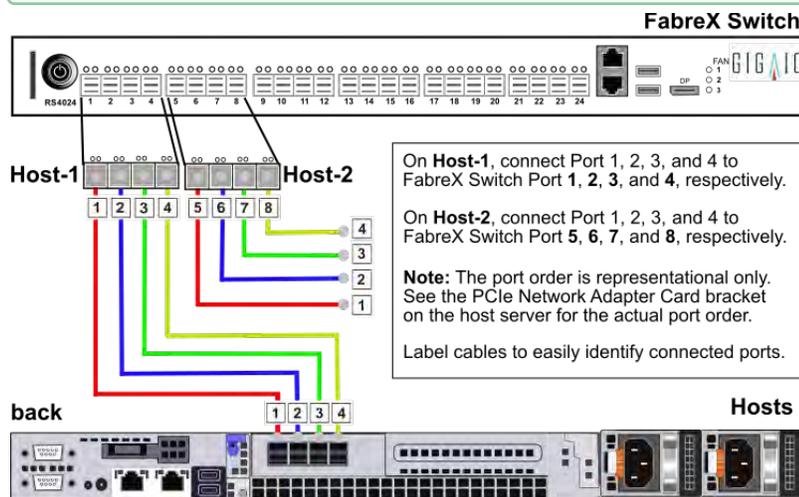


Figure 9 . Hosts to FabreX Switch Port connections

7.3.3 Step 2: Connecting the Storage Pooling Appliance to the FabreX Switch

Use the following figure to connect the GigaIO Storage Pooling Appliance PCIe Gen 4 (SPA RB4248) to the FabreX Switch.

i When connecting x16 PCIe links, ensure that the Switch Ports used to connect are from the same group of four on the switch.

The following example connects Ports 1 through 4 on SPA Canister A to Switch Ports 9 through 12 (stack 3), and Ports 5 through 8 on SPA Canister A to Switch Ports 13 through 16 (stack 4).

✓ Use cables of the same length cables when connecting a device.

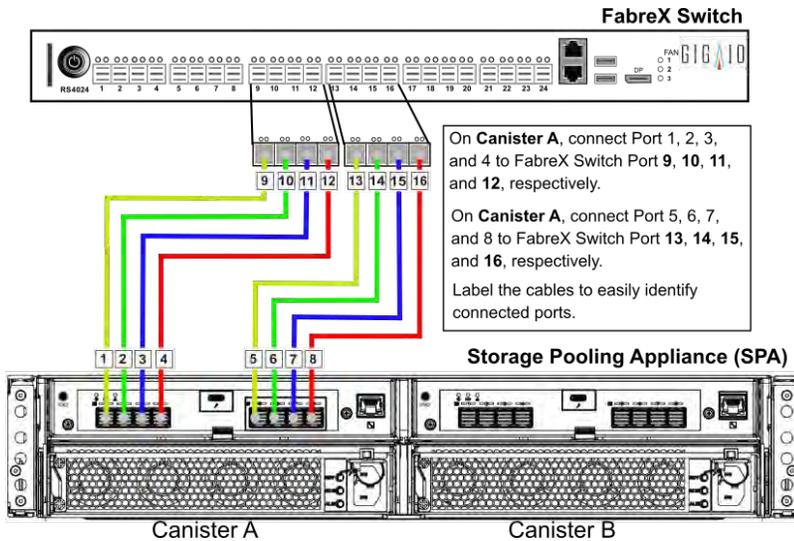


Figure 10 . SPA RB4248 to FabreX Switch Port connections

7.3.4 Step 3: Connecting the Accelerator Pooling Appliance to the FabreX Switch

The Accelerator Pooling Appliance, Model RB4082 or (RB4082 APA) includes two or four target adapter cards for upstream connection to the FabreX Switch.

- When two target cards are installed, the APA provides basic fanout functionality, with up to four add-in cards (GPUs) linked per target card. This two-card APA configuration is referred to as Standard Mode.
- When four target adapter cards are installed, the APA has the ability to allocate from one to four add-in cards per target card, allowing higher utilization of resources. The four-card APA configuration is referred to as Advanced (fabric) Mode.

An APA with four target adapters installed can be configured for either Standard or Advanced Mode via the management interface. The target cards available for the RB4082 APA can include the FabreX Adapter (switch-based) or Re-timer cards, depending on the RB4082 APA model purchased.

i When connecting x16 PCIe links, ensure that the Switch Ports used to connect are from the same stack (group of four) on the switch. See the GigaCell x16 switch topology used for these examples. Refer to the following figure for port numbers. There is also a useful port numbering label attached to the lid of the RB4082 APA that may also be used as a reference.

The following figure shows port cabling to the FabreX Switch for the APA two-card configuration. Riser card slot 1:H1, ports 1 through 4, connect to FabreX Switch ports 17 through 20 (stack 5), respectively. Riser card slot 2:H1, ports 1 through 4, connect to FabreX Switch ports 21 through 24 (stack 6), respectively.

✓ Use cables of the same length cables when connecting a device.

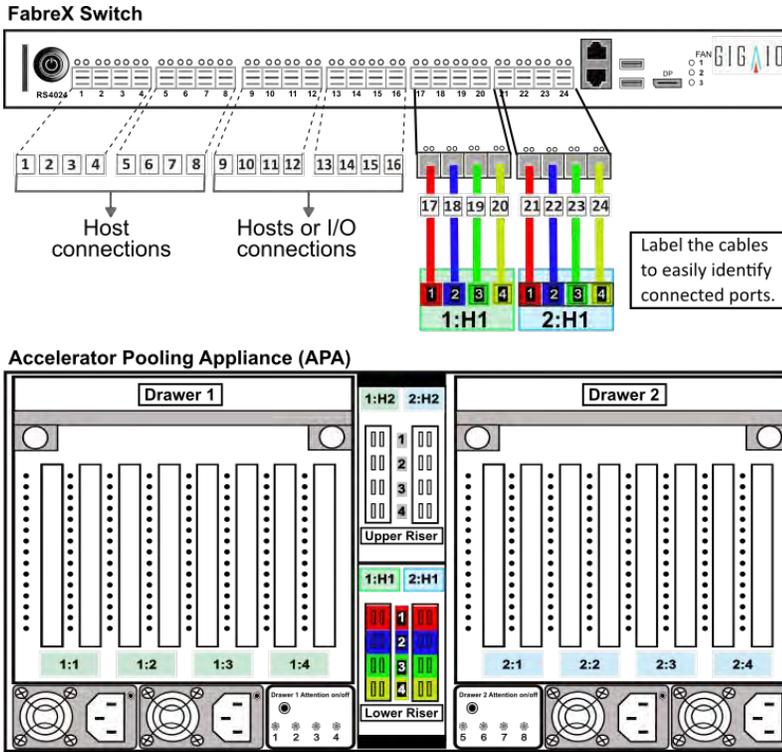


Figure 11 . GigaIO APA to FabreX Switch Standard Mode Port Connections

The next figure shows port cabling to the FabreX Switch for the four-card configuration. Riser card slots 1:H1 and 1:H2, ports 1 through 4, connect to FabreX Switch ports 9 through 12 (stack 3) and 13 through 16 (stack 4), respectively. Riser card slot 2:H1 and 2:H2, ports 1 through 4, connect to FabreX Switch ports 17 through 20 and 21 through 24, respectively.

✔ Use cables of the same length cables when connecting a device.

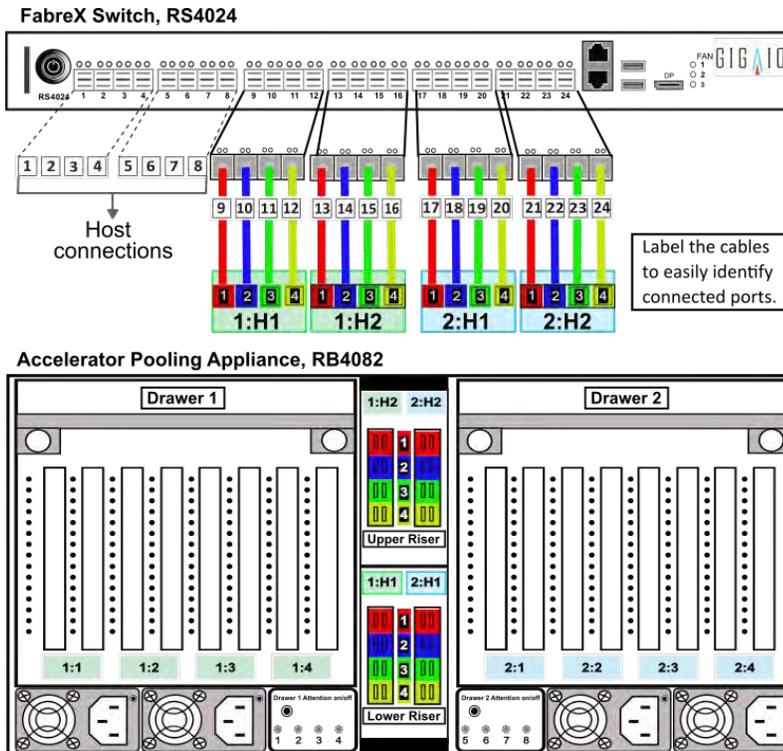


Figure 12 . GigaIO APA to FabreX Switch Advanced Mode Port Connections

7.4 Connecting power cords to the hardware components

⚠ Verify power is off at the source. Check that the power distribution bus outlets are off or, if necessary, turn off the power distribution bus or the circuit breakers that power the equipment.

Connect power cords from the top down to component hardware in the following order:

1. **FabreX Switch**
2. **Host-1**
3. **Host-2**
4. **Storage Pooling Appliance**
5. **Accelerator Pooling Appliance**

7.4.1 Step 1: FabreX Switch

1. Confirm that power is off at the source. Check that the power distribution bus outlets are off or, if necessary, turn off the power distribution bus or the circuit breakers that power the equipment.
2. Carefully connect the top component, the FabreX Switch, using the power cords provided. Connect the power cords in the following order:
 - Connect the power cord plugs to the FabreX Switch outlet
 - Connect the power cord plugs to the power source.



- Verify that the power cord routing does not interfere with other power cords and cables before securing them to the rack for safety.
- Verify that the power cords to the FabreX Switch are firmly connected and secured.

7.4.2 Step 2: Host-1

1. Confirm that power is off at the source. Check that the power distribution bus outlets are off or, if necessary, turn off the power distribution bus or the circuit breakers that power the equipment.
2. Carefully connect the second from the top component, Host-1, using the power cords provided. Connect the power cords in the following order:
 - Connect the power cord plugs to the Host outlet.
 - Connect the power cord plugs to the power source.



- Verify that the power cord routing does not interfere with other power cords and cables before securing them to the rack for safety.
- Verify that the power cords to Host-1 are firmly connected and secured.

7.4.3 Step 3: Host-2

1. Confirm that power is off at the source. Check that the power distribution bus outlets are off or, if necessary, turn off the power distribution bus or the circuit breakers that power the equipment.
2. Carefully connect the third from the top component, the Host-2, using the power cords provided. Connect the power cords in the following order:
 - Connect the power cord plugs to the Host outlet.
 - Connect the power cord plugs to the power source.



- Verify that the power cord routing does not interfere with other power cords and cables before securing them to the rack for safety.
- Verify that the power cords to Host-2 are firmly connected and secured.

7.4.4 Step 4: Storage Pooling Appliance

1. Confirm that power is off at the source. Check that the power distribution bus outlets are off or, if necessary, turn off the power distribution bus or the circuit breakers that power the equipment.
2. Carefully connect the fourth from the top component, the Storage Pooling Appliance using the power cords provided. Connect the power cords in the following order:
 - Connect the power cord plugs to the outlet of the appliance.
 - Connect the power cord plugs to the power source.



- Verify that the power cord routing does not interfere with other power cords and cables before securing them to the rack for safety.
- Verify that the power cords to the Storage Pooling Appliance are firmly connected and secured.

7.4.5 Step 5: Accelerator Pooling Appliance

1. Confirm that power is off at the source. Check that the power distribution bus outlets are off or, if necessary, turn off the power distribution bus or the circuit breakers that power the equipment.
2. Carefully connect the fifth from the top component, the Accelerator Pooling Appliance using the power cords provided. Connect the power cords in the following order:
 - Connect the power cord plugs to the outlet of the appliance.
 - Connect the power cord plugs to the power source.



- Verify that the power cord routing does not interfere with other power cords and cables before securing them to the rack for safety.
- Verify that the power cords to the Accelerator Pooling Appliance are firmly connected and secured.



Verify that all the power connections are properly inserted and secured.

Do NOT turn on power! Follow the instructions in the next section to power equipment on in the proper order.

8 Configuring the Server

8.1 Configuring the BIOS Setting

- ✔ BIOS screens and settings differ between server models. Refer to your server documentation for specific BIOS settings and configuration instructions.
- The configuration steps below list the BIOS settings needed. These steps use a SUPERMICRO Intel® Xeon® server only as an example. Your server's BIOS settings may differ.

1. Before you begin:
 - a. Ensure that the FabreX Switch is powered off so it does not affect the enumeration process before setting up the BIOS and server software.
 - b. Verify the Host Server has FabreX Cards installed with each card's DIP Switch set to Host Mode. For instructions, go to [Installing FabreX Cards in a Host Server](#).
2. Start the server and enter the BIOS screens.

For SUPERMICRO Intel® Xeon® servers, reboot and press the **Del** key during the Power-On Self-Test (POST). When the POST completes, the BIOS main screen displays.

 - a. Select **Advanced**.
 - b. Select **PCIe/PCI/PnP**.
 - c. Enable 64-bit PCIe addressing by setting Above **4G Decoding** to **Enabled**.
 - d. Set MMIO Base to **56TB**.
 - e. Set MMIO High Size **1024GB**.
 - f. Enable PCIe native power management by setting **ASPM Support** to **Auto**.
 - g. For the IOMMU, set the Intel VT for Directed I/O (VT-d) to **Enable**.
3. If using other server brands, be sure to find and set each of the functions listed in step **2a** through **g** to ensure proper system operation.

8.2 Installing the FabreX Server Package

The following table lists each FabreX Server package available for installation, along with whether it is required or optional and a brief functional description.

- ⓘ Filenames applicable to Centos or Ubuntu installations are listed in the following table using parentheses (Centos or Ubuntu).

Table 13 . FXS Server Packages

Packages	Description
<ul style="list-style-type: none"> ▪ kernel (Centos) ▪ kernel-devel (Centos) ▪ kernel-headers (Centos) ▪ linux-image (Ubuntu) ▪ linux-headers (Ubuntu) 	<p>Required: The <i>Kernel</i> package includes the Linux operating system's core (Centos or Ubuntu) for the host server.</p>

Packages	Description
<ul style="list-style-type: none"> ▪ gigaio-fabrexfm-host-worker ▪ gigaio-support 	<p>Required: The <i>FabreX</i> package includes:</p> <p>GigaIO FabreX Fabric Manager hostside daemon and GigaIO scripts and configuration file required by FabreX users.</p>
<ul style="list-style-type: none"> ▪ gigaio-libfabric ▪ gigaio-libfabric-devel (Centos) ▪ gigaio-libfabric-dev (Ubuntu) ▪ gigaio-mpich ▪ gigaio-mpich-devel (Centos) ▪ gigaio-mpich-dev (Ubuntu) 	<p>Optional: The high performance computing (<i>HPC</i>) package includes:</p> <p>Libfabric PCIe Provider (LPP) that runs on FabreX PCIe networks. FabreX offers high-performance RDMA functions to form the foundation of the LPP provider. Higher level primitives are implemented at the libfabric and kernel LPP module (KLPP) layers.</p> <p>GigaIO Message Passing Interface CHameleon (<i>MPICH</i>), a high performance and widely portable implementation of the Message Passing Interface (MPI) standard. The MPICH 3.3 release is currently used.</p>
<ul style="list-style-type: none"> ▪ gigaio-nvme-cli ▪ nvmetcli 	<p>Optional: The Non-Volatile Memory over Fabrics (<i>NVMe-oF</i>) package includes:</p> <p>NVMe management command line interface with a command set and a tool available to configure the NVMe.</p>
<ul style="list-style-type: none"> ▪ gigaio-fabrex-nccl ▪ gigaio-nv-klpp-peer-dkms 	<p>Optional: The GPUDirect RDMA (<i>GDR</i>) package that enables a GPU application to be run over multiple servers with GPUs attached to them. This package includes:</p> <p>GigaIO FabreX NVIDIA Collective Communications Library (NCCL) to support multi-GPU collective communication primitives that are topology-aware and can easily be integrated into applications to enhance GPU performance.</p> <p>KLPP, a peer module required to support GDR functionality.</p>

8.2.1 Downloading the FabreX Server Package

You can download the FabreX Server Package from the [Software Releases](#) site on the GigaIO Service Desk (login required).

8.2.2 Installing the CentOS and Development Tools

1. Verify CentOS 7.0 or later with "Development Tools" installed.
2. To install "Development Tools" use the following command:

```
sudo yum group install "Development Tools"
```

i If yum group install is not successful, use yum groupinstall with no space between group and install in the command.

3. The modules included in the FabreX Server Package may be installed via script or manually:
 - a. To run the FabreX installation script, go to the next section.
 - b. For manual installation, go to [Installing the FabreX Server Package Manually](#) section.

8.2.3 Running the FabreX Installation Script to Install the FabreX Server Package

The FabreX installation script is convenient and easy-to-use CLI to install modules included in the FabreX Server Package.

To run the FabreX installation script, perform the following steps, as applicable to your Centos or Ubuntu-based system:

1. Copy the downloaded FabreX software release tarball to the host.
2. Go to the directory where the software package was downloaded and untar the files. To untar the files, perform step **a** for Centos and step **b** for Ubuntu:

i The tarball takes approximately 30 seconds to a minute to unpack.

- a. For Centos, enter the following command:

```
tar -xjvf FabreX_<VERSION>_CentOS7.tar.bz2
```

- b. For Ubuntu, enter the following command:

```
tar -xjvf FabreX_<VERSION>_Ubuntu20.tar.bz2
```

3. Enter the extracted directory.
 - a. For Centos, enter the following command:

```
cd centos7/package
```

- b. For Ubuntu, enter the following command:

```
cd ubuntu20/package
```

4. During package installations, the following options may be used, unless otherwise indicated.

i Option usage is interchangeable and may include flags (prepped with one dash) and/or names (prepped with two dashes).

Table 14 . FabreX installation script command options

Option		Description
Flag	Name	
-k	--kernel	Installs kernel packages for Centos or Ubuntu on host
-x	--fabrex	Installs fabrex packages on host
-l	--libfabric	Installs libfabric packages on host
-n	--nvme	Installs nvme packages on host
-g	--gdr	Installs gdr packages on host
-f	--full	Use the full option to install all packages on the host
-d	--downgrade	Use the downgrade option when downgrading a package. Use with an option flag to specify which package to downgrade.  Not supported for Ubuntu.
-a	--airgapped	Use the airgapped option when an airgapped installation is intended. Use with an option flag to specify the package.  Not supported for Ubuntu.
-h	--help	Use the help option to display a list of command options like the one shown here.

- Run the install script from the extracted directory using the basic command and options from the preceding table. For example:

```
sudo /home/user/centos7/host_install_<linux_host>.sh -options --options
```

 Where <linux_host> indicates the installation's script for the linux host server, either **host_install_centos.sh** or **host_install_ubuntu20.sh**.

The following examples show two use cases applicable to a Centos host server installation. The first use case shows how to downgrade a full package install to the prior version using the option names. The second use case shows how to install two modules, fabrex and libfabric using option flags.

 Note that --downgrade and --airgapped options are not supported for Ubuntu host servers.

```
sudo /home/user/centos7/host_install_centos.sh --downgrade --full ## for a
complete package downgrade
sudo /home/user/centos7/host_install_centos.sh -xl ## installing
fabrex and libfabric package
```

- i** The script uses a pre-defined hierarchy to install packages in the correct order. The install script displays the results from each package installed in one of the colors below:
- **green** = Successful package install
 - **yellow** = Prompts and instructs users on actions to perform
 - **red** = Indicates where the installation failed and directs the user to the log file for details
- Each time the installation script runs it creates a log file, `install.log`. Each new log file is appended one after another. The installation script also compares the packages installed against those needed, and only installs the packages needed.

6. Once you have finished running the script to install FabreX Server Package modules, go to [Configuring Grub to Boot FabreX Kernel](#) to complete the configuration process.

8.2.4 Installing the FabreX Server Package Manually

- i** To install the FabreX installation script manually, use the following steps as applicable to your Centos or Ubuntu-based system:

1. Copy the downloaded FabreX software release tarball to the host.
2. Go to the directory where the software package was downloaded and untar the files:
 - a. For Centos, enter the following command:

```
tar -xjvf FabreX_<VERSION>_CentOS7.tar.bz2
```

- b. For Ubuntu, enter the following command:

```
tar -xjvf FabreX_<VERSION>_Ubuntu20.tar.bz2
```

3. Enter the extracted directory.
 - a. For Centos, enter:

```
cd centos7/package
```

- b. For Ubuntu, enter:

```
cd ubuntu20/package
```

- i** Note that If you are installing in an environment without external network access, add the following arguments to your yum commands:

```
--disablerepo='*' --disableplugin='*'
```

4. The **gigaio-support** package installs the GigaIO scripts and configuration file required by users. To install the package, perform step a for Centos and step b for Ubuntu:

- a. For Centos, enter the following command:

```
sudo yum localinstall -y gigaio-support*.rpm
```

- b. For Ubuntu, enter the following command:

```
sudo apt install -y ./gigaio-support_*.deb
```

- i** If using Ubuntu, skip step 5 and continue to step 6.

5. The **kernel-devel** package installs this portion of the Linux operating system's core on a Centos system using the following command:

```
sudo yum localinstall -y kernel-devel-5.3.*
```

6. For this portion of the Linux operating system's core installation, perform step **a** for Centos and step **b** for Ubuntu:

- a. For Centos, install the **kernel** package using the following command:

```
sudo yum localinstall -y kernel-5.3.*
```

- b. For Ubuntu, install the **linux-image** package using the following command:

```
sudo apt install ./linux-image-*.deb
```

7. For this portion of the Linux operating system's core installation, perform step a for Centos and step b for Ubuntu:

- a. For Centos, install the **kernel-headers** package using the following command:

```
sudo yum --setopt=obsoletes=0 localinstall -y --setopt=obsoletes=0 kernel-headers-5.3.*.x86_64.rpm
```

- b. For Ubuntu, install the **linux-headers** package using the following command:

```
sudo apt install ./linux-headers-*.deb
```

8. The **gigaio-libfabric** package installs the Libfabric PCIe Provider (LPP) that runs on FabreX PCIe networks. To install the package, perform step **a** for Centos and step **b** for Ubuntu:

- a. For Centos, enter the following command:

```
sudo yum localinstall -y gigaio-libfabric-*.rpm
```

- b. For Ubuntu, enter the following command:

```
sudo apt install ./gigaio-libfabric*.deb
```

9. The **gigaio-mpich** package installs the GigaIO Message Passing Interface CHameleon (MPICH). To install the package, perform step **a** for Centos and step **b** for Ubuntu:

- a. For Centos, enter the following command:

```
sudo yum localinstall -y gigaio-mpich-*.rpm
```

- b. For Ubuntu, enter the following command:

```
sudo apt install ./gigaio-mpich*.deb
```

10. The **gigaio-fabrex-fm-host-worker** package installs the GigaIO FabreX Fabric Manager hostside daemon. To install the package, perform step **a** for Centos and step **b** for Ubuntu:

- a. For Centos, enter the following command:

```
sudo yum localinstall -y gigaio-fabrefm-host-worker*.rpm
```

- b. For Ubuntu, enter the following command:

```
sudo apt install ./gigaio-fabrefm-host-worker*.deb
```

11. You may need to configure the Fabrex Host Service if you don't have the `/etc/fabrex.conf` file on the system. Without the file the service will fail because the host daemon expects to be configured via this file.

- a. To create the `fabrex.conf` file, use the following command:

```
sudo vi /etc/fabrex.conf
```

- b. Enter your switch hostname (replace "**myswitch**" with your switch hostname).

```
Switch: myswitch
```

12. Create/update the `/etc/fabrex/VERSION` file.

The contents should be **FabreX 2.x.x**, where **x** matches the version number installed.

13. The manual installation is complete. Go to the next section to configure grub to boot the FabreX kernel.

8.2.5 Configuring Grub to Boot FabreX Kernel

1. Use grubby to configure grub to boot from the new kernel.

```
sudo grubby --set-default /boot/vmlinuz-<VERSION>
```

<VERSION> should match the version from the kernel package file installed in the previous section. For example, if the kernel installed was:

```
5.3.0.release.47.6909b14f842e
```

Then replace **<VERSION>** to match the kernel package version that was just installed.

2. Use grubby to add iommu to the kernel args.
 - a. If using an Intel CPU server, enter the following argument:

```
sudo grubby --args=intel_iommu=on --update-kernel /boot/vmlinuz-<VERSION>
```

- b. If using an AMC CPU server, enter the following argument:

```
sudo grubby --args=amd_iommu=on --update-kernel /boot/vmlinuz-<VERSION>
```

 In the next section you will verify that the IOMMU argument was properly applied.

3. Reboot the host server.

8.2.6 Verifying Kernel Version, Grub Settings, and Fabrexfm-host.service

After a host server reboot, confirm that the confirm that the kernel version and grub settings have taken effect.

1. Check that you are running the GigaIO kernel by logging into the server and issuing the following command:

```
uname -r
```

The output should be the **<VERSION>** from the Grub configuration step.

2. Verify that IOMMU argument has been applied for the connected CPU server, using step **a** for Intel and step **b** for AMD.

 The BOOT_IMAGE output string should include an argument, **intel_iommu=on** or **amd_iommu=on**, as applicable.

- a. If using an Intel CPU server, enter the following:

```
cat /proc/cmdline | grep intel_iommu=on
```

- b. If using an AMD CPU server, enter the following:

```
cat /proc/cmdline | grep amd_iommu=on
```

3. Verify that the `fabrexfm-host.service` is active.

```
[user@clownfish ~]$ sudo systemctl status fxworker.service
● fxworker.service - FabreX Fabric Host Worker Service
Loaded: loaded (/etc/systemd/system/fxworker.service; enabled; vendor preset:
disabled)
Active: active (running) since Tue 2020-10-13 19:24:36 PDT; 6 days ago
Main PID: 1937 (fxwd)
Tasks: 4
CGroup: /system.slice/fxworker.service
├─1937 /opt/gigaio-fabrexfm-host-worker/fxwd
└─1938 /opt/gigaio-fabrexfm-host-worker/fxwd

Oct 13 19:24:52 clownfish fxwd[1938]: nfp_dtf_bar: 0x2
Oct 13 19:24:52 clownfish fxwd[1938]: nfp_dtf_sz: 0x400000000
Oct 13 19:24:52 clownfish fxwd[1938]: nfp_dtf_off: 0x1400000000
Oct 13 19:24:52 clownfish fxwd[1938]: nfp_mtf_bar: 0x2
Oct 13 19:24:52 clownfish fxwd[1938]: nfp_mtf_sz: 0x100000
Oct 13 19:24:52 clownfish fxwd[1938]: nfp_mtf_off: 0x14fee00000
Oct 13 19:24:52 clownfish fxwd[1938]: nfp_peer_ccs_off: 0xffff8000
Oct 13 19:24:52 clownfish fxwd[1938]: nfp_peer_ccs_msi_off: 0x0
```

4. Power down the host server. All servers connected to FabreX Switches need to be powered off prior to installing a topology configuration.

 When power cycling a switch, add 30 seconds to allow the switch power supplies to fully discharge.

9 Setting up the Switch

9.1 Configuring the Switch

9.1.1 Changing the Default FabreX Switch Password

1. Connect an Ethernet cable for management to the bottom RJ45 connector of the FabreX Switch.
2. Turn on the switch by applying power from an AC source.
3. Obtain the IP address for the FabreX Switch. You will need the IP address to load the Host configuration.

i The FabreX Switch has two USB ports and a DisplayPort to support standard USB keyboard and mouse connectors.

4. To change the default FabreX Switch password, use the following steps:
 - a. Log on to the FabreX Switch using the keyboard and monitor (if attached to the FabreX Switch) or through the SSH login).

✓ You can log-on to the switch using the "ssh admin@<switch IP address>" command if you have the switch connected to the network with a DHCP server and you know its IP address or the DNS name.

- b. Enter the Username and default Password:
Username: **admin**
Password: **password1**
- c. After the details about the FabreX Switch and the installed GigaIO packages display, invoke the FabreX restricted shell (rShell) **passwd** (fx> passwd) command.
- d. Enter a new Password and reboot the switch.

9.1.2 Logging into the FabreX Switch to check the FXS version

The FabreX restricted shell (rShell) is an interface that enables the user to interact with the FabreX Switch on a limited basis.

1. You can log-on to the switch using the "ssh admin@<switch IP address>" command *if* you have the switch connected to the network with a DHCP server *and* you know its IP address or the DNS name.

i Important!
If you have multiple switches in your fabric, the username and password must be kept exactly the same for all switches.

2. Once you log in, rShell displays details about the switch. For example, the status of ports and LEDs, the cables connected to the switch, the software installed, and so on. The following example shows the beginning of the display:

```
GIGAI0 FabreX (TM) 24 Port PCIe Switch
fabrex2 login: admin
password: password1
Last login: Wed Feb 24 09:25:43 2021 from <switch IP address> on pts/2
```

```

WELCOME to FABREX (TM)
FabreX Shell
=====
                Switch Details
- Hostname.....: sw-rs4024
- Manager.....: localhost
- IP.....: <switch IP address>
- GUID.....:
- FabreX Version ..: 2.X.X
- Platform.....: rs4024
- FPGA.....: 5f9.3002
- Firmware.....: 0x010b008c,0x7b2c3834
- Uptime.....: 1:59,1
=====
...

```

You may display the switch software information at any time by running the rShell command option,

✔ Use the **Shift** and **Page Up** keys together if you need to scroll up the display, such as when the screen's content scrolls out of view during rShell initialization or when running the `swinfo` command. Use the **Tab** key to autocomplete commands entered on the command line. The rShell user interface supports command auto-completion. Autocomplete should work once the completion engine can locate a uniquely matching command.

✔ For complete information on rShell options, along with output examples, see the *FabreX Software (FXS) User's Manual*.

3. Verify that you have the most-up-to-date packages installed by visiting [Software Releases](#) on the GigaIO Service Desk to check for the latest software releases.

ℹ It is strongly recommended that you check the GigaIO package versions listed against the latest releases to ensure that all software packages are current.

4. For steps on changing the FabreX Switch hostname and updating the FabreX software (FXS), if needed, continue to the following sections.

9.1.3 Changing the FabreX Switch Hostname

It is recommended to change the FabreX Switch hostname from the default of `sw-rs4024` (or `sw-rs3024`) to a desired hostname. You will need to use the switch hostname in the command line to bring up the fabric.

```
fx> hostname <switch_name>
```

✔ Enter the same switch hostname used in [Running the FabreX Installation Script to Install the FabreX Server Package](#) or [Installing the FabreX Server Package Manually](#) sections.

If you checked the [Software Releases](#) on the GigaIO Service Desk and found that you need to update FXS on your Switch, go to the next section. Otherwise, go to [Installing the FabreX Manager Tool](#).

9.1.4 Updating FXS on your Switch

If your switch needs to be updated, the FabreX Switch includes a Web User Interface. The Web UI displays brief status information about the current running state of the switch and allows a privileged user to update the current package and firmware—provided that a name server performs resolution within the context of your network.

To access the Web UI's home page and navigate to the switch, in a browser enter **https://** followed by *either* its **IP address** or its **host and domain name**. If the name server resolves within the context of your network, the Web UI displays.

Login Page

The User or Update Menu presents the login page when a user has not logged in.



The screenshot shows the login page of the GigaIO FabreX switch. At the top, there is a navigation bar with three tabs: 'Home', 'User', and 'Update'. The 'User' tab is currently selected. Below the navigation bar, the GigaIO logo is displayed, followed by the text 'FabreX (TM)'. A red message indicates that the user must log in to access the page. The main section is titled 'Login' and contains a sub-section for 'Administrator Login'. This section includes input fields for 'Email' and 'Password', a 'Keep me logged in' checkbox, and a 'Log In' button.

A special updater account is provided with which the user may initially login. The user enters an email address as a login name, along with a default password.

Email: admin@gigaio.com

Default password: **password1**

Once logged in, the user can change the email and password on the User Profile page.

 **Important!** If you have multiple switches in your fabric, the username and password must be kept *exactly* the same for all switches.

User Profile Page

Home User Update

GIGAIO
FabreX (TM)

User Profile

User Profile

User: admin
Email: admin@gigaio.com
Logout

Update email

Email
Update Email

Change Password

Current Password
New Password
Re-enter New Password
Change Password

User Profile information is displayed along with a LOGOUT button.

The email address, which functions as the login name for the user, can be changed.

Also, the password for the user may be changed with this page as well.



Important! If you lose your password, see the Password Recovery section in the *FabreX Software (FXS) User's Manual* for instructions.

Update Page

When a new release is available, the user must obtain a .gio package file, by visiting [Software Releases](#) on the GigaIO Service Desk.

After downloading, the .gio file may be uploaded to the switch via the **Upload Configuration Package** function shown in the following screen.

The screenshot shows a web interface for updating the switch. At the top, there is a navigation menu with 'Home', 'User', and 'Update' (the active page). Below the navigation is the main heading 'GigaIO FabreX (TM) Switch Update'. The page is divided into three main sections:

- Switch Updates:** A text box explaining that updates are supported at the package level. It instructs the user to choose a .gio file from their disk, submit it for upload, and then select a package from the 'Available Packages' list. It notes that removing a package only deletes the file, while installing it updates the switch, including the firmware.
- Upload Configuration Package:** A section containing a 'Choose File' button, the text 'No file chosen', and a 'Submit' button.
- Available Packages:** A section showing 'No Packages Available'.

A file chooser is provided to allow selection of the .gio file from the user's system, after which the user should submit the upload request, using the **Submit** button.

Once a .gio file has been properly uploaded, the page displays an Installation Option above the Execute button, as shown in the following screen example.

Home User Update

GigaIO FabreX (TM) Switch Update

Switch Updates

Switch updates are supported at the package level. Choose a package (.gio) file from your disk and submit to upload. Then, select the appropriate package from the Available Packages list, and Install or Remove as desired. Removal of a package merely deletes the package file. Installing a package installs package software to update the switch. This includes Switch Firmware.

- FILE: <FabreX_v1.0.0_Ubuntu.gio> Successfully Uploaded. Package Validated

Upload Configuration Package

Choose File No file chosen Submit

Available Packages

Package Operation: Install Remove

FabreX_v1.0.0_Ubuntu ▾

Execute

i Note that in your screen the version should reflect the version you are installing.

The Available Packages section provides a list of available package files on the switch. Package Operation allows for a package file to be "Installed" or "Removed" using these screen options. Removal of a package file simply deletes the package file. Removal does not alter the current running software on a switch. The Install operation actually updates the running software on the switch.

A user must select the desired operation and submit the request via the **Execute** button.

9.2 Installing the FabreX Manager Tool

9.2.1 FabreX Manager Tool Package

The FabreX Manager Tool is an optional command line interface and its usage is not required when Redfish or other orchestration software tools are available.

- ✓ When installing the FabreX Manager Tool use a system that is outside the fabric and run it from a **CentOS 7.x** (or later) or **Ubuntu 16.04.x** (or later) LTS-based management workstation.

The following packages are available for FabreX Manager Tool:

- Centos: `gigaio-fabrexfm-tool-*.x86_64.rpm`
- Ubuntu: `gigaio-fabrexfm-tool_*_amd64.deb`

These files are downloadable from the Service Desk. Visit [Software Releases](#) to download the latest version.

9.2.2 CentOS Installation

1. Download the latest **CentOS 7.x** software release.
2. Install **`gigaio-fabrexfm-tool-*.x86_64.rpm`** package.

```
sudo yum localinstall -y gigaio-fabrexfm-tool-*.x86_64.rpm
```

9.2.3 Ubuntu Installation

1. Download the Latest **Ubuntu 16.04.x** software release.
2. Install **`gigaio-fabrexfm-tool_*_amd64.deb`** package.

```
sudo apt install ./gigaio-fabrexfm-tool_*_amd64.deb
```

9.3 Loading a Topology

Once the FabreX Management Tools (fmtree) package has been installed on a management workstation, the fabric is ready to be configured. To create a configuration, perform the following steps:

1. Create an authorization file
2. Select a FabreX Topology Record (LTR) from the list of supported topology configurations. See [FabreX Topology Record](#) for information about LTRs. For supported configurations, visit [Topologies](#) on the GigaIO Service Desk.
3. Edit the accompanying `host_list.json` file that identifies the site-specific component names in the topology.
4. Configure the topology using the LTR and `host_list.json` file.

The following sections describe the various files used by FabreX Management Tool.

9.3.1 Authorization File

You must provide HTTP Basic authorization credentials to fmtree. The credentials should be stored in a file, the default is \$HOME/.fabrex_auth. To create the credentials file, run the following command:

```
$ echo -n admin@gigaio.com:password1 | base64 > ~/.fabrex_auth
$ chmod 600 ~/.fabrex_auth
$ cat ~/.fabrex_auth
YWRtaW5AZ2ZlbnYwLmNvbTpwYXNzd29yZDE=
```

i Important! If you have changed the admin user password (on the master switch) via the restricted shell interface, you should change the password given above accordingly. If you would like to provide an alternate location for the authorization file, you can direct fmtree to use it by providing the arguments -a <path_to_auth_file> to fmtree. With the default authorization file in place, you should now be able to run the fmtree command:

```
$ fmtree -s <manager_switch>
Requesting status from manager_switch...
{
  "body": {
    "Fabric": "UNINITIALIZED",
    ...
  },
  "status": 200
}
Done
```

i The topology directory for Gen 4 equipment is in the following location:
/opt/gigaio-fabrexfm-tool/topologies/release/sj5/
The directory contains the ltr.yml and host_list.json files needed to initialize the fabric.
Visit [Topologies](#) on the GigaIO Service Desk to view specific switch topologies, file requirements, as well as command line information necessary to load a particular topology.

9.3.2 FabreX Topology Record (LTR)

FabreX Topology Records (LTRs) describe a specific topology consisting of one or more FabreX Switch(es) and one or more servers. The support list of LTR files are delivered in the FabreX FM Tool package and can be found on the management workstation. Each of these directories also has a host_list.json file that needs to be modified for components within the topology installed onto the fabric.

i The topology directory for Gen 4 equipment is in the following location:
/opt/gigaio-fabrexfm-tool/topologies/release/sj5/
Each directory contains the ltr.yml and host_list.json files needed to initialize the fabric. Visit [Topologies](#) on the GigaIO Service Desk to view specific switch topologies, file requirements, and the command line information required to load a particular topology.

The following example shows a 1S-2x4-1 topology on PCIe Gen 4 equipment.

```
/opt/gigaio-fabrefm-tool/topologies/release/sj5/1S-2x4-1/
-rw-rw-r-- 1 root root 291 Aug 23 10:56 host_list.json
-rw-rw-r-- 1 root root 2114 Aug 23 10:56 ltr.yml
-rw-rw-r-- 1 root root 1513 Aug 23 10:56 README.md
```

Each LTR contains symbolic tags identifying components in the topology.

 Users should never edit or modify the ltr.yml file.

9.3.3 The host_list.json file

An example host_list.json file is found in the topology directory and is used to identify required, optional, and restricted components:

- The unique names of FabreX switch(es).
- The unique aliases of any IO devices connected to the "dsp" ports on the switch(es).
- The resource "zone" identifier name(s). A resource zone is a collection of IO devices connect to "dsp" ports (ResourceBlocks) which can be composed together. For a single hybrid switch configuration, the entire switch is one zone. For multiple switch configurations, you may have multiple zones and each should have an unique name. Redfish uses these zones to keep track of which IO resources can be connected to which "host" (USP) ports.
- The unique host names of servers connected to the "host" ports of the switch(es).

The initialization PATCH command `toredfish/v1/Fabrics/Oem/GigaIO/Topologies/<id>` should follow these rules:

Table 15 . Rules for Entities

REQUIRED	switch-tags, zone-tags, dsp tags	Switch values must equal the DNS hostname of the switch
OPTIONAL	host-tags	Whether or not supplied by the Redfish template
RESTRICTED	everything else	

 All switches and server host names must resolve to an IP address.

If the connection is to be blank, you can use any unique name to identify that the connection will be not be used. You can change this unique name at a later date when you add another server. All default tag-values MUST be replaced. For any device that is not connected, a unique dummy name is still required for proper Redfish functionality.

 Host-tags are no longer (since FabreX 2.3) part of the host_list.json content. Any host may join the fabric if connected to an appropriate USP host port. These port connections are in every topology map (tmap.json) and diagram. The Dynamic Host Mode (DHM or dynahost) conditional flag available in rShell can be set to include host-tags or exclude them when fetching topology templates via Redfish. The FabreX Manager (FM) behaves *dynamically* with host addition or removal, so long as the host-tags were excluded from the

initialization PATCH for the topology. The FM behaves *statically* to host addition and removal if host-tags were included during topology initialization. For dynahost usage in rShell, see the *FabreX Software (FXS) User's Manual*.

The following example shows the content of the `host_list.json` file from the 1S-2x4-1 topology.

- ✔ Note the absence of a comma for the last entry in the example. You leave out the comma in the last entry, which is the required syntax. Be sure to use the exact syntax shown when configuring your host JSON file. Only change the parameters on the right side of the colon between the quotes.

```
$ cat host_list.json
{
  "s1p9dsp": "<SWITCH1_PORT9_NAME>",
  "s1p13dsp": "<SWITCH1_PORT13_NAME>",
  "s1p17dsp": "<SWITCH1_PORT17_NAME>",
  "s1p21dsp": "<SWITCH1_PORT21_NAME>",
  "switch1": "<SWITCH1_NAME>",
  "zone1": "<ZONE1_NAME>"
}
```

9.3.4 Uninitializing a Topology on the Fabric

To remove the currently established topology, use the `uninitialize` command. The `fmtool` usage for uninitializing a fabric is given by:

```
fmtool -u <switch_name>
```

The expected output is shown in the following example:

```
fmtool: 2021-08-20 at 13:42:54
Sending uninit fabric to sw-rs4024...
Request:
PUT https://<SWITCH>/fabrex/v2/uninit
Response:
HTTP/1.1 200 OK
SUCCESS: uninitialize fabric complete on sw-rs4024
```

9.3.5 Initializing a Topology on the Fabric

- i Make sure to uninitialize a fabric before initializing it.

The `fmtool` usage for configuring a fabric is given by:

```
fmtool [-v] [-l <loglevel>] [-f] [<host_list.json> <ltr.yml>] <manager_switch>
```

You must include the `host_list.json` file you modified from the same directory as the `ltr.yml` file. In the following example, the single switch topology (LTR) is used; the `<manager_switch>` is the switch name. The command is run from the `/opt/gigaio-fabrexfm-tool/topologies/release/sj5/1S-2x4-1/` directory where the two files are located. If there is more than one switch in the topology, then you must select one of the switches to be the `<manager_switch>`. All subsequent `fmtool` commands must use the same `<manager_switch>` name.

```
[user@fmtool-server 1S-2x4-1] $ fmtool host_list.json ltr.yml <manager_switch>
fmtool: 2020-02-21 at 09:34:12
Configuring fabric...
Sending host_list.json to <manager_switch>...
Success: Sent host_list.json to SW-RS4024
Sending ltr.yml to <manager_switch>...
Success: Sent ltr.yml to <manager_switch>
[user@fmtool-server 1S-2x4-1] $
```

9.4 Powering on the FabreX System

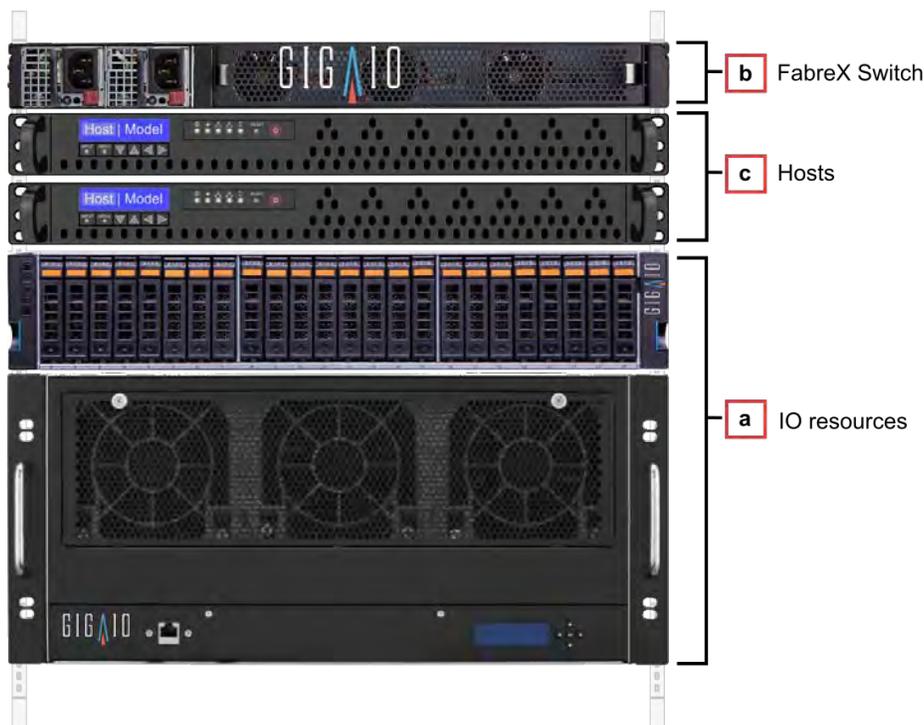


Figure 13 . FabreX System Power-on Sequence

1. Power on the hardware, allowing 30 seconds between devices a, b, and c, as follows:

i It is important to power on the hardware in the following order to establish the proper connection between the specified devices.

- a. IO resources**
- b. FabreX Switch**
- c. Hosts**

As you power on devices, ensure that the LEDs are GREEN on IO resources and host servers. Green LEDs indicate that these devices are successfully powered to the FabreX Switch.

✓ On the FabreX Switch, the Power Button needs to be solid green before proceeding to the next section on configuring the host. It is assumed the system is running and no monitor is attached when performing these checks.

If any LEDs are AMBER, check that the power cables are secure and perform a power cycle in the a, b, c order listed in step 1. For any other condition, refer to the equipment user's manual for information.

i If you need to power cycle a switch, allow 30 seconds to enable the switch power supplies to fully power down.

2. Configure Linux network parameters per site requirements.
3. Verify that the FabreX Switch Power Button is solid green. For any other condition, refer to [FabreX Switch Power Button Checks](#).
4. After the hosts are configured, check that the FabreX Switch Port LEDs show all links are up at the expected PCIe Gen 4 rates. For details, see the *24-Port FabreX Switch User's Manual: Models RS4024*.

9.5 Booting the Host and Verifying the Fabric is Loaded on the Host Server

i This task is not needed for composition-only mode.

1. Bring up the hosts and verify the fabric is loaded by running the following command on each host server:

```
sudo fabrex-status.sh
```

To produce an output that looks like the following example:

```
sudo fabrex-status.sh
=====
                        Host Details
- Hostname.....: <HOST1_NAME>
- IP.....: 192.168.70.108
- IOMMU.....: Enabled
```

```

- Uptime.....: 2:39,2
- CPU usage.....: 0.07, 0.03, 0.01 (1, 5, 15 min)
- Memory used.....: 2644 MB / 63526 MB
- Space on /.....: 20G
=====
                          Fabric Details
- Manager: SW-RS4024      Switchtec NTB Control Plane Link Status
  Nodename "<HOST1_NAME>": FLID: 0x00000001
  NIC IDX: 0
  NTB NIC GUID: 0x0000050110200006
  Partition 0
  Peers: 1
  PNUM  STATE  PCCS  LLINK  POLL  PSTATE  PLINK  EPOCH  FLID          PEER ID
        0  rdy   cfg   up     slow  rdy     up     1    0x00000003  <HOST2_NAME>
=====
                          NTB Netdev Network
NTB Subnets
> <HOST1_NAME>.eth0 <-> <HOST2_NAME>.eth0
NTB Interfaces
- ntb<HOST2_NAME>:          UP
=====
                          GigaIO Packages
Kernel Packages
- kernel                    5.3.0.release.67.7b36f7b74433
- kernel-devel              5.3.0.release.67.7b36f7b74433
- kernel-headers            5.3.0.release.67.7b36f7b74433
FabreX Packages
- gigaio-fabrexfm-host-worker 2.1.0r10.release.34.d9a46a0
- gigaio-support              2.1.0r10.release.39.29711c9
HPC Packages
- gigaio-libfabric           1.7.1.release.23.b4275954b
- gigaio-libfabric-devel     1.7.1.release.23.b4275954b
- gigaio-mpich                3.3.2.release.23.b4275954b
- gigaio-mpich-devel         3.3.2.release.23.b4275954b
NVMeoF Packages
- gigaio-nvme-cli            1.9.0.13.d31930f
- nvmetcli                    0.6
GDR Packages
- gigaio-fabrex-nccl         2.1.0r8.release.13.ee42ba6
- gigaio-nv-klpp-peer-dkms   2.1.0r8.release.13.e9dfd77
=====
GigaIO Services
- fxworker.service          RUNNING
=====
GigaIO Kernel Modules
- fm                          LOADED
- klpp                         LOADED
- ntb                          LOADED
- ntb_dm                       LOADED
- ntb_hw_switchtec            LOADED
- ntb_msi                      LOADED
- ntb_netdev                  LOADED
- nvme_fabrics                LOADED

```

```
- nvme_ntb          LOADED
- nvmet            LOADED
- nvmet_ntb       LOADED
- switchtec       LOADED
=====
```

2. Check that you see the following items in the output:

i Note that some modules may be missing depending on what was installed. The prior code example shows a full installation of all-feature rpms.

- a. IOMMU.....: Enabled (Required for host to host communication.)
- b. Manager: SW-RS4024 (Indicates that you have configured the manager switch correctly.)
- c. **"up"** for the LLINK and PLINK and **"rdy"** for the STATE and PSTATE for each peer of the host.
- d. fxworker.service RUNNING (Ensures that the host is communicating with the FabreX Manager Service.)

10 Troubleshooting

10.1 FabreX Switch Power Button Checks

The following tables list checks the user can perform to validate Power Button operations and conditions.

Table 16 . FabreX Switch Power Button Operational Checks

Checks	User action	System response
1	Press and release the Power Button (hold approximately 1 second).	Suspend screen appears. This screen only appears on a display directly connected to the switch.
2	Press and hold the Power Button momentarily (approximately 5 seconds).	Operating system shuts down and power to the switch turns off. If the operating system hangs, press and hold 5 seconds to shut down power.

Table 17 . FabreX Switch Power Button Status Conditions

Case	Indicator	Pattern	Condition
1	GREEN	Solid	Indicates the normal operational power condition with either one or two powers supplies installed.
2	GREEN	Blinks at 50% duty cycle	Indicates the normal operational power condition with two power supply modules installed, but one power supply module is either not plugged into AC or possibly out of tolerance. While fully operational in this state, the user should investigate.
3	AMBER	Solid	Indicates STANDBY mode. STANDBY is the default powered-down condition.
4	AMBER	Blinks at 50% duty cycle	Indicates STANDBY mode operating on backup “golden” image. FPGA update process may be required.
5	RED	Solid	Indicates FPGA configuration is in process. Indicator remains RED if configuration fails. If an AC power cycle fails to clear the condition, the unit has a fatal flaw and must be returned for repair. See the note following the table.
6	RED	Blinks at 50% duty cycle	Fatal flaw. If an AC power cycle fails to clear this condition, the unit has a fatal flaw. In this event, load a new switch configuration file through a utility. See the note following the table.

Case	Indicator	Pattern	Condition
7	RED	2 fast blinks followed by a pause	Indicates a catastrophic power shutdown. Cycle AC power to recover. See the following note following the table.
8	RED	3 fast blinks followed by a pause	Indicates a catastrophic thermal shutdown. Cycle AC power to recover. See the following note following the table. If unfavorable environmental conditions have not been resolved, this shutdown may occur again.

 **Note:** Cycle AC power by removing the attached power cords from the AC source for a minimum of 30 seconds before re-attaching the power cords to allow the power supplies to fully power down.

10.2 FabreX Network Adapter Card Port Status Checks

Each of the four ports on the FabreX Card has a bi-color status LED that illuminates through a small hole, labeled from 1 to 4 on the PCI mounting bracket. The FabreX Card LEDs can indicate the following port status conditions.

Table 18 . FabreX Network Adapter Card Status LED Indicators

Link Status	LED Indicator			
	FA4004		FA3004	
Gen 4 (16GT/sec) link is Up		Solid Green	—	Gen 4 not supported
Gen 3 (8GT/sec) link is Up		Blinking Green — Fast (2 Hz)		Solid Green
Gen 2 (5GT/sec) link is Up		Blinking Green — Medium (1 Hz)		Blinking Green — Fast (2 Hz)
Gen 1 (2.5GT/sec) link is Up		Blinking Green — Slow (0.5 Hz)		Blinking Green — Medium (1 Hz)
No link on that port with cable installed but there is a link (FA4004 only) No link on that port (FA3004 only)		Red	 -OR- 	Red (Solid or Blinking)
No cable installed in that port - OR - No link on all ports		Off		Off

- i** If one or more of the indicators are not lit (no link), double-check the cable connections from FabreX Card to the Switch (see the preceding [Status LED Indicators](#) table). Labeling the PCIe cables (1-4) at both ends (relative to the FabreX Card) will help you to keep track of the cable connections. If the cables are connected in the correct order, then be sure that power is brought up in the correct order. Specifically, power the I/O expansion-resource platform first, the FabreX Switch second, and the host-server last.

10.3 FabreX Switch Fan Tray Unit Replacement

The FabreX Switch employs three high reliability fans designed to perform well for many years. The three fans are mounted on an easily removable tray unit. Model number RS3024-FT. The standard air flow direction on the RS3024-FT is from power to port, and can be configured in the field to match the air flow direction of the FabreX Switch PSUs. Only two fans are required to cool the FabreX Switch when the ambient temperature is $\leq 25^{\circ}\text{C}$ (78°F) at an elevation of ≤ 950 meters (3117 feet).

In the unlikely event of a fan failure, email support@gigaio.com or call 1 (760) 487-8395 to schedule service to repair or replace the unit. Be sure to provide the FabreX Switch model and serial to ensure that the correct PSU is used.

10.3.1 Fan Tray Removal

- i** Before removing the fan tray from the switch, unpack the replacement fan tray and check its airflow direction, as indicated by arrows on the fan housings. Do not let any dirt or debris fall into the fans or fan tray. Temporarily store the tray in a clean and dry location until needed for installation.

When a replacement fan tray is available for the scheduled installation, be sure to turn off the FabreX Switch.

1. Press the Multi-status Power button to power off or disconnect power to the switch.
2. When power is Off, use the following steps:

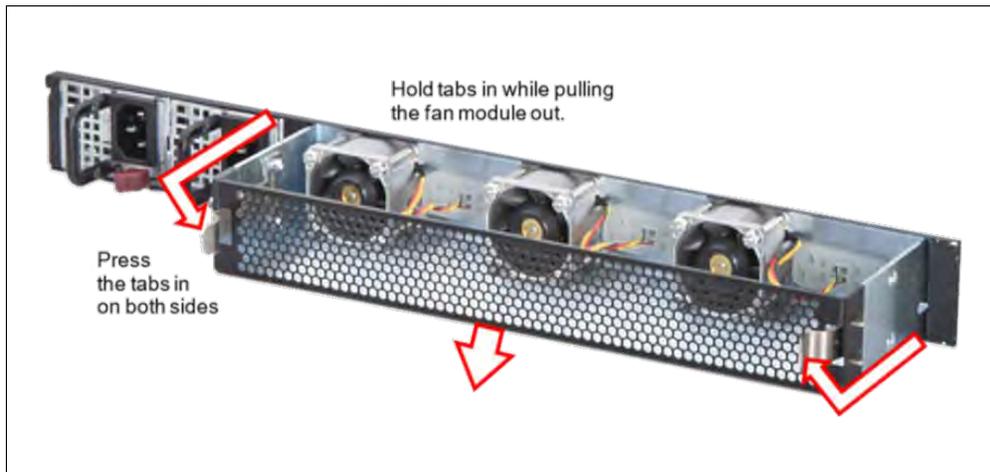


Figure 14 . FabreX Switch Fan Tray Unit Replacement

- a. Disconnect power from the switch by unplugging the power cords.
- b. To remove a fan tray from a FabreX Switch, use two hands to bend the locking tabs towards each other; and at the same time, pull the fan tray out, away from the switch.
- c. Inspect the empty fan tray bay of the FabreX Switch. Be sure no dirt or debris have fallen into the empty bay while removing the fan tray.

10.3.2 Fan Tray Installation

Checking Airflow

- ✔ Before installing the fan tray in the switch, unpack the replacement fan tray and check the airflow direction. Do not let any dirt or debris fall into the fans or fan tray. Temporarily store the replacement fan tray in a clean and dry location, until ready for installation.

1. When ready to replace the fan tray, unpack the replacement unit and see the airflow (arrow) indicators, located on the housing of each fan. Model RS3024-FT has its fans installed. Arrow indicators point in the direction of the switch interior, away from the fan tray venting grill. That airflow direction is from the power to the port side of the switch.
2. Check the PSU locking latch handle color of the FabreX Switch being serviced.
 - A RED latch handle indicates the PSU fan airflow direction is from the power to the port side of the switch.
 - A BLACK latch handle indicates the PSU fan airflow direction is from the port to the power side of the switch.

In the case of a black latch PSU, the fans in the fan tray will need to be removed and reinstalled, so the directional arrows point towards the fan tray grill. If necessary, use a #X Phillips screwdriver and a pair of small (needle-nose) pliers or a #Y wrench to remove and re-install the fans, in the desired direction.
3. When done changing fan airflow direction, double check that: (1) all fans are pointing in the same direction, (2) screws and nuts are tightened securely, and (3) make sure no debris is in the tray, before installing.
4. Disconnect power from the FabreX Switch by unplugging the power cords. If necessary, remove the Fan Tray. See described in the previous [Fan Tray Removal](#) section.

Installing the Fan Tray

1. Disconnect power from the FabreX Switch by unplugging the power cords. If necessary, remove the Fan Tray as described in the previous section [Fan Tray Removal](#).
2. Inspect the empty fan bay of the FabreX Switch for obstructions and foreign objects. If there is any dust, dirt or debris in the empty fan bay, clean out the fan bay, with no-lint, anti-static wipes.
3. Gently insert the fan tray unit by sliding it into the empty fan bay, until a slight resistance is felt. Continue inserting gently, as the fan connectors mate and the locking tabs snap into position.
4. Power-On switch by connecting the power cords, first to the PSUs then to the power source. Or, power on the FabreX Switch per the desired power sequence, as described in [Powering on the FabreX System](#).
5. Once the FabreX Switch has initialized and the Multi-status Power indicator glows green, verify that all three Fan Status LEDs on the port side of the panel are illuminated (as the following image shows). Solid green LEDs indicate that all fans are functioning correctly.



- i** In the event that fan tray replacement did not result in all fans functioning, remove fan tray as described above, check fan connectors on fan tray for obstructions or damage, and check the empty fan bay on the FabreX Switch for obstructions or damage. If reinstallation does not correct issue, contact your GigaIO representative for assistance.

10.4 Web User Interface Error Messages

Table 19 . FabreX System error messages

Error Message	Description and/or Resolution
<p>The Web User Interface shows "An internal error has occurred with the FabreX Switch. "</p>	<p>Perform a power cycle. Power off the Host(s), FabreX Switch, and I/O resource(s).</p> <p>Power on the devices in following order:</p> <ol style="list-style-type: none"> 1. IO resources 2. FabreX Switch <div style="border: 1px solid #ccc; padding: 5px; margin: 10px 0;"> <p>i When power cycling the switch, allow 30 seconds for its power supplies to fully power down before applying power again.</p> </div> <ol style="list-style-type: none"> 3. Host(s)

10.5 FM Tool Error Messages

Table 20. FM Tool Error Messages

Error Message	Description and/or Resolution
<p>If you do not have your authorization information correct or in the default location, you will see the following error returned by fmtreeol:</p> <pre> user@manager_switch:~\$ cat ~/.fabrex_auth_bad Zm1hZ2VudEBnaWdhaW8uY29tOkhhbmcxMFRheWxvck1hZA== \$ fmtreeol -a /home/user/.fabrex_auth_bad -s manager_switch Requesting status from manager_switch... Error 401, invalid authorization </pre> <p>If you do not have your authorization information correct you will also see the following authorization failure errors in switchd.log.</p> <pre> Apr 10 21:21:20 manager_switch switchd: [INFO] Request: 127.0.0.1:53852 0x7fb6c4000970 HTTP/ 1.1 GET /status Apr 10 21:21:20 manager_switch switchd: [ERROR] AUTH: authorization failed, status = 401 Apr 10 21:21:20 manager_switch switchd: [ERROR] /status: invalid authorization Apr 10 21:21:20 manager_switch switchd: [INFO] Response: 0x7fb6c4000970 / status 401 0 </pre>	<p>Set up the authorization file. See the <i>FabreX Software (FXS) User's Manual</i> for instructions on setting up the authorization file.</p>

11 Product Model Numbers and Field Replaceable Units

Table 21 . Switch, Software, and FRU Model Numbers

Model Number	Description
RS4024-FNA	FabreX Switch, 1U, 24x4-port, PCIe Gen 4, 1 PSU, air flow = power to port; North America power and rail rack mount kit
RS4024-FEU	FabreX Switch, 1U, 24x4-port, PCIe Gen 4, 1 PSU, air flow = power to port; European Union power and rail rack mount kit
RS4024-FUK	FabreX Switch, 1U, 24x4-port, PCIe Gen 4, 1 PSU, air flow = power to port; United Kingdom power and rail rack mount kit
RS4024-BNA	FabreX Switch, 1U, 24x4-port, PCIe Gen 4, 1 PSU, air flow = port to power; North America power and rail rack mount kit
RS4024-BEU	FabreX Switch, 1U, 24x4-port, PCIe Gen 4, 1 PSU, air flow = port to power; European Union power and rail rack mount kit
RS4024-BUK	FabreX Switch, 1U, 24x4-port, PCIe Gen 4, 1 PSU, air flow = port to power; United Kingdom kit and rack-rails
RS3024-RL	FabreX Switch - Rail Kit - Long (standard)
RS3024-FT	FabreX Switch - Fan Tray, with 3 fans, configurable air flow
FA4004	FabreX Host/Target Adapter Card, PCIe Gen 4 (1x16 or 2x8 or 4x4), Full- and half-height brackets included
FC-C4005	FabreX PCIe Gen 4, Cu Cable 0.5 meter – RoHS
FC-C4010	FabreX PCIe Gen 4, Cu Cable 1.0 meter – RoHS
FC-C4020	FabreX PCIe Gen 4, Cu Cable 2.0 meter – RoHS
FC-C4030	FabreX PCIe Gen 4, Cu Cable 3.0 meter – RoHS
FC-A4010	FabreX PCIe Gen 4, Active Optical Cable 10 meters - RoHS
FC-A4030	FabreX PCIe Gen 4, Active Optical Cable 30 meters - RoHS
FC-A4010	FabreX PCIe Gen 4, Active Optical Cable 10 meters - RoHS
FC-A4030	FabreX PCIe Gen 4, Active Optical Cable 30 meters - RoHS
SW-CO	Composer Software - Perpetual, Node-Locked License
SW-LD	Leader Software – Perpetual, Node-Locked License

Model Number	Description
SW-MS	Maestro Software – Perpetual, Node-Locked License

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Deployment Guide



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