

# Flex System CN4054 and CN4054R 10Gb Virtual Fabric Adapters

## Product Guide (withdrawn product)

The Flex System™ CN4054 and CN4054R 10Gb Virtual Fabric Adapters are 4-port 10Gb converged network adapters (CNAs) that support Ethernet, iSCSI, and FCoE. The adapters support up to 16 virtual NIC (vNIC) devices, where each physical 10 GbE port can be divided into four virtual ports with flexible bandwidth allocation. The CN4054 Virtual Fabric Adapter Upgrade adds FCoE and iSCSI hardware initiator functionality to either adapter. The CN4054R adds support for compute nodes with the Intel Xeon E5-2600 v2 and v3 processors.

Figure 1 shows the adapters (they have the same physical appearance).

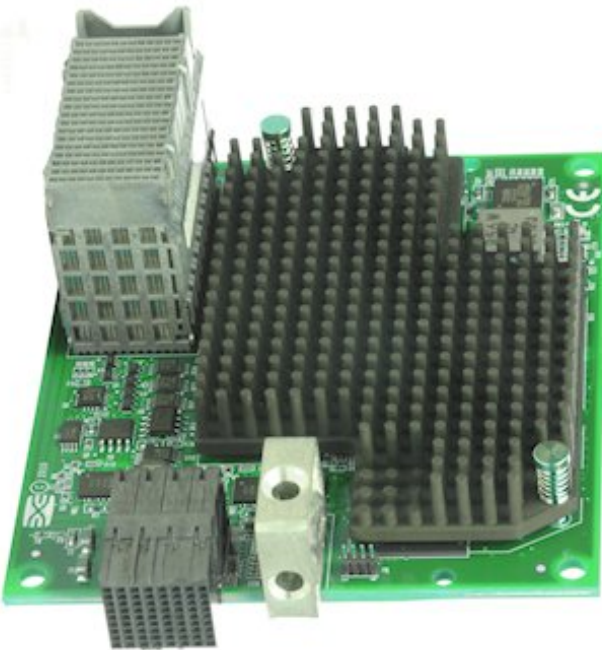


Figure 1. Flex System CN4054 & CN4054R 10Gb Virtual Fabric Adapters

### Did you know?

This CN4054 is based on industry-standard PCIe architecture and offers the flexibility to operate as a Virtual NIC Fabric Adapter. Because this adapter supports up to 16 virtual NICs on a single quad-port Ethernet adapter, you see benefits in cost, power/cooling, and data center footprint by deploying less hardware. Compute nodes like the x240 support up to two of these adapters for a total of 32 virtual NICs per system.

## Ordering information

The Flex System is a new category of computing that integrates multiple server architectures, networking, storage, and system management capability into a single system that is easy to deploy and manage. Flex System has full built-in virtualization support of servers, storage, and networking to speed provisioning and increased resiliency. In addition, it supports open industry standards, such as operating systems, networking and storage fabrics, virtualization, and system management protocols, to easily fit within existing and future data center environments. Flex System is scalable and extendable with multi-generation upgrades to protect and maximize IT investments.

**Withdrawn:** All part numbers and feature codes are now withdrawn from marketing.

Table 1. Ordering information and feature codes

Description	Part number	Feature code
Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	A1R1
Flex System CN4054R 10Gb Virtual Fabric Adapter	00Y3306	A4K2
Flex System CN4054 Virtual Fabric Adapter Upgrade**	90Y3558	A1R0

\*\* Adds FCoE and iSCSI functionality to CN4054 or CN4054R; One upgrade needed per adapter

The adapter part numbers include the following items:

- One adapter
- Documentation package

The Flex System CN4054 and CN4054R 10Gb Virtual Fabric Adapters can be upgraded to run storage protocols iSCSI and FCoE by applying the upgrade license, Flex System CN4054 Virtual Fabric Adapter Upgrade, part number 90Y3558.

## Features

The adapters have these features:

- Four-port 10 Gb Ethernet adapter
- Two ASICs per adapter:
  - CN4054: Dual-ASIC Emulex BladeEngine 3 (BE3) controller
  - CN4054R: Dual-ASIC Emulex BladeEngine 3R (BE3R) controller
- Connection to either 1 Gb or 10 Gb data center infrastructure (1 Gb and 10 Gb auto-negotiation)
- PCI Express 3.0 x8 host interface
- Operates either as a 4-port 1/10 Gb Ethernet adapter or supports up to 16 vNICs.
- Supports Unified Fabric Port (UFP)
- In virtual NIC (vNIC) mode, each adapter supports:
  - Virtual port bandwidth allocation in 100 Mbps increments.
  - Up to 16 virtual ports per adapter (four per port).
  - With the CN4054 Virtual Fabric Adapter Upgrade, 90Y3558, four of the 16 vNICs (one per port) support iSCSI or FCoE.
- Supports for two vNIC modes: Virtual Fabric Mode and Switch Independent Mode
- Wake On LAN support.
- With the CN4054 Virtual Fabric Adapter Upgrade, 90Y3558, the adapter adds FCoE and iSCSI hardware initiator support.
  - iSCSI support is implemented as a full offload and presents an iSCSI adapter to the operating system.

- TCP Offload Engine (TOE) support with Windows Server and Linux.
  - Connection and its state are passed to the TCP offload engine.
  - Data transmit and receive is handled by adapter.
  - Supported with iSCSI.
- Full-duplex (FDX) capability
- Bus-mastering support
- Direct memory access (DMA) support
- Preboot Execution Environment (PXE) support
- IPv4/IPv6 TCP, UDP checksum offload
  - Large send offload (LSO)
  - Large receive offload
  - Receive side scaling (RSS)
  - IPv4 TCP Chimney Offload
  - TCP Segmentation Offload
- VLAN insertion and extraction
- Jumbo frames up to 9000 bytes
- Load balancing and failover support, including adapter fault tolerance (AFT), switch fault tolerance (SFT), adaptive load balancing (ALB), teaming support, and IEEE 802.3ad
- Enhanced Ethernet (draft)
  - Enhanced Transmission Selection (ETS) (P802.1Qaz)
  - Priority-based Flow Control (PFC) (P802.1Qbb)
  - Data Center Bridging Capabilities eXchange Protocol, CIN-DCBX and CEE-DCBX (P802.1Qaz)
- Supports Serial over LAN (SoL)
- Total Max Power: 23.1 W

## Modes of operation

The CN4054 and CN4054R 10Gb Virtual Fabric Adapters support three vNIC modes of operation in addition to pNIC mode:

- Virtual Fabric Mode. This mode only works in conjunction with any of the following switches installed in the chassis:
  - Flex System Fabric CN4093 10Gb Converged Scalable Switch
  - Flex System Fabric EN4093R 10Gb Scalable Switch
  - Flex System Fabric EN4093 10Gb Scalable Switch

In this mode, the adapter communicates with the switch module to obtain vNIC parameters (using DCBX). Also, a special tag within each data packet is added and later removed by the NIC and switch for each vNIC group to maintain separation of the virtual channels.

In vNIC mode, each physical port is divided into four virtual ports, providing a total of 16 virtual NICs per adapter. The default bandwidth for each vNIC is 2.5 Gbps. Bandwidth for each vNIC can be configured at the switch from 100 Mbps to 10 Gbps, up to a total of 10 Gb per physical port. The vNICs can also be configured to have 0 bandwidth if you must allocate the available bandwidth to fewer than eight vNICs. In Virtual Fabric Mode, you can change the bandwidth allocations through the switch user interfaces without requiring a reboot of the server.

When storage protocols are enabled on the adapter (using CN4054 Virtual Fabric Adapter Upgrade, 90Y3558), six ports are Ethernet, and two ports are either iSCSI or FCoE

- Switch Independent Mode, where the adapter works with the following switches:
  - Cisco Nexus B22 Fabric Extender for Flex System
  - Flex System EN4023 10Gb Scalable Switch
  - Flex System Fabric CN4093 10Gb Converged Scalable Switch

- Flex System Fabric EN4093R 10Gb Scalable Switch
- Flex System Fabric EN4093 10Gb Scalable Switch
- Flex System Fabric SI4093 System Interconnect Module
- Flex System EN4091 10Gb Ethernet Pass-thru and a top-of-rack (TOR) switch

Switch Independent Mode offers the same capabilities as Virtual Fabric Mode in terms of the number of vNICs and the bandwidth that each can be configured to have. However, Switch Independent Mode extends the existing customer VLANs to the virtual NIC interfaces. The IEEE 802.1Q VLAN tag is essential to the separation of the vNIC groups by the NIC adapter or driver and the switch. The VLAN tags are added to the packet by the applications or drivers at each end station rather than by the switch.

- Unified Fabric Port (UFP) provides a feature rich solution compared to the original vNIC Virtual Fabric mode. Like Virtual Fabric mode vNIC, UFP allows carving up a single 10 Gb port into four virtual NICs (called vPorts in UFP). UFP also has a number of modes associated with it, including:
  - Tunnel mode: Provides Q-in-Q mode, where the vPort is customer VLAN-independent (very similar to vNIC Virtual Fabric Dedicated Uplink Mode)
  - Trunk mode: Provides a traditional 802.1Q trunk mode (multi-VLAN trunk link) to the virtual NIC (vPort) interface, i.e. permits host side tagging
  - Access mode: Provides a traditional access mode (single untagged VLAN) to the virtual NIC (vPort) interface which is similar to a physical port in access mode
  - FCoE mode: Provides FCoE functionality to the vPort
  - Auto-VLAN mode: Auto VLAN creation for Qbg and VMready environments

Only one vPort (vPort 2) per physical port can be bound to FCoE. If FCoE is not desired, vPort 2 can be configured for one of the other modes.

- In pNIC mode, the expansion card can operate as a standard 10 Gbps or 1 Gbps 4-port Ethernet expansion card. When in pNIC mode, the expansion card functions with all supported I/O modules. In pNIC mode, the adapter with the CN4054 Virtual Fabric Adapter Upgrade, 90Y3558, applied operates in traditional Converged Network Adapter (CNA) mode with four ports of Ethernet and four ports of storage (iSCSI or FCoE) available to the operating system.

## Supported servers

The following table lists the Flex System compute nodes that support the adapters.

Table 2. Supported servers

Description	Part number	x220 (7906)	x222 (7916)	x240 (8737, E5-2600)	x240 (8737, E5-2600 v2)	x240 (7162)	x240 M5 (9532)	x440 (7917)	x440 (7167)	x280 / x480 / x880 X6 (7903)	x280 / x480 / x880 X6 (7196)
Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	Y	N	Y	N	N	N	Y	N	N	N
Flex System CN4054R 10Gb Virtual Fabric Adapter	00Y3306	N	N	N	Y	Y	Y	N	Y	Y*	Y**
Flex System CN4054 Virtual Fabric Adapter Upgrade	90Y3558	Y	N	Y	Y	Y	Y	Y	Y	Y*	Y

\* Only supported in slots 1 and 2 of the x280 X6, x480 X6, and x880 X6

\*\* The Flex System CN4054R 10Gb Virtual Fabric Adapter with two ASICs is not supported in slots 3 and 4

See ServerProven at the following web address for the latest information about the expansion cards that are supported by each blade server type: <http://www.lenovo.com/us/en/serverproven/flexsystem.shtml>

I/O adapter cards are installed in the slot in supported servers, such as the x240, as highlighted in the following figure.

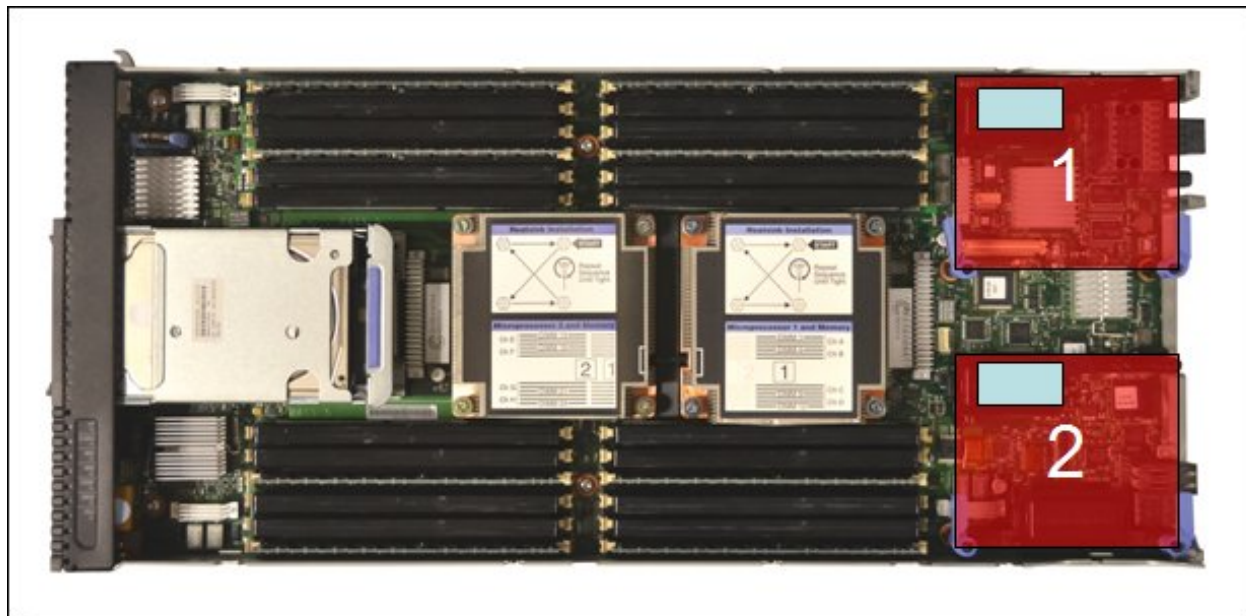


Figure 2. Location of the I/O adapter slots in the Flex System x240 Compute Node

## Embedded 10Gb Virtual Fabric Adapter

Some models of the x240 include a two-port Embedded 10Gb Virtual Fabric Adapter (VFA, also known as LAN on Motherboard or LOM) built into the system board:

- x240 models 8737-x2x and E5-2600 processors have an Embedded 10Gb Virtual Fabric Adapter based on the BE3 controller
- x240 models 8737-x4x and E5-2600 v2 processors have an Embedded 10Gb Virtual Fabric Adapter based on the BE3R controller

Each x240 model that includes the embedded 10Gb VFA also has the Compute Node Fabric Connector installed in I/O connector 1 (and physically screwed onto the system board) to provide connectivity to the Enterprise Chassis midplane.

The Fabric Connector enables port 1 on the Embedded 10Gb VFA to be routed to I/O module bay 1 and port 2 to be routed to I/O module bay 2. The Fabric Connector can be unscrewed and removed, if required, to allow the installation of an I/O adapter on I/O connector 1.

The Embedded 10Gb VFA has two 10 GbE ports and has the same features as the 4-port CN4054 10Gb Virtual Fabric Adapter. The Embedded 10Gb VFA also supports iSCSI and FCoE using the upgrade license listed in the following table.

Table 3. Feature on Demand upgrade for FCoE and iSCSI support

Part number	Description
90Y9310	Virtual Fabric Advanced Software Upgrade (LOM)

## Supported I/O modules

These adapters can be installed in any I/O adapter slot of a supported Flex System compute node. One or two compatible 1 Gb or 10 Gb I/O modules must be installed in the corresponding I/O bays in the chassis. The following table lists the switches that are supported. When connected to the 1 Gb switch, the adapter will operate at 1 Gb speeds. When connected to the 40 Gb switch, the adapter will operate at 10 Gb speeds.

To maximize the number of adapter ports usable, you may also need to order switch upgrades to enable additional ports as listed in the table. Alternatively, for CN4093, EN4093R, and SI4093 switches, you can use Flexible Port Mapping, a new feature of Networking OS 7.8, that allows you to minimize the number of upgrades needed. See the Product Guides for the switches for more details:

<https://lenovopress.com/servers/blades/networkmodule>

The table also specifies how many ports of the adapter are supported once the indicated upgrades are applied. Switches should be installed in pairs to maximize the number of ports enabled and to provide redundant network connections.

Table 4. I/O modules and upgrades for use with the CN4054 and CN4054R adapters

Description	Part number	Port count (per pair of switches)
Lenovo Flex System Fabric EN4093R 10Gb Scalable Switch + EN4093 10Gb Scalable Switch (Upgrade 1)	00FM514 49Y4798	4
Lenovo Flex System Fabric CN4093 10Gb Converged Scalable Switch + CN4093 10Gb Converged Scalable Switch (Upgrade 1)	00FM510 49Y4798	4
Lenovo Flex System SI4091 10Gb System Interconnect Module	00FE327	2
Lenovo Flex System Fabric SI4093 System Interconnect Module + SI4093 System Interconnect Module (Upgrade 1)	00FM518 95Y3318	4
Flex System EN6131 40Gb Ethernet Switch	90Y9346	2
Flex System Fabric CN4093 10Gb Converged Scalable Switch + CN4093 10Gb Converged Scalable Switch (Upgrade 1)	00D5823 49Y4798	4
Flex System Fabric EN4093R 10Gb Scalable Switch + EN4093 10Gb Scalable Switch (Upgrade 1)	95Y3309 49Y4798	4
Flex System Fabric EN4093 10Gb Scalable Switch + EN4093 10Gb Scalable Switch (Upgrade 1)	49Y4270 49Y4798	4
Flex System EN4091 10Gb Ethernet Pass-thru	88Y6043	2
Flex System Fabric SI4093 System Interconnect Module + SI4093 System Interconnect Module (Upgrade 1)	95Y3313 95Y3318	4
Flex System EN2092 1Gb Ethernet Scalable Switch + EN2092 1Gb Ethernet Scalable Switch (Upgrade 1)	49Y4294 90Y3562	4
Cisco Nexus B22 Fabric Extender for Flex System	94Y5350	2
Flex System EN4023 10Gb Scalable Switch (Base switch has 24 port licenses; Upgrades 1 & 2 may be needed)	94Y5212	4

\* This column indicates the number of adapter ports that will be active if indicated upgrades are installed.

The following table shows the connections between adapters installed in the compute nodes to the switch bays in the chassis.

Table 5. Adapter to I/O bay correspondence

I/O adapter slot in the server	Port on the adapter	Corresponding I/O module bay in the chassis
Slot 1	Port 1	Module bay 1
	Port 2	Module bay 2
	Port 3*	Module bay 1
	Port 4*	Module bay 2
Slot 2	Port 1	Module bay 3
	Port 2	Module bay 4
	Port 3*	Module bay 3
	Port 4*	Module bay 4
Slot 3 (full-wide compute nodes only)	Port 1	Module bay 1
	Port 2	Module bay 2
	Port 3*	Module bay 1
	Port 4*	Module bay 2
Slot 4 (full-wide compute nodes only)	Port 1	Module bay 3
	Port 2	Module bay 4
	Port 3*	Module bay 3
	Port 4*	Module bay 4

\* Ports 3 and 4 require Upgrade 1 of either the EN4093 10Gb or the EN2092 1Gb switch. The EN4091 Pass-thru and Cisco B22 only supports ports 1 and 2 (and only when two I/O modules are installed).

The connections between the adapters installed in the compute nodes to the switch bays in the chassis are shown diagrammatically in the following figure. The figure shows both half-wide servers, such as the x240 with two adapters, and full-wide servers, such as the p460 with four adapters.



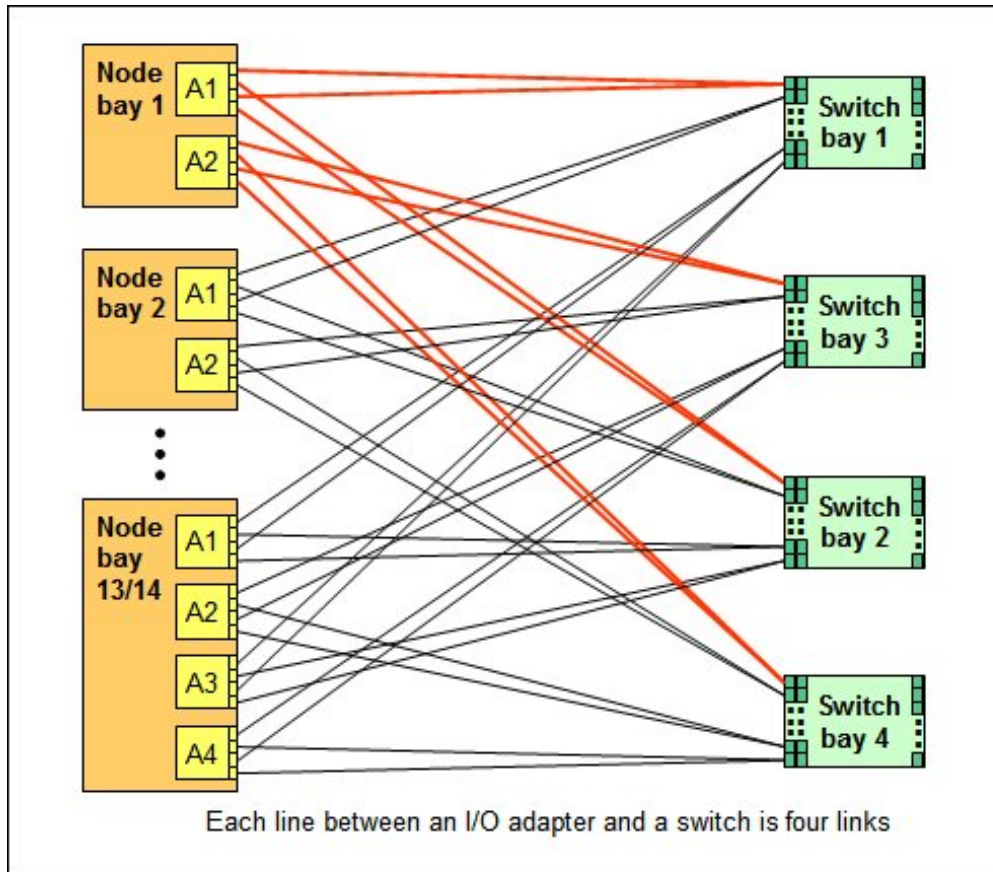


Figure 3. Logical layout of the interconnects between I/O adapters and I/O modules

## Operating system support

The Flex System CN4054 10Gb Virtual Fabric Adapter supports the following operating systems:

- Microsoft Windows Server 2008 HPC Edition
- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2008, Datacenter x64 Edition
- Microsoft Windows Server 2008, Enterprise x64 Edition
- Microsoft Windows Server 2008, Standard x64 Edition
- Microsoft Windows Server 2008, Web x64 Edition
- Microsoft Windows Server 2012
- Microsoft Windows Server 2012 R2
- Red Hat Enterprise Linux 5 Server with Xen x64 Edition
- Red Hat Enterprise Linux 5 Server x64 Edition
- Red Hat Enterprise Linux 6 Server x64 Edition
- Red Hat Enterprise Linux 7
- SUSE LINUX Enterprise Server 10 for AMD64/EM64T
- SUSE LINUX Enterprise Server 10 with Xen for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 with Xen for AMD64/EM64T
- VMware ESX 4.1
- VMware ESXi 4.1
- VMware vSphere 5.0 (ESXi)
- VMware vSphere 5.1 (ESXi)
- VMware vSphere 5.5 (ESXi)

The Flex System CN4054R 10Gb Virtual Fabric Adapter supports the following operating systems:

- Microsoft Windows Server 2008 HPC Edition
- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2008, Datacenter x64 Edition
- Microsoft Windows Server 2008, Enterprise x64 Edition
- Microsoft Windows Server 2008, Standard x64 Edition
- Microsoft Windows Server 2008, Web x64 Edition
- Microsoft Windows Server 2012
- Microsoft Windows Server 2012 R2
- Red Hat Enterprise Linux 5 Server with Xen x64 Edition
- Red Hat Enterprise Linux 5 Server x64 Edition
- Red Hat Enterprise Linux 6 Server x64 Edition
- Red Hat Enterprise Linux 7
- SUSE LINUX Enterprise Server 11 for AMD64/EM64T
- SUSE LINUX Enterprise Server 11 with Xen for AMD64/EM64T
- VMware vSphere 5.0 (ESXi)
- VMware vSphere 5.1 (ESXi)
- VMware vSphere 5.5 (ESXi)

Support for operating systems is based on the combination of the expansion card and the blade server on which it is installed. See the ServerProven website for the latest information about the specific versions and service packs supported. Select the blade server, and then select the expansion card to see the supported operating systems: <http://www.lenovo.com/us/en/serverproven/flexsystem.shtml>

## Warranty

There is a 1-year, customer-replaceable unit (CRU) limited warranty. When installed in a server, these adapters assume your system's base warranty and any Lenovo warranty service upgrade purchased for the system.

## Physical specifications

The dimensions and weight of the adapter are as follows:

- Width: 100 mm (3.9 inches)
- Depth: 80 mm (3.1 inches)
- Weight: 13 g (0.3 lb)

Shipping dimensions and weight (approximate):

- Height: 58 mm (2.3 in)
- Width: 229 mm (9.0 in)
- Depth: 208 mm (8.2 in)
- Weight: 0.4 kg (0.89 lb)

## Regulatory compliance

The adapter conforms to the following standards:

- United States FCC 47 CFR Part 15, Subpart B, ANSI C63.4 (2003), Class A
- United States UL 60950-1, Second Edition
- IEC/EN 60950-1, Second Edition
- FCC - Verified to comply with Part 15 of the FCC Rules, Class A
- Canada ICES-003, issue 4, Class A
- UL/IEC 60950-1
- CSA C22.2 No. 60950-1-03
- Japan VCCI, Class A
- Australia/New Zealand AS/NZS CISPR 22:2006, Class A
- IEC 60950-1(CB Certificate and CB Test Report)
- Taiwan BSMI CNS13438, Class A
- Korea KN22, Class A; KN24
- Russia/GOST ME01, IEC-60950-1, GOST R 51318.22-99, GOST R 51318.24-99, GOST R 51317.3.2-2006, GOST R 51317.3.3-99
- IEC 60950-1 (CB Certificate and CB Test Report)
- CE Mark (EN55022 Class A, EN60950-1, EN55024, EN61000-3-2, EN61000-3-3)
- CISPR 22, Class A

## Popular configurations

The adapters can be used in various configurations. The following figure shows CN4054 10Gb Virtual Fabric Adapters installed in both slots of the x240 (a model without the Embedded 10Gb Virtual Fabric Adapter), which in turn is installed in the chassis. The chassis also has four Flex System Fabric EN4093 10Gb Scalable Switches, each with Upgrade 1 installed to enable 28 internal ports.

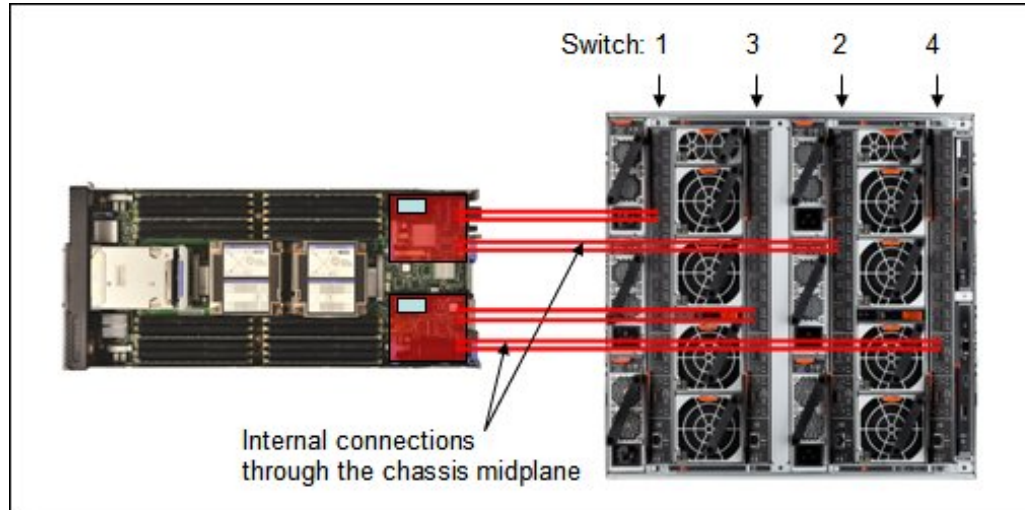


Figure 4. Example configuration

The following table lists the parts that are used in the configuration.

Table 6. Components used when connecting the adapter to the 10 GbE switches

Part number/machine type	Description	Quantity
8737-x1x	Flex System x240 Compute Node or other supported server (without Embedded 10Gb Virtual Fabric Adapter)	1 to 14
90Y3554	Flex System CN4054 10Gb Virtual Fabric Adapter	2 per server
8721-A1x	Flex System Enterprise Chassis	1
95Y3309	Flex System Fabric EN4093R 10Gb Scalable Switch	4
49Y4798	Flex System Fabric EN4093 10Gb Scalable Switch (Upgrade 1)	4

## Related publications

For more information refer to the following resources:

- Flex System Switch Product Guides  
<https://lenovopress.com/servers/blades/networkmodule>
- Flex System Server Product Guides  
<https://lenovopress.com/servers/blades/server>
- Flex System Information Center (User's Guides for servers and options)  
<http://publib.boulder.ibm.com/infocenter/flexsys/information>
- *Flex System Interoperability Guide*  
<http://lenovopress.com/fsig>
- *Flex System Products and Technology for x86 Systems*  
<http://lenovopress.com/sg248255>
- *System x Configuration and Options Guide*
- <http://ibm.com/systems/xbc/cog/>
- ServerProven for Flex System  
<http://www.lenovo.com/us/en/serverproven/flexsystem.shtml>

## Related product families

Product families related to this document are the following:

- [10 Gb Embedded Connectivity](#)
- [Blade Network Adapters](#)

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