Flex System Fabric EN4093R 10Gb Scalable Switch
Product Guide (withdrawn product)

The Flex System® Fabric EN4093R 10Gb Scalable Switch provides unmatched scalability, port flexibility and performance, while also delivering innovations to help address a number of networking concerns today and providing capabilities that will help you prepare for the future. This switch is capable of supporting up to sixty-four 10 Gb Ethernet connections while offering Layer 2/3 switching, in addition to OpenFlow and "easy connect" modes. It is designed to install within the I/O module bays of the Flex System Enterprise Chassis. This switch can help clients migrate to a 10 Gb or 40 Gb Ethernet infrastructure and offers cloud ready virtualization features like Virtual Fabric and VMready® in addition to being Software Defined Network (SDN) ready. The EN4093R switch is shown in Figure 1.

Figure 1. Flex System Fabric EN4093R 10Gb Scalable Switch

Did you know?

The base switch configuration comes standard with 24x 10 GbE port licenses that can be assigned to internal connections or external SFP+ or QSFP+ ports with flexible port mapping. For example, this feature allows you to trade off four 10 GbE ports for one 40 GbE port (or vice versa) or trade off one external 10 GbE SFP+ port for one internal 10 GbE port (or vice versa). You then have the flexibility of turning on more ports when you need them using Lenovo's Features on Demand upgrade licensing capabilities that provide “pay as you grow” scalability without the need to buy additional hardware.

The EN4093R is cloud ready with support for VM aware networking and advanced NIC virtualization technologies such as Unified Fabric Port (UFP). In addition, the switch offers different operational modes - from "easy connect" transparent networking connectivity to Layer 3 functionality - to satisfy diverse client networking requirements. The EN4093R switch is SDN ready with support for OpenFlow.

Part number information

The EN4093R switch is initially licensed for 24x 10 GbE ports. Further ports can be enabled with Upgrade 1 and Upgrade 2 license options. Upgrade 1 must be applied before Upgrade 2 can be applied. Table 1 shows the part numbers for ordering the switch and the upgrades.

Table 1. Part numbers and feature codes for ordering

Description	Part number	Feature code
Switch module		
Flex System Fabric EN4093R 10Gb Scalable Switch	95Y3309*	A3J6
Features on Demand upgrades		
Flex System Fabric EN4093 10Gb Scalable Switch (Upgrade 1)	49Y4798	A1EL
Flex System Fabric EN4093 10Gb Scalable Switch (Upgrade 2)	88Y6037	A1EM

* Withdrawn from marketing

The part number for the switch includes the following items:

- One Flex System Fabric EN4093R 10Gb Scalable Switch
- Documentation package

Note: SFP, SFP+, and QSFP+ transceivers or DAC cables are not included with the switch. They must be ordered separately (See Table 3).

The switch does not include a serial management cable. However, Flex System Management Serial Access Cable, 90Y9338, is supported and contains two cables, a mini-USB-to-RJ45 serial cable and a mini-USB-to-DB9 serial cable, either of which can be used to connect to the switch locally for configuration tasks and firmware updates.

The part numbers for the upgrades, 49Y4798 and 88Y6037, include the following items:

- Features on Demand Activation Flyer
- Upgrade authorization letter

The base switch and upgrades are as follows:

- 95Y3309 is the part number for the base physical device, and it comes with 14 internal 10 GbE ports enabled (one to each compute node) and ten external 10 GbE ports enabled.
- 49Y4798 (Upgrade 1) can be applied on the base switch when you take full advantage of four-port adapter cards installed in each compute node. This upgrade enables 14 additional internal ports, for a total of 28 ports. The upgrade also enables two 40 GbE external ports. This upgrade requires the base switch.
- 88Y6037 (Upgrade 2) can be applied on top of the Upgrade 1 when you need more external bandwidth on the switch or if you need additional internal bandwidth to the compute nodes with the six-port capable adapter cards. The upgrade will enable the remaining four external 10 GbE external ports, plus 14 additional internal 10 GbE ports, for a total of 42 internal ports (three to each compute node).

Flexible port mapping: With Networking OS version 7.8 or later clients have more flexibility in assigning ports that they have licensed on the EN4093R which can help eliminate or postpone the need to purchase upgrades. While the base model and upgrades still activate specific ports, flexible port mapping provides clients with the capability of reassigning ports as needed by moving internal and external 10 GbE ports, or trading off four 10 GbE ports for the use of an external 40 GbE port. This is very valuable when you

consider the flexibility with the base license and with Upgrade 1.

Note: Flexible port mapping is not available in Stacking mode.

With flexible port mapping, clients have licenses for a specific number of ports:

- 95Y3309 is the part number for the base switch, and it provides 24x 10 GbE port licenses that can enable any combination of internal and external 10 GbE ports and external 40 GbE ports (with the use of four 10 GbE port licenses per one 40 GbE port).
- 49Y4798 (Upgrade 1) upgrades the base switch by activation of 14 internal 10 GbE ports and two external 40 GbE ports which is equivalent to adding 22 more 10 GbE port licenses for a total of 46x 10 GbE port licenses. Any combination of internal and external 10 GbE ports and external 40 GbE ports (with the use of four 10 GbE port licenses per one 40 GbE port) can be enabled with this upgrade. This upgrade requires the base switch.
- 88Y6037 (Upgrade 2) requires the base switch and Upgrade 1 already be activated and simply activates all the ports on the EN4093R which is 42 internal 10 GbE ports, 14 external SFP+ ports, and two external QSFP+ ports.

Note: When both Upgrade 1 and Upgrade 2 are activated, flexible port mapping is no longer used because all the ports on the EN4093R are enabled.

Table 2 lists supported port combinations on the switch and required upgrades.

Table 2. Supported port combinations (Part 1: Default port mapping)

Supported port combinations (Default port mapping)	**Quantity required**		
	Base switch, 95Y3309	**Upgrade 1, 49Y4798**	**Upgrade 2, 88Y6037**
14x internal 10 GbE ports 10x external 10 GbE ports	1	0	0
28x internal 10 GbE ports 10x external 10 GbE ports 2x external 40 GbE ports	1	1	0
42x internal 10 GbE ports† 14x external 10 GbE ports 2x external 40 GbE ports	1	1	1

† This configuration leverages six of the eight ports on the CN4058S adapter.

Table 2. Supported port combinations (Part 2: Flexible port mapping*)

Supported port combinations (Flexible port mapping)	**Quantity required**		
	Base switch, 95Y3309	**Upgrade 1, 49Y4798**	**Upgrade 2, 88Y6037****
24x 10 GbE ports (internal and external) or 20x 10 GbE ports (internal and external) 1x external 40 GbE ports or 16x 10 GbE ports (internal and external) 2x external 40 GbE ports	1	0	0

46x 10 GbE ports (internal and external) or 42x 10 GbE ports (internal and external) 1x external 40 GbE ports or 38x 10 GbE ports (internal and external) 2x external 40 GbE ports	1	1	0

* Flexible port mapping is available in Networking OS 7.8 or later.
** Upgrade 2 is not used with flexible port mapping because with Upgrade 2 all ports on the switch become licensed and there is no need to reassign ports.

Supported cables and transceivers

With the flexibility of the EN4093R switch, clients can take advantage of the technologies that they require for multiple environments:

- For 1 GbE links, clients can use RJ-45 SFP transceivers with UTP cables up to 100 m. Clients that need longer distances can use a 1000BASE-SX transceiver, which can drive distances up to 220 meters by using 62.5 µ multi-mode fiber and up to 550 meters with 50 µ multi-mode fiber, or the 1000BASE-LX transceivers that support distances up to 10 kilometers using single-mode fiber (1310 nm).
- For 10 GbE (on external SFP+ ports), clients can use SFP+ direct-attached copper (DAC) cables for in-rack cabling and distances up to 7 m. These DAC cables have SFP+ connectors on each end, and they do not need separate transceivers. For longer distances the 10GBASE-SR transceiver can support distances up to 300 meters over OM3 multimode fiber or up to 400 meters over OM4 multimode fiber. The 10GBASE-LR transceivers can support distances up to 10 kilometers on single mode fiber.
  To increase the number of available 10 GbE ports, clients can split out four 10 GbE ports for each 40 GbE port using QSFP+ DAC breakout cables for distances up to 5 meters. For distances up to 100 m, the 40GBASE-iSR4 QSFP+ transceivers can be used with OM3 optical MTP-to-LC break-out cables or up to 150 m with OM4 optical MTP-to-LC break-out cables. For longer distances, the 40GBASE-eSR4 transceivers can be used with OM3 optical break-out cables for distances up to 300 m or OM4 optical break-out cables for distances up to 400 m.
- For 40 GbE to 40 GbE connectivity, clients can use the affordable QSFP+ to QSFP+ DAC cables for distances up to 7 meters. For distances up to 100 m, the 40GBASE-SR4/iSR4 QSFP+ transceivers can be used with OM3 multimode fiber or up to 150 m when using OM4 multimode fiber. For distances up to 300 m, the 40GBASE-eSR4 QSFP+ transceiver can be used with OM3 multimode fiber or up to 400 m when using OM4 multimode fiber. For distances up to 10 km, the 40GBASE-LR QSFP+ transceiver can be used with single mode fiber.

Table 3 lists the supported cables and transceivers.

Table 3. Supported transceivers and direct-attach cables

Description	Part number	Feature code	Maximum supported
Serial console cables			
Flex System Management Serial Access Cable Kit	90Y9338	A2RR	1
SFP transceivers - 1 GbE			
Lenovo 1000BASE-T SFP Transceiver (does not support 10/100 Mbps)	00FE333	A5DL	14
Lenovo 1000BASE-SX SFP Transceiver	81Y1622	3269	14
Lenovo 1000BASE-LX SFP Transceiver	90Y9424	A1PN	14
SFP+ transceivers - 10 GbE			
Lenovo 10GBASE-SR SFP+ Transceiver	46C3447	5053	14
Lenovo 10GBASE-LR SFP+ Transceiver	90Y9412	A1PM	14
Optical cables for 1 GbE SX SFP and 10 GbE SR SFP+ transceivers			
Lenovo 1m LC-LC OM3 MMF Cable	00MN502	ASR6	14
Lenovo 3m LC-LC OM3 MMF Cable	00MN505	ASR7	14
Lenovo 5m LC-LC OM3 MMF Cable	00MN508	ASR8	14
Lenovo 10m LC-LC OM3 MMF Cable	00MN511	ASR9	14
Lenovo 15m LC-LC OM3 MMF Cable	00MN514	ASRA	14

Description	Part number	Feature code	Maximum supported
Lenovo 25m LC-LC OM3 MMF Cable	00MN517	ASRB	14
Lenovo 30m LC-LC OM3 MMF Cable	00MN520	ASRC	14
SFP+ direct-attach cables - 10 GbE			
Lenovo 1m Passive SFP+ DAC Cable	90Y9427	A1PH	14
Lenovo 1.5m Passive SFP+ DAC Cable	00AY764	A51N	14
Lenovo 2m Passive SFP+ DAC Cable	00AY765	A51P	14
Lenovo 3m Passive SFP+ DAC Cable	90Y9430	A1PJ	14
Lenovo 5m Passive SFP+ DAC Cable	90Y9433	A1PK	14
Lenovo 7m Passive SFP+ DAC Cable	00D6151	A3RH	14
QSFP+ transceiver and cables - 40 GbE			
Lenovo 40GBASE-SR4 QSFP+ Transceiver	49Y7884	A1DR	2
Lenovo 40GBASE-iSR4 QSFP+ Transceiver	00D9865	ASTM	2
Lenovo 40GBASE–eSR4 QSFP+ Transceiver	00FE325	A5U9	2
Lenovo 40GBASE-LR4 QSFP+ Transceiver	00D6222	A3NY	2
Optical cables for 40 GbE QSFP+ SR4/iSR4/eSR4 transceivers			
Lenovo 10m QSFP+ MTP-MTP OM3 MMF Cable	90Y3519	A1MM	2
Lenovo 30m QSFP+ MTP-MTP OM3 MMF Cable	90Y3521	A1MN	2
Lenovo 10m QSFP+ MTP-MTP OM3 MMF Cable (replaces 90Y3519)	00VX003	AT2U	2
Lenovo 30m QSFP+ MTP-MTP OM3 MMF Cable (replaces 90Y3521)	00VX005	AT2V	2
Optical breakout cables for 40 GbE QSFP+ iSR4/eSR4 transceivers			
Lenovo 1m MTP-4xLC OM3 MMF Breakout Cable	00FM412	A5UA	2
Lenovo 3m MTP-4xLC OM3 MMF Breakout Cable	00FM413	A5UB	2
Lenovo 5m MTP-4xLC OM3 MMF Breakout Cable	00FM414	A5UC	2
QSFP+ breakout cables - 40 GbE to 4x10 GbE			
Lenovo 1m Passive QSFP+ to SFP+ Breakout DAC Cable	49Y7886	A1DL	2
Lenovo 3m Passive QSFP+ to SFP+ Breakout DAC Cable	49Y7887	A1DM	2
Lenovo 5m Passive QSFP+ to SFP+ Breakout DAC Cable	49Y7888	A1DN	2
QSFP+ direct-attach cables - 40 GbE			
Lenovo 1m Passive QSFP+ DAC Cable	49Y7890	A1DP	2
Lenovo 3m Passive QSFP+ DAC Cable	49Y7891	A1DQ	2
Lenovo 5m Passive QSFP+ DAC Cable	00D5810	A2X8	2
Lenovo 7m Passive QSFP+ DAC Cable	00D5813	A2X9	2

Benefits

The Flex System Fabric EN4093R 10Gb Scalable Switch is considered particularly suited for these clients:

- Clients who want to use 10 GbE communications between compute nodes in the chassis but still require upstream 1 GbE connections to their existing infrastructure.
- Clients who are implementing a virtualized environment.
- Clients who require investment protection for 40 GbE external ports.
- Clients who want to reduce TCO and improve performance, while maintaining high levels of availability and security.
- Clients interested in Software Defined Networking using the OpenFlow standard.
- Clients who want to avoid or minimize oversubscription, which can result in congestion and loss of performance.
- Clients who want to implement a converged infrastructure with NAS, iSCSI or FCoE. For FCoE implementations, the EN4093R acts as a transit switch forwarding FCoE traffic upstream to other devices like the RackSwitch™ G8264CS, Brocade VDX, or Cisco Nexus 5548/5596, where the FC traffic is broken out.

The switches offer the following key features and benefits:

- Increased performance
  With the growth of virtualization and the evolution of cloud, many of today's applications require low latency and high bandwidth performance. The EN4093R is the embedded 10 GbE switch for a compute node chassis to support sub-microsecond latency and up to 1.28 Tbps, while also delivering full line rate performance, making it ideal for managing dynamic workloads across the network. Furthermore, this switch provides a rich Layer 2 and Layer 3 feature set that is ideal for many of today's data centers, and it offers industry-leading external bandwidth by being the first integrated switch to support 40 GbE external ports.

- Pay as you grow investment protection and lower total cost of ownership
  The EN4093R flexible port mapping allows you to buy only the ports that you need, when you need them to lower acquisition and operational costs. The base switch configuration includes 24x 10 GbE port licenses that can be assigned to internal connections and 10 GbE or even 40 GbE (by using four 10 GbE licenses per 40 GbE port) external ports. You then have the flexibility of turning on more 10 GbE internal connections and more 10 GbE or 40 GbE external ports when you need them using Lenovo Features on Demand licensing capabilities that provide "pay as you grow" scalability without the need for additional hardware.

- Cloud ready - Optimized network virtualization with virtual NICs
  With the majority of IT organizations implementing virtualization, there has been an increased need to reduce the cost and complexity of their environments. Lenovo is helping to address these requirements by removing multiple physical I/O ports. Virtual Fabric provides a way for companies to carve up 10 GbE ports into virtual NICs (vNICs) to meet those requirements with Intel processor-based compute nodes.

  To help deliver maximum performance per vNIC and to provide higher availability and security with isolation between vNICs, the switch leverages capabilities of its Networking Operating System. For large-scale virtualization, the Flex System solution can support up to 32 vNICs using a pair of CN4054 10Gb Virtual Fabric Adapters in each compute node and four EN4093R 10Gb Scalable Switches in the chassis.

  The EN4093R switch offers the benefits of next-generation vNIC - Unified Fabric Port (UFP). UFP is an advanced, cost-effective solution that provides a flexible way for clients to allocate, reallocate, and adjust bandwidth to meet their ever-changing data center requirements.

- Cloud ready - VM-aware networking
  Delivering advanced virtualization awareness helps simplify management and automates VM mobility by making the network VM aware with VMready, which works with all the major hypervisors. For companies using VMware or KVM, Defined Network for Virtual Environment (SDN VE, sold separately) enables network administrators to simplify management by having a consistent virtual and physical networking environment. SDN VE virtual and physical switches use the same configurations, policies, and management tools. Network policies migrate automatically along with virtual machines (VMs) to ensure that security, performance, and access remain intact as VMs move from compute node to compute node.

  Support for Edge Virtual Bridging (EVB) based on the IEEE 802.1Qbg standard enables scalable, flexible management of networking configuration and policy requirements per VM and eliminates many of the networking challenges introduced with server virtualization.

- Simplified network infrastructure
  The EN4093R 10Gb Scalable Switch simplifies deployment and growth because of its innovative scalable architecture. This architecture helps increase return on investment by reducing the qualification cycle, while providing investment protection for additional I/O bandwidth requirements in the future. The extreme flexibility of the switch comes from the ability to turn on additional ports as required, both down to the compute node and for upstream connections (including 40 GbE). Also, as you consider migrating to a converged LAN and SAN, the EN4093R switch supports the newest protocols, including Data Center Bridging/Converged Enhanced Ethernet (DCB/CEE) that can be leveraged in either an iSCSI, Fibre Channel over Ethernet (FCoE), or NAS converged environment.

  EN4093R's stacking capabilities simplify management for clients by stacking up to eight switches that share one IP address and one management interface. Support for Switch Partition (SPAR) allows clients to virtualize the switch with partitions that isolate communications for multi-tenancy environments.

- Transparent networking capability
  With a simple configuration change to "easy connect" mode, the EN4093R switch becomes a transparent network device, invisible to the core, eliminating network administration concerns of Spanning Tree Protocol configuration/interoperability, VLAN assignments and avoidance of possible loops.

  By emulating a host NIC to the data center core, it accelerates the provisioning of VMs by eliminating the need to configure the typical access switch parameters.

- SDN ready - OpenFlow enabled
  The EN4093R switch is Lenovo's first 10 GbE Flex System offering with OpenFlow. OpenFlow is the new open protocol that enables the network administrator to easily configure and manage virtual networks that control traffic on a "per-flow" basis. OpenFlow creates multiple independent virtual networks and related policies without dealing with the complexities of the underlying physical network and protocols.

- Integrated network management
  A key challenge is the management of a discrete network environment. The EN4093R 10Gb Scalable Switch is tightly integrated and managed through Flex System Manager. The switch also supports a command-line interface (CLI) for integration into existing scripting and automation. Network management can be simplified by using port profiles, topology views, and virtualization management.

  Switch Center is used for more advanced levels of management and control, which can significantly reduce deployment and day-to-day maintenance times, while providing in-depth visibility into the network performance and operations of Lenovo switches. Plus, when leveraging tools like VMware vCenter Server (formerly VMware VirtualCenter) or vSphere, Switch Center provides additional integration for better optimization.

Features and specifications

Note: Features and specifications listed in this section are based on Networking OS 7.8.

The Flex System Fabric EN4093R 10Gb Scalable Switch has the following features and specifications:

- Internal ports
  - 42 internal full-duplex 10 Gigabit ports.
  - Two internal full-duplex 1 GbE ports connected to the chassis management module.
- External ports
  - 14 ports for 1 Gb or 10 Gb Ethernet SFP+ transceivers (support for 1000BASE-SX, 1000BASE-LX, 1000BASE-T, 10GBASE-SR, or 10GBASE-LR) or SFP+ direct-attach copper cables. SFP+ modules and DAC cables are not included and must be purchased separately.
  - Two ports for 40 Gb Ethernet QSFP+ transceivers, QSFP+ to QSFP+ DAC cables, or QSFP+ to 4x 10 Gb SFP+ break-out cables. QSFP+ modules and DAC cables are not included and must be purchased separately.
  - One RS-232 serial port (mini-USB connector) that provides an additional means to configure the switch module.
- Scalability and performance
  - 40 Gb Ethernet ports for extreme external bandwidth and performance
  - Fixed-speed external 10 Gb Ethernet ports to leverage 10 GbE core infrastructure
  - Non-blocking architecture with wire-speed forwarding of traffic and aggregated throughput of 1.28 Tbps
  - Media access control (MAC) address learning: automatic update, support for up to 128,000 MAC addresses
  - Up to 128 IP interfaces per switch
  - Static and LACP (IEEE 802.3ad) link aggregation, up to 220 Gb of total external bandwidth per switch, up to 64 trunk groups, up to 16 ports per group
  - Support for jumbo frames (up to 9,216 bytes)
  - Broadcast/multicast storm control
  - IGMP snooping to limit flooding of IP multicast traffic
  - IGMP filtering to control multicast traffic for hosts participating in multicast groups
  - Configurable traffic distribution schemes over trunk links based on source/destination IP or MAC addresses, or both
  - Fast port forwarding and fast uplink convergence for rapid STP convergence
- Availability and redundancy
  - Virtual Router Redundancy Protocol (VRRP) for Layer 3 router redundancy
  - IEEE 802.1D STP for providing L2 redundancy
  - IEEE 802.1s Multiple STP (MSTP) for topology optimization, up to 32 STP instances are supported by a single switch
  - IEEE 802.1w Rapid STP (RSTP) provides rapid STP convergence for critical delay-sensitive traffic like voice or video
  - Per-VLAN Rapid STP (PVRST) enhancements
  - Layer 2 Trunk Failover to support active/standby configurations of network adapter teaming on compute nodes
  - Hot Links provides basic link redundancy with fast recovery for network topologies that require Spanning Tree to be turned off
- VLAN support
  - Up to 4095 VLANs supported per switch, with VLAN numbers ranging from 1 to 4095 (4095 is used for management module's connection only.)
  - 802.1Q VLAN tagging support on all ports
  - Private VLANs
- Security

        - VLAN-based, MAC-based, and IP-based access control lists (ACLs)
        - 802.1x port-based authentication
        - Multiple user IDs and passwords
        - User access control
        - Radius, TACACS+ and LDAP authentication and authorization
        - NIST 800-131A Encryption
        - Selectable encryption protocol; SHA 256 enabled as default
        - IPv6 ACL metering
- Quality of Service (QoS)
    - Support for IEEE 802.1p, IP ToS/DSCP, and ACL-based (MAC/IP source and destination addresses, VLANs) traffic classification and processing
    - Traffic shaping and re-marking based on defined policies
    - Eight Weighted Round Robin (WRR) priority queues per port for processing qualified traffic
- IP v4 Layer 3 functions
    - Host management
    - IP forwarding
    - IP filtering with ACLs, up to 896 ACLs supported
    - VRRP for router redundancy
    - Support for up to 128 static routes
    - Routing protocol support (RIP v1, RIP v2, OSPF v2, BGP-4); up to 2048 entries in a routing table
    - Support for DHCP Relay
    - Support for IGMP snooping and IGMP relay
    - Support for Protocol Independent Multicast (PIM) in Sparse Mode (PIM-SM) and Dense Mode (PIM-DM).
- IPv6 Layer 3 functions
    - IPv6 host management (except default switch management IP address)
    - IPv6 forwarding
    - Up to 128 static routes
    - Support for OSPF v3 routing protocol
    - IPv6 filtering with ACLs
    - Virtual Station Interface Data Base (VSIDB) support
- OpenFlow support
    - OpenFlow 1.0 and 1.3.1
    - OpenFlow hybrid mode
- Virtualization
    - Virtual NICs (vNICs)
        - Ethernet, iSCSI, or FCoE traffic is supported on vNICs
    - Unified fabric ports (UFPs)
        - Ethernet or FCoE traffic is supported on UFPs
        - Supports up to 256 VLAN for the virtual ports
        - Integration with L2 failover
    - Virtual link aggregation groups (vLAGs)
    - 802.1Qbg Edge Virtual Bridging (EVB) is an emerging IEEE standard for allowing networks to become virtual machine (VM)-aware.
        - Virtual Ethernet Bridging (VEB) and Virtual Ethernet Port Aggregator (VEPA) are mechanisms for switching between VMs on the same hypervisor.
        - Edge Control Protocol (ECP) is a transport protocol that operates between two peers over an IEEE 802 LAN providing reliable, in-order delivery of upper layer protocol data units.
        - Virtual Station Interface (VSI) Discovery and Configuration Protocol (VDP) allows centralized configuration of network policies that will persist with the VM, independent of its location.

        - EVB Type-Length-Value (TLV) is used to discover and configure VEPA, ECP, and VDP.
    - VMready
    - Switch partitioning (SPAR)
        - SPAR forms separate virtual switching contexts by segmenting the data plane of the module. Data plane traffic is not shared between SPARs on the same switch.
        - SPAR operates as a Layer 2 broadcast network. Hosts on the same VLAN attached to a SPAR can communicate with each other and with the upstream switch. Hosts on the same VLAN but attached to different SPARs communicate through the upstream switch.
        - SPAR is implemented as a dedicated VLAN with a set of internal compute node ports and a single external port or link aggregation (LAG). Multiple external ports or LAGs are not allowed in SPAR. A port can be a member of only one SPAR.
- Converged Enhanced Ethernet
    - Priority-Based Flow Control (PFC) (IEEE 802.1Qbb) extends 802.3x standard flow control to allow the switch to pause traffic based on the 802.1p priority value in each packet's VLAN tag.
    - Enhanced Transmission Selection (ETS) (IEEE 802.1Qaz) provides a method for allocating link bandwidth based on the 802.1p priority value in each packet's VLAN tag.
    - Data Center Bridging Capability Exchange Protocol (DCBX) (IEEE 802.1AB) allows neighboring network devices to exchange information about their capabilities.
    - Support for SPAR and FCoE
- Fibre Channel over Ethernet (FCoE)
    - FC-BB5 FCoE specification compliant
    - FCoE transit switch operations
    - FCoE Initialization Protocol (FIP) support for automatic ACL configuration
    - FCoE Link Aggregation Group (LAG) support
    - Multi-hop RDMA over Converged Ethernet (RoCE) with LAG support
    - Supports 2,000 secure FCoE sessions with FIP Snooping by using Class ID ACLs
- Stacking
    - Up to eight switches in a stack - single IP management
    - Hybrid stacking support (from two to six EN4093R switches with two CN4093 switches)
    - FCoE support
        - FCoE LAG on external ports
    - 802.1Qbg support
    - vNIC and UFP support
        - Support for UFP with 802.1Qbg
- Manageability
    - Simple Network Management Protocol (SNMP V1, V2 and V3)
    - HTTP browser GUI
    - Telnet interface for CLI
    - SSH
    - Secure FTP (sFTP)
    - Service Location Protocol (SLP)
    - Serial interface for CLI
    - Scriptable CLI
    - Firmware image update (TFTP and FTP)
    - Network Time Protocol (NTP) and Precision Time Protocol (PTP) for switch clock synchronization
- Monitoring
    - Switch LEDs for external port status and switch module status indication
    - Remote Monitoring (RMON) agent to collect statistics and proactively monitor switch performance
    - Port mirroring for analyzing network traffic passing through switch

- Change tracking and remote logging with syslog feature
- Support for sFLOW agent for monitoring traffic in data networks (separate sFLOW analyzer required elsewhere)
- POST diagnostics

The following features are not supported with IPv6:

- Default switch management IP address
- SNMP trap host destination IP address
- Bootstrap Protocol (BOOTP) and DHCP
- RADIUS, TACACS+ and LDAP
- QoS metering and re-marking ACLs for out-profile traffic
- VMware Virtual Center (vCenter) for VMready
- Routing Information Protocol (RIP)
- Internet Group Management Protocol (IGMP)
- Border Gateway Protocol (BGP)
- Virtual Router Redundancy Protocol (VRRP)
- sFLOW

Standards supported

The switch supports the following standards:

- IEEE 802.1AB Data Center Bridging Capability Exchange Protocol (DCBX)
- IEEE 802.1D Spanning Tree Protocol (STP)
- IEEE 802.1p Class of Service (CoS) prioritization
- IEEE 802.1s Multiple STP (MSTP)
- IEEE 802.1Q Tagged VLAN (frame tagging on all ports when VLANs are enabled)
- IEEE 802.1Qbg Edge Virtual Bridging
- IEEE 802.1Qbb Priority-Based Flow Control (PFC)
- IEEE 802.1Qaz Enhanced Transmission Selection (ETS)
- IEEE 802.1x port-based authentication
- IEEE 802.1w Rapid STP (RSTP)
- IEEE 802.3 10BASE-T Ethernet
- IEEE 802.3ab 1000BASE-T copper twisted pair Gigabit Ethernet
- IEEE 802.3ad Link Aggregation Control Protocol
- IEEE 802.3ae 10GBASE-KR backplane 10 Gb Ethernet
- IEEE 802.3ae 10GBASE-SR short range fiber optics 10 Gb Ethernet
- IEEE 802.3ae 10GBASE-LR long range fiber optics 10 Gb Ethernet
- IEEE 802.3ba 40GBASE-SR4 short range fiber optics 40 Gb Ethernet
- IEEE 802.3ba 40GBASE-CR4 copper 40 Gb Ethernet
- IEEE 802.3u 100BASE-TX Fast Ethernet
- IEEE 802.3x Full-duplex Flow Control
- IEEE 802.3z 1000BASE-SX short range fiber optics Gigabit Ethernet
- IEEE 802.3z 1000BASE-LX long range fiber optics Gigabit Ethernet
- SFF-8431 10GSFP+Cu SFP+ Direct Attach Cable

Chassis and adapters

The switches are installed in I/O module bays in the rear of the Flex System chassis, as shown in Figure 2. Switches are normally installed in pairs because ports on the I/O adapter cards installed in the compute nodes are routed to two I/O bays for redundancy and performance.

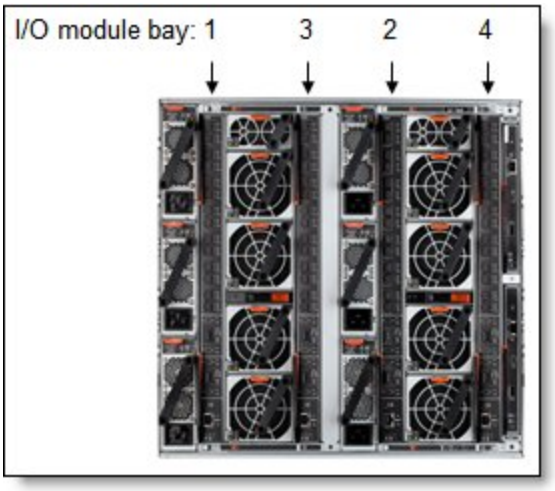

Figure 2. Location of the I/O bays in the Flex System chassis

The EN4093R switch can be installed in bays 1, 2, 3, and 4 of the Flex System chassis. A supported adapter card must be installed in the corresponding slot of the compute node. Each adapter can use up to four lanes to connect to the respective I/O module bay. The EN4093R is able to use up to three of the four lanes.

Prior to Networking OS 7.8, with four-port adapters, an optional Upgrade 1 (49Y4798) was required for the switch to allow communications on all four ports. With eight-port adapters, both optional Upgrade 1 (49Y4798) and Upgrade 2 (88Y6037) were required for the switch to allow communications on six adapter ports, and two remaining ports are not used. With Networking OS 7.8 or later, there is no need to buy additional switch upgrades for 4-port and 8-port adapters if the total number of port licenses on the switch does not exceed the number of external (upstream network ports) and internal (compute node network ports) connections used.

In compute nodes that have an integrated dual-port 10 GbE network interface controller (NIC), NIC ports are routed to bays 1 and 2 with a specialized periscope connector, and the adapter card is not required. However, when needed, the periscope connector can be replaced with the adapter card. In this case, integrated NIC will be disabled.

Table 4 shows compatibility information for the EN4093R and Flex System chassis.

Table 4. Flex System chassis compatibility

Description	Part number	Enterprise Chassis with CMM	Enterprise Chassis with CMM2	Carrier-grade Chassis with CMM2
Flex System Fabric EN4093R 10Gb Scalable Switch	95Y3309	Yes	Yes	No

The midplane 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 compute nodes, such as the x240 with two adapters, and full-wide compute nodes, such as the x440 with four

adapters.

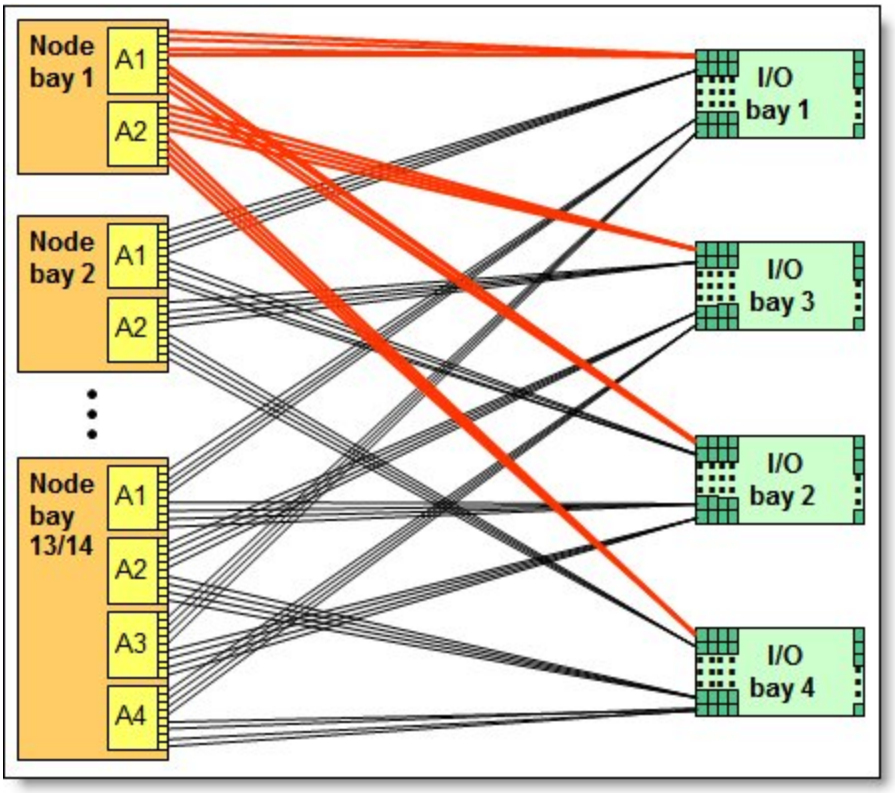

Figure 3. Logical layout of the interconnects between I/O adapters and I/O modules

Table 5 shows the connections between adapters installed in the compute nodes to the I/O bays in the chassis.

Table 5. Adapter to I/O bay correspondence

I/O adapter slot in the compute node	Port on the adapter	Corresponding I/O module bay in the chassis			
		Bay 1	Bay 2	Bay 3	Bay 4
Slot 1	Port 1	Yes			
	Port 2		Yes		
	Port 3	Yes			
	Port 4		Yes		
	Port 5	Yes			
	Port 6		Yes		
	Port 7*				
	Port 8*				

Slot 2	Port 1			Yes	
	Port 2				Yes
	Port 3			Yes	
	Port 4				Yes
	Port 5			Yes	
	Port 6				Yes
	Port 7*				
	Port 8*				
Slot 3 (full-wide compute nodes only)	Port 1	Yes			
	Port 2		Yes		
	Port 3	Yes			
	Port 4		Yes		
	Port 5	Yes			
	Port 6		Yes		
	Port 7*				
	Port 8*				
Slot 4 (full-wide compute nodes only)	Port 1			Yes	
	Port 2				Yes
	Port 3			Yes	
	Port 4				Yes
	Port 5			Yes	
	Port 6				Yes
	Port 7*				
	Port 8*				

* Ports 7 and 8 are routed to I/O bays 1 and 2 (Slot 1 and Slot 3) or 3 and 4 (Slot 2 and Slot 4), but these ports cannot be used with the EN4093R.

The following table lists the adapters that are supported by the I/O module.

Table 6. Network adapters

Description	**Part number**	**Feature code**
50 Gb Ethernet		
ThinkSystem QLogic QL45212 Flex 50Gb 2-Port Ethernet Adapter	7XC7A05843	B2VT
ThinkSystem QLogic QL45262 Flex 50Gb 2-Port Ethernet Adapter with iSCSI/FCoE	7XC7A05845	B2VV
25 Gb Ethernet		
ThinkSystem QLogic QL45214 Flex 25Gb 4-Port Ethernet Adapter	7XC7A05844	B2VU
10 Gb Ethernet		
Embedded 10Gb Virtual Fabric Adapter (2-port)†	None	None
Flex System CN4022 2-port 10Gb Converged Adapter	88Y5920	A4K3
Flex System CN4052 2-port 10Gb Virtual Fabric Adapter	00JY800*	A5RP
Flex System CN4052S 2-port 10Gb Virtual Fabric Adapter	00AG540	ATBT
Flex System CN4052S 2-port 10Gb Virtual Fabric Adapter Advanced	01CV780	AU7X

Flex System CN4054 10Gb Virtual Fabric Adapter (4-port)	90Y3554*	A1R1
Flex System CN4054R 10Gb Virtual Fabric Adapter (4-port)	00Y3306*	A4K2
Flex System CN4054S 4-port 10Gb Virtual Fabric Adapter	00AG590	ATBS
Flex System CN4054S 4-port 10Gb Virtual Fabric Adapter Advanced	01CV790	AU7Y
Flex System CN4058S 8-port 10Gb Virtual Fabric Adapter	94Y5160	A4R6
Flex System EN4132 2-port 10Gb Ethernet Adapter	90Y3466	A1QY
Flex System EN4172 2-port 10Gb Ethernet Adapter	00AG530	A5RN
1 Gb Ethernet		
Embedded 1 Gb Ethernet controller (2-port)**	None	None
Flex System EN2024 4-port 1Gb Ethernet Adapter	49Y7900	A10Y

* Withdrawn from marketing
† The Embedded 10Gb Virtual Fabric Adapter is built into selected compute nodes.
** The Embedded 1 Gb Ethernet controller is built into selected compute nodes.

The adapters are installed in slots in each compute node. Figure 4 shows the locations of the slots in the x240 Compute Node. The positions of the adapters in the other supported compute nodes are similar.

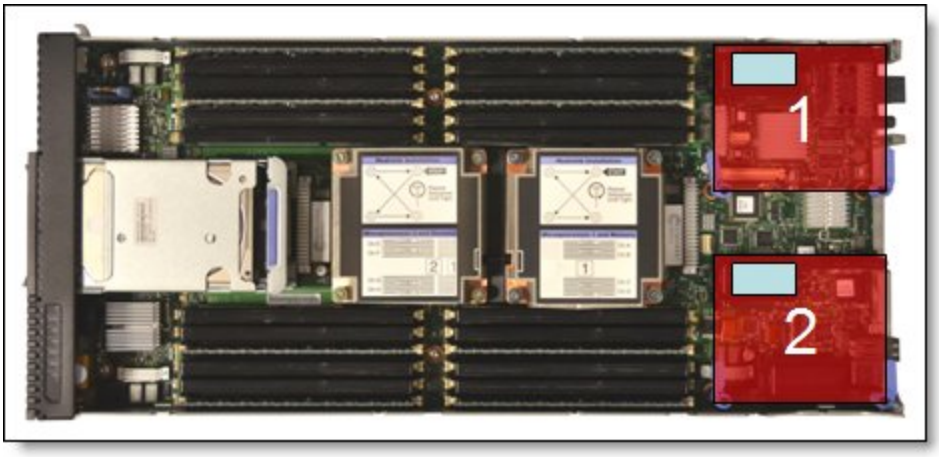

Figure 4. Location of the I/O adapter slots in the Flex System x240 Compute Node

Connectors and LEDs

Figure 5 shows the front panel of the Flex System Fabric EN4093R 10Gb Scalable Switch.

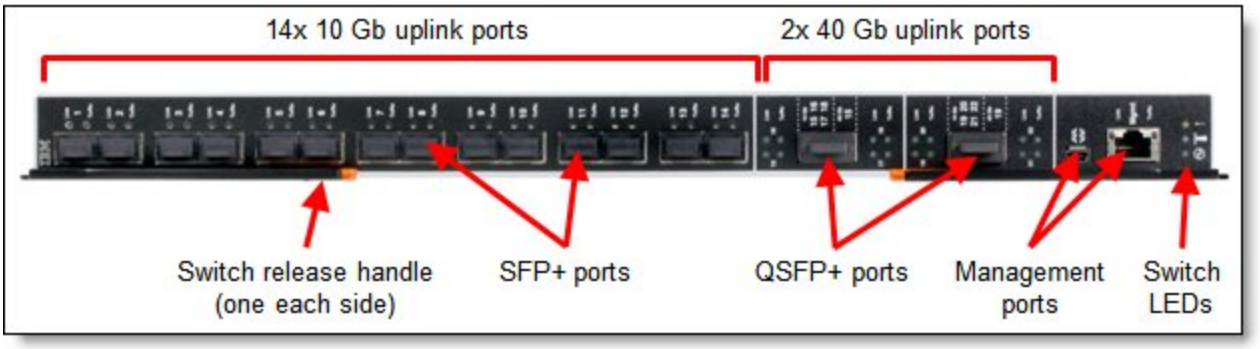

Figure 5. Front panel of the Flex System Fabric EN4093R 10Gb Scalable Switch

The front panel contains the following components:

- LEDs that display the status of the switch module and the network:
  - The OK LED indicates that the switch module has passed the power-on self-test (POST) with no critical faults and is operational.
  - Identify: This blue LED can be used to identify the switch physically by illuminating via the management software.
  - The error LED (switch module error) indicates that the switch module has failed the POST or detected an operational fault.
- One mini-USB RS-232 console port that provides an additional means to configure the switch module. This mini-USB-style connector enables connection of a special serial cable. (The cable is optional and it is not included with the switch. See the Part number information section for details.)
- Fourteen external SFP+ ports for 1 GbE or 10 GbE connections.
- Two external QSFP+ port connectors to attach QSFP+ transceivers or cables for a single 40 GbE connectivity or for splitting of a single port into 4x 10 GbE connections.
- An Ethernet link OK LED and an Ethernet Tx/Rx LED for each external port on the switch module.

Network cabling requirements

The network cables that can be used with the EN4093R switch are shown in Table 7.

Table 7. EN4093R network cabling requirements

Transceiver	Standard	Cable	Connector
40 Gb Ethernet			
40GBASE-SR4 QSFP+ Transceiver (49Y7884)	40GBASE-SR4	10 m or 30 m MTP fiber optics cables supplied by Lenovo (see Table 3); support for up to 100 m with OM3 multimode fiber or up to 150 m with OM4 multimode fiber	MTP
40GBASE-iSR4 QSFP+ Transceiver (00D9865)	40GBASE-SR4	10 m or 30 m MTP fiber optics cables or MTP-4xLC breakout cables up to 5 m supplied by Lenovo (see Table 3); support for up to 100 m with OM3 multimode fiber or up to 150 m with OM4 multimode fiber	MTP
40GBASE-eSR4 QSFP+ Transceiver (00FE325)	40GBASE-SR4	10 m or 30 m MTP fiber optics cables or MTP-4xLC breakout cables up to 5 m supplied by Lenovo (see Table 3); support for up to 300 m with OM3 multimode fiber or up to 400 m with OM4 multimode fiber	MTP
40GBASE-LR4 QSFP+ Transceiver (00D6222)	40GBASE-LR4	1310 nm single-mode fiber cable up to 10 km	LC
Direct attach cable	40GBASE-CR4	QSFP+ to QSFP+ DAC cables up to 7 m; QSFP+ to 4x SFP+ DAC break-out cables up to 5 m for 4x 10 GbE SFP+ connections out of a 40 GbE port (see Table 3)	QSFP+
10 Gb Ethernet			
10GBASE-SR SFP+ Transceiver (46C3447)	10GBASE-SR	Up to 30 m with fiber optic cables supplied by Lenovo (see Table 3); 850 nm OM3 multimode fiber cable up to 300 m or up to 400 m with OM4 multimode fiber	LC
10GBASE-LR SFP+ Transceiver (90Y9412)	10GBASE-LR	1310 nm single-mode fiber cable up to 10 km	LC
Direct attach cable	10GSFP+Cu	SFP+ DAC cables up to 7 m (see Table 3)	SFP+
1 Gb Ethernet			
1000BASE-T SFP Transceiver (00FE333)	1000BASE-T	UTP Category 5, 5E, and 6 up to 100 meters	RJ-45
1000BASE-SX SFP Transceiver (81Y1622)	1000BASE-SX	Up to 30 m with fiber optic cables supplied by Lenovo (see Table 3); 850 nm multimode fiber cable up to 550 m (50 µ) or up to 220 m (62.5 µ)	LC
1000BASE-LX SFP Transceiver (90Y9424)	1000BASE-LX	1310 nm single-mode fiber cable up to 10 km	LC
Management ports			

Transceiver	Standard	Cable	Connector
1 GbE management port	1000BASE-T	UTP Category 5, 5E, and 6 up to 100 meters	RJ-45
External RS-232 management port	RS-232	DB-9-to-mini-USB or RJ-45-to-mini-USB console cable (comes with optional Management Serial Access Cable, 90Y9338)	Mini-USB

Warranty

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

Physical specifications

These are the approximate dimensions and weight of the switch:

- Height: 30 mm (1.2 in.)
- Width: 401 mm (15.8 in.)
- Depth: 317 mm (12.5 in.)
- Weight: 3.7 kg (8.1 lb)

Shipping dimensions and weight (approximate):

- Height: 114 mm (4.5 in.)
- Width: 508 mm (20.0 in.)
- Depth: 432 mm (17.0 in.)
- Weight: 4.1 kg (9.1 lb)

Agency approvals

The switch conforms to the following regulations:

- United States FCC 47 CFR Part 15, Subpart B, ANSI C63.4 (2003), Class A
- IEC/EN 60950-1, Second Edition
- Canada ICES-003, issue 4, Class A
- Japan VCCI, Class A
- Australia/New Zealand AS/NZS CISPR 22:2006, Class A
- Taiwan BSMI CNS13438, Class A
- CE Mark (EN55022 Class A, EN55024, EN61000-3-2, EN61000-3-3)
- CISPR 22, Class A
- China GB 9254-1998
- Turkey Communique 2004/9; Communique 2004/22
- Saudi Arabia EMC.CVG, 28 October 2002

Typical configurations

The following usage scenarios are described:

- EN4093R as a 10 Gb Ethernet Virtual Fabric switch
- EN4093R as an FCoE transit switch
- EN4093R with flexible port mapping (4-port network adapter example)

EN4093R as a 10 Gb Ethernet Virtual Fabric switch

The EN4093R Virtual Fabric vNIC solution is based on the Flex System Enterprise Chassis with a 10 Gb Converged Enhanced Ethernet (CEE) infrastructure and 10 Gb Virtual Fabric Adapters (VFAs) installed in each compute node. In Virtual Fabric mode, the EN4093R 10 GbE switch is vNIC-aware, that is, the configuration of vNICs is done on a switch, then it propagates vNIC parameters to VFA using the DataCenter Bridging eXchange (DCBX) protocol. vNIC bandwidth allocation and metering is performed by both the switch and the VFA. In such a case, a bidirectional virtual channel of an assigned bandwidth is established between them for each vNIC. Up to 32 vNICs can be configured on a half-wide compute node.

The EN4093R switches can be connected to the top-of-rack aggregator switches:

- RackSwitch G8264 via the 10 GbE external connections
- RackSwitch G8316/G8332 via the 40 GbE external ports

Figure 6 illustrates this scenario. The solution components used in the scenario shown in Figure 6 are

listed in Table 7.

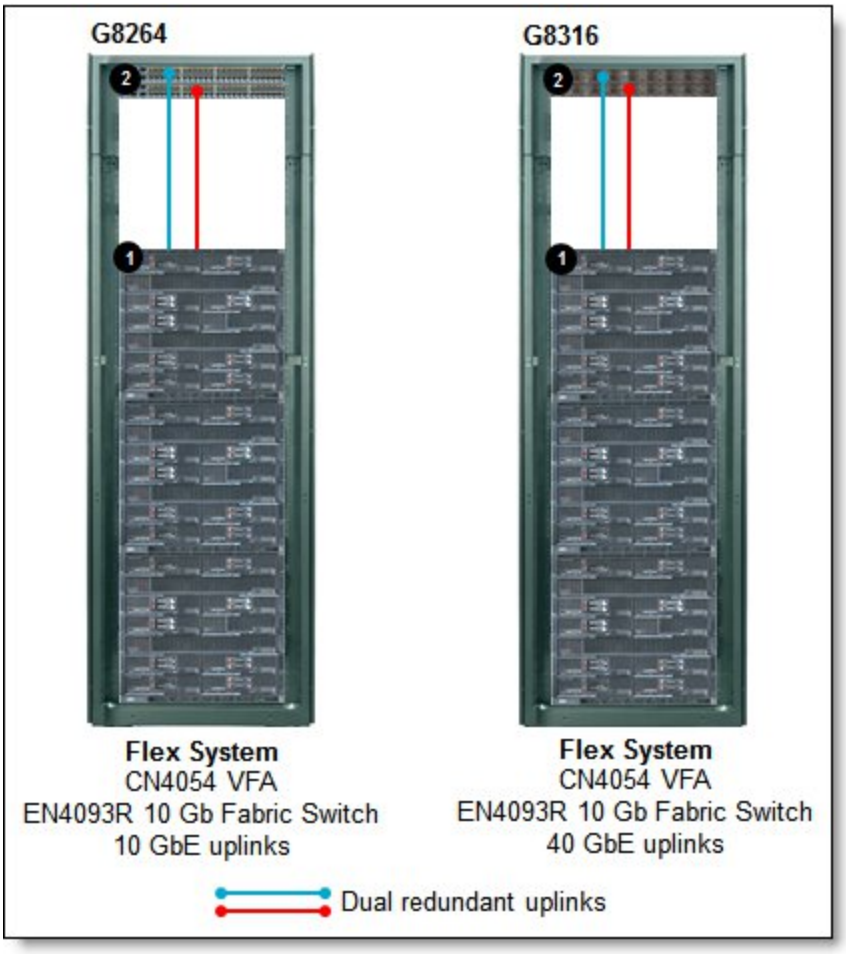

Figure 6. EN4093R as a 10 Gb Virtual Fabric Switch

Table 8. Components used in a Virtual Fabric solution with the EN4093R switch (Figure 6)

Diagram reference	Description	Part number	Quantity
1	**Flex System Virtual Fabric solution**		
	Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	1 per compute node
	Flex System CN4054 Virtual Fabric Adapter Upgrade	90Y3558	1 per VFA
	Flex System Fabric EN4093R 10Gb Scalable Switch	95Y3309	2 per chassis
	Flex System Fabric EN4093 10Gb Scalable Switch (Upgrade 1)*	49Y4798	1 per EN4093R
2	**RackSwitch G8264 or G8316/G8332**		

* The Upgrade 1 might not be needed with flexible port mapping if the total number of the internal and external ports used on the EN4093R is less or equal to 24.

Note: You also need SFP+/QSFP+ modules and optical cables or SFP+/QSFP+ DAC cables (not shown in Table 8; see Table 3 for details) for the external 10 Gb Ethernet connectivity.

EN4093R as an FCoE transit switch

Flex System Fabric EN4093R 10Gb Scalable Switch is a Data Center Bridging (DCB) switch that can

transport FCoE frames by using FCoE Initialization Protocol (FIP) snooping. This switch provides an inexpensive solution for transporting encapsulated FCoE packet to the Fibre Channel Forwarder (FCF) which is functioning as both an aggregation switch and an FCoE gateway, Examples of this scenario are depicted in Figure 7, Figure 8, and Figure 9. The solution components used in the scenarios shown in Figure 7, Figure 8, and Figure 9 are listed in Table 9, Table 10, and Table 11 respectively.

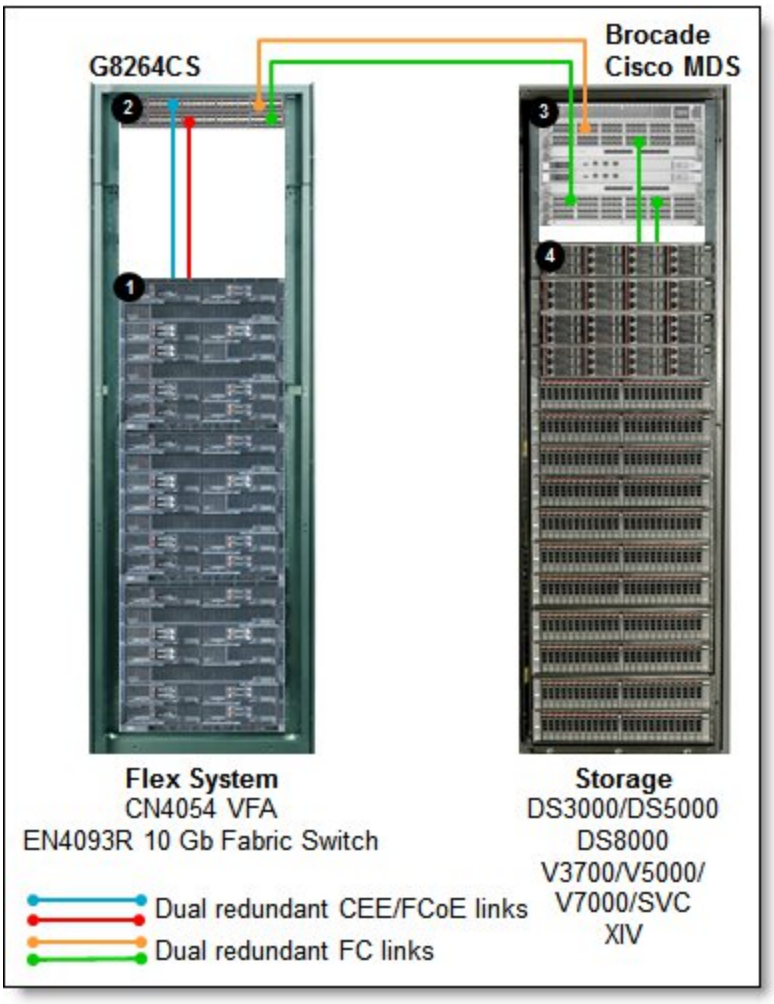

Figure 7. EN4093R as an FCoE transit

switch with the RackSwitch G8264CS as an FCF

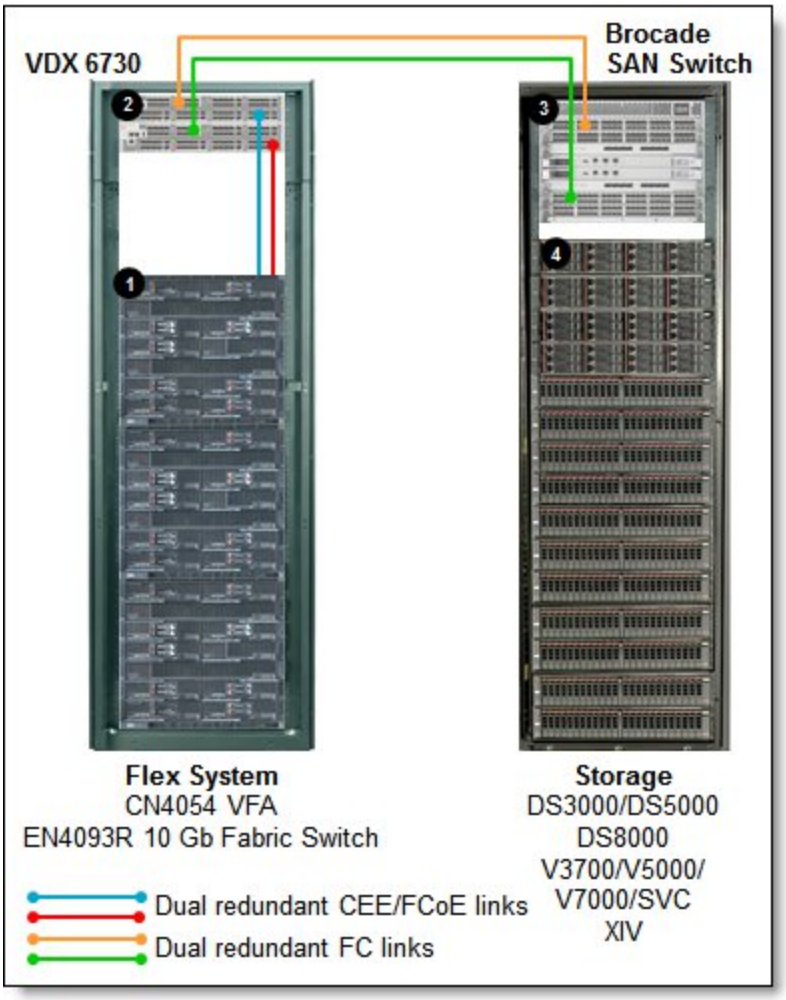

Figure 8. EN4093R as an FCoE transit

switch with the Brocade VDX 6730 as an FCF

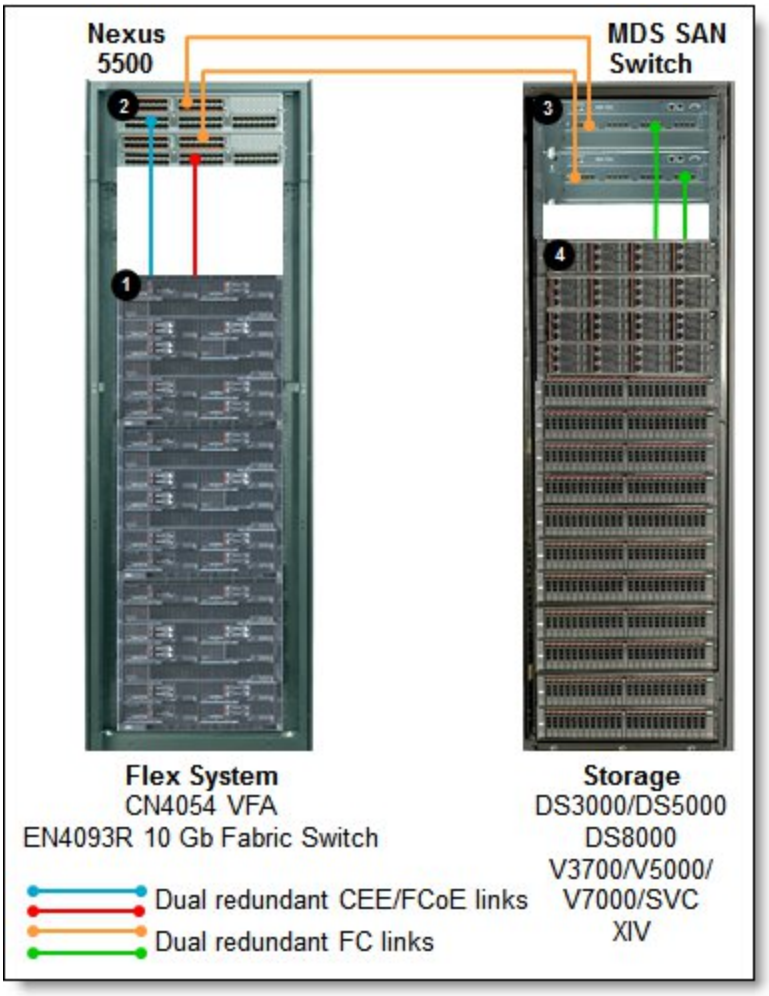

Figure 9. EN4093R as an FCoE transit switch with the Cisco Nexus 5548/5596 as an FCF

Table 9. EN4093R as an FCoE transit switch with the RackSwitch G8264CS as an FCF (Figure 7)

Diagram reference	Description	Part number	Quantity
1	**Flex System FCoE solution**		
	Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	1 per compute node
	Flex System CN4054 Virtual Fabric Adapter Upgrade	90Y3558	1 per VFA
	Flex System Fabric EN4093R 10Gb Scalable Switch	95Y3309	2 per chassis
	Flex System Fabric EN4093 10Gb Scalable Switch (Upgrade 1)*	49Y4798	1 per EN4093R
2	**RackSwitch G8264CS**		
3	**Brocade or Cisco MDS SAN fabric**		
4	**Storage systems**		
	IBM DS3000 / DS5000		
	IBM DS8000		
	IBM Storwize V3700 / V5000 / V7000 / SAN Volume Controller		
	IBM XIV		

* The Upgrade 1 might not be needed with flexible port mapping if the total number of the internal and external ports used on the EN4093R is less or equal to 24.

Table 10. EN4093R as an FCoE transit switch with the Brocade VDX 6730 as an FCF (Figure 8)

Diagram reference	Description	Part number	Quantity
1	**Flex System FCoE solution**		
	Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	1 per compute node
	Flex System CN4054 Virtual Fabric Adapter Upgrade	90Y3558	1 per VFA
	Flex System Fabric EN4093R 10Gb Scalable Switch	95Y3309	2 per chassis
	Flex System Fabric EN4093 10Gb Scalable Switch (Upgrade 1)*	49Y4798	1 per EN4093R
2	**Brocade VDX 6730 Converged Switch**		
3	**Brocade SAN fabric**		
4	**Storage systems**		
	DS3000 / DS5000		
	DS8000		
	Storwize V3700 / V5000 / V7000 / SAN Volume Controller		
	XIV		

* The Upgrade 1 might not be needed with flexible port mapping if the total number of the internal and external ports used on the EN4093R is less or equal to 24.

Table 11. EN4093R as an FCoE transit switch with the Cisco Nexus 5548/5596 as an FCF (Figure 9)

Diagram reference	Description	Part number	Quantity
1	**Flex System FCoE solution**		
	Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	1 per compute node
	Flex System CN4054 Virtual Fabric Adapter Upgrade	90Y3558	1 per VFA
	Flex System Fabric EN4093R 10Gb Scalable Switch	95Y3309	2 per chassis
	Flex System Fabric EN4093 10Gb Scalable Switch (Upgrade 1)*	49Y4798	1 per EN4093R
2	**Cisco Nexus 5548/5596 Switch**		
3	**Cisco MDS SAN fabric**		
4	**Storage systems**		
	DS3000 / DS5000		
	DS8000		
	Storwize V3700 / V5000 / V7000 / SAN Volume Controller		
	XIV		

* The Upgrade 1 might not be needed with flexible port mapping if the total number of the internal and external ports used on the EN4093R is less or equal to 24.

Note: You also need SFP+ modules and optical cables or SFP+ DAC cables (not shown in Table 8, Table 9, and Table 10; see Table 3 for details) for the external 10 Gb Ethernet connectivity.

For a full listing of supported FCoE and iSCSI configurations, see the System Storage Interoperation Center (SSIC) website at:

http://ibm.com/systems/support/storage/ssic

EN4093R with flexible port mapping (4-port network adapter example)

Prior to Networking OS 7.8, compute nodes with 4-port network adapters required Upgrade 1 for the EN4093R to enable connectivity on all four adapter ports despite of number of compute nodes and external connections used. With the introduction of flexible port mapping in Networking OS 7.8, if the Flex System chassis is not fully populated with the compute nodes that have four network ports, there might be no need to buy Upgrade 1.

Consider the following scenario. You are planning to install ten x240 compute nodes with CN4054 adapters or ten high-density x222 compute nodes that will be connected to two EN4093R switches installed in I/O bays 1 and 2. You are also planning to use four external 10 GbE ports on each EN4093R for the connectivity to the upstream network. In this scenario, the total number of 10 GbE ports needed per one EN4093R is 24. The base switch supplies required 24 port licenses; therefore, the solution can be implemented without the need to buy Upgrade 1.

Figure 10 illustrates this scenario.

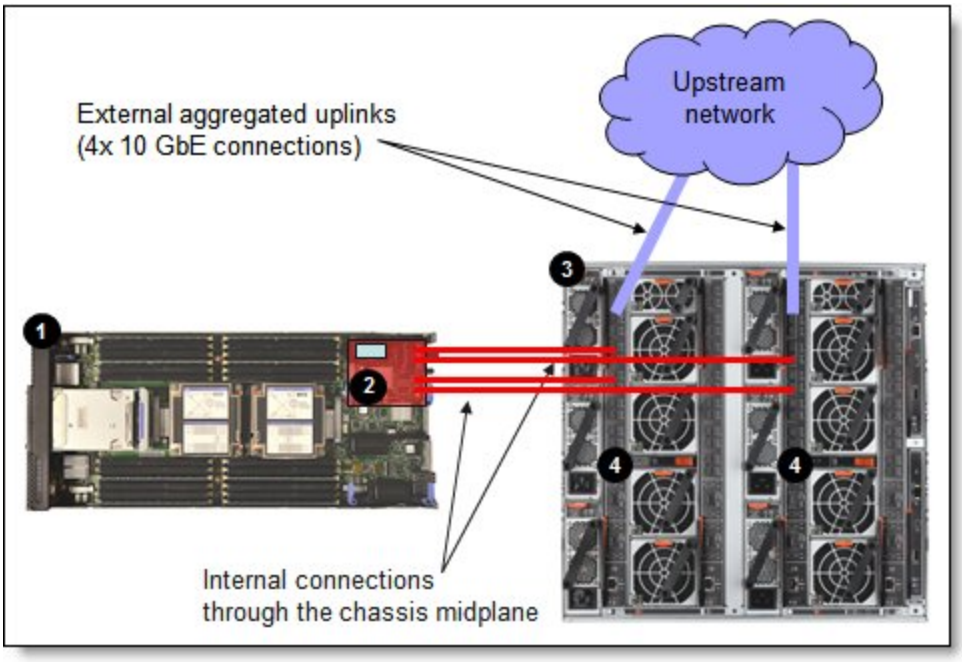

Figure 10. EN4093R with flexible port mapping (4-port network adapter example)

The solution components used in the scenario shown in Figure 10 are listed in Table 12.

Table 12. EN4093R with 4-port network adapters

Diagram reference	Description	Part number	Quantity
1	Flex System x240 Compute Node or other supported compute node	Varies	Up to 10
2	Flex System CN4054R 10Gb Virtual Fabric Adapter	00Y3306	1 per compute node
3	Flex System Enterprise Chassis with additional power supplies and fan modules if needed	8721A1G	1
4	Flex System Fabric EN4093R 10Gb Scalable Switch	95Y3309	2 per chassis
	SFP+ modules and optical cables or SFP+ DAC cables (see Table 3)	Varies	8 (4 per EN4093R)

Related publications and links

For more information see the following Flex System Fabric EN4093R 10Gb Scalable Switch product publications, available from the Flex System Information Center at http://publib.boulder.ibm.com/infocenter/flexsys/information/index.jsp

- *Installation Guide*
- *Application Guide*
- *Command Reference*

These are other useful references:

- US Announcement Letter for the EN4093R http://ibm.com/common/ssi/cgi-bin/ssialias?infotype=dd&subtype=ca&&htmlfid=897/ENUS112-185
- Flex System Enterprise Chassis Product Guide http://lenovopress.com/tips0865
- *Flex System Products and Technology*, SG24-8255 http://lenovopress.com/sg248255
- Flex System Interoperability Guide http://lenovopress.com/fsig
- Configuration and Option Guide http://www.ibm.com/systems/xbc/cog/

Related product families

Product families related to this document are the following:

- Blade Networking Modules

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