Introduction to the EMC CLARiiON CX4 Series Featuring UltraFlex Technology

Applied Technology

Abstract

This white paper introduces the full architecture and functionality of the EMC® CLARiiON® CX4 series with UltraFlex™ technology, including the CX4-120, CX4-240, CX4-480, and CX4-960. This paper lists the software capabilities of the series and also introduces the new features.

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Executive summary

The EMC® CLARiiON® CX4 series with UltraFlex™ technology is based on a new, breakthrough architecture and extensive technological innovation, providing a midrange storage solution that cannot be matched by any competitor. The CX4 series with UltraFlex technology delivers industry-leading application performance, and new levels of scalability, reliability, flexibility, and affordability. It also includes new levels of ease of use, making the CX4 easy to install, manage, and scale. The CX4 is the fourth-generation CX series, and continues EMC's commitment to maximizing customers' investments in CLARiiON technology by ensuring that existing resources and capital assets are optimally utilized as customers adopt new technology.

The unique modularity of the UltraFlex technology allows you to use a combination of protocols within a single storage system. The CX4's architecture is based on state-of-the-art I/O interconnect PCI Express technology, enabling it to provide high bandwidth and low latency. Furthermore, as your requirements change, you can use CLARiiON's unique virtual LUN technology to dynamically move data from one tier of storage to a higher or lower tier within the same CX4 storage system.

Introduction

This white paper describes the architecture and functionality of the CX4 storage systems with UltraFlex technology. It compares the features and capabilities of the models in the fourth-generation CX CLARiiON storage system family. It describes the CX4 storage processors (SPs) and subcomponents, and describes and illustrates major system subassemblies and configurations.

This paper also provides an overview of the software capabilities of the CX4 storage system family, including an overview of the CX4 **auto-sense** speed setting that allows you to use a combination of 2 and 4 Gb/s drives. Tiered storage systems are greatly simplified due to this ability to detect and recognize the characteristics of existing drives and new drives as they are added. Furthermore, this paper provides an overview of CLARiiON's unique virtual LUN technology that allows you to perform an online transfer of data between different tiers of storage in a CX4 system.

Audience

This white paper is intended for EMC employees, partners, IT planners, storage architects, administrators, and any others involved in evaluating, acquiring, managing, operating, or designing an EMC networked storage environment.

Overview

CX4 series storage systems are made up of the following modular components:

- A modular 4 Gb/s storage processor enclosure (SPE) – Houses the storage processors (SPs), power supplies, blower modules, and I/O modules.
- A 4 Gb/s UltraPoint™ disk-array enclosure (DAE) – Houses up to 15 drives. Additional DAEs can be added for a maximum of 120 drives for Model 120, 240 drives for Model 240, 480 drives for Model 480, and 480 or 960 drives for Model 960.
- Dual standby power supplies (SPS) – Enable proper shutdown of the storage system during power failure by safely moving the data in the write cache to a reserved area in the first five drives.

The following are CX4 features:

- Support for both direct-attach and SAN environments
- Hot-pluggable I/O modules – either 4 Gb/s FC or 1 Gb/s iSCSI
- Hot-swappable storage processors with up to 16 GB of memory per SP

- RAID level 0, 1, 1/0, 3, 5, and 6, individual disk support, and global hot sparing
- Online upgrade capability
- Five-drive minimum to 960-drive maximum system configuration
- Support for data-in-place upgrades
- Support for Windows, Solaris, Linux, AIX, HP-UX, and VMware Fibre Channel attaches
- Support for Windows, Solaris, Linux, AIX, HP-UX, and VMware iSCSI attaches

The CX4 supports the following software:

- FLARE® Operating Environment
- Navisphere® Management Suites - includes Access Logix™ technology and the appropriate Navisphere Agent or Navisphere Server Utility
- Navisphere Analyzer
- Navisphere Quality of Service Manager
- CLARalert®
- PowerPath® (full-featured or utility kit)
- SnapView™ (snapshots and clones)
- MirrorView™/A and MirrorView/S
- SAN Copy™
- RecoverPoint

CLARiiON CX4 series architecture

The breakthrough CX4 architecture delivers cutting-edge performance, including the highest levels of resiliency and availability; tiered-storage flexibility; and powerful, easy-to-use interfaces. CX4's UltraFlex technology provides you with the flexibility of using a combination of FC and iSCSI connections.

Initial tiered storage configurations are simplified due to the CX4's ability to detect the characteristics of drives as they are added. Furthermore, as your requirements change, CLARiiON's unique virtual LUN technology can move data from one tier of storage to a higher or lower tier of storage without disrupting the host application.

UltraFlex technology

UltraFlex technology is a breakthrough approach to array connectivity. The CX4's UltraFlex technology delivers a storage system that you can easily customize by populating your I/O slots with the I/O modules that meet your specific needs.

These I/O modules are placed horizontally in the CX4-960, and vertically in the CX4-480, CX4-240, and CX4-120. Figure 1 shows the connectivity of a CX4-960 being expanded by adding an FC I/O module.
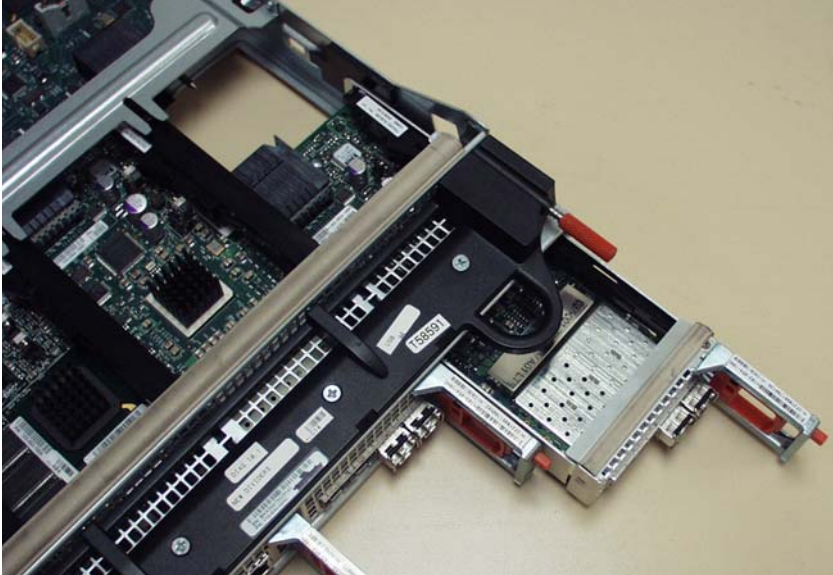
Figure 1. CLARiiON CX4 UltraFlex I/O module addition

Each model has a base configuration that includes Fibre Channel connectivity, iSCSI connectivity, and additional I/O slots for future connectivity expansion. You can expand this base configuration by adding Fibre Channel and/or iSCSI I/O modules. With this unique architecture, future I/O modules can be added as they are developed. Table 1 lists the base and maximum configurations for the CX4 models.

Table 1. CX4 base and maximum connectivity options

Connectivity	CX4 Model 120	CX4 Model 240	CX4 Model 480	CX4 Model 960
Total I/O slots per array	6	8	10	12
I/O slots populated by base configuration	4	4	6	6
I/O slots available for expansion	2	4	4	6
Front-end 4 Gb/s FC ports (Base configuration)	4	4	8	8
Front-end 4 Gb/s FC ports (Optimized configuration) [1]	12	12	16	24
Front-end 1 Gb/s iSCSI ports (Base configuration)	4	4	4	4
Front-end 1 Gb/s iSCSI ports (Optimized configuration)[1]	8	12	12	16
Back-end FC ports (Base configuration)	2	4	8	8
Back-end FC ports (Optimized configuration) [2]	2	4	8	16

[1] The CX4 can be optimized for either maximum Fibre Channel front-end connectivity or maximum iSCSI front-end. It cannot be optimized for both at the same time.
[2] The CX4 can also be optimized for maximum Fibre Channel back-end connectivity.

Where the CX4 series fits into the EMC CLARiiON storage family

The CLARiiON CX4 series is the fourth generation of the CLARiiON CX series. The CX4 series continues to expand the capabilities of CLARiiON storage systems. It supports 4 Gb/s throughput from end to end, and provides high functionality, data integrity, high availability, and expanded flexibility. It also offers excellent price/performance, along with scalable capacity and upgradeability.

Table 2 on page 8 compares the different features for each type of CX4 storage system.

Table 2. Side-by-side comparison of the CX4 series

| Components/ Connectivity	CX4 Model 120	CX4 Model 240	CX4 Model 480	CX4 Model 960
Processor architecture per SP[3]	1 dual-core processor 1.2 GHz	1 dual-core processor 1.6 GHz	1 dual-core processor 2.2 GHz	2 quad-core processors 2.33 GHz
Physical memory per SP	3 GB	4 GB	8 GB	16 GB
Max cache	600 MB	1.264 GB	4.5 GB	10.764 GB
Max write cache	600 MB	1.264 GB	4.5 GB	10.764 GB
Max drives per storage system	120	240	480	960
Min drives per storage system	5	5	5	5
Max initiators per storage system	256	512	512	1024
Max H/A hosts per storage system	128	256	256	512
Max LUNs per storage system	1024	1024	4096	4096
Max RAID groups per storage system	60	120	240	480
Max drives per RAID group	16	16	16	16
Max LUNs per RAID group	256	256	256	256
SPE form factor	2U	2U	2U	4U
Minimum configuration form factor	6U	6U	6U	9U
SnapView snapshots	512	512	1024	2048
SnapView clones	256	512	1024	2048
MirrorView/S	128	256	512	512
MirrorView/A	100	100	100	100
SAN Copy	Yes	Yes	Yes	Yes
146, 300 and 450 GB 4 Gb/s 15k rpm Fibre Channel	Yes	Yes	Yes	Yes
400 GB 4 Gb/s 10k rpm Fibre Channel	Yes	Yes	Yes	Yes
1 TB 4 Gb/s 7.2k and 5.4k rpm SATA-II[4]	Yes	Yes	Yes	Yes

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[3] All models in the CX4 series have two SPs.
[4] SATA-II disk drives can be used as the FLARE OS drives for the CX4-120 only.

CX4 Model 960 major subassemblies

The minimum CX4 Model 960 assembly consists of a single 4U storage processor enclosure (SPE), a 2U standby power supply (SPS), and a 3U 4 Gb/s UltraPoint disk-array enclosure (DAE), for a total of 9U. A fully configured CX4-960 consists of the SPE and dual SPS, plus 64 3U DAEs, for a total of 201U. This requires the use of five additional cabinets. Minimum and maximum configurations for the CX4-960 assembly are shown in Figure 2.
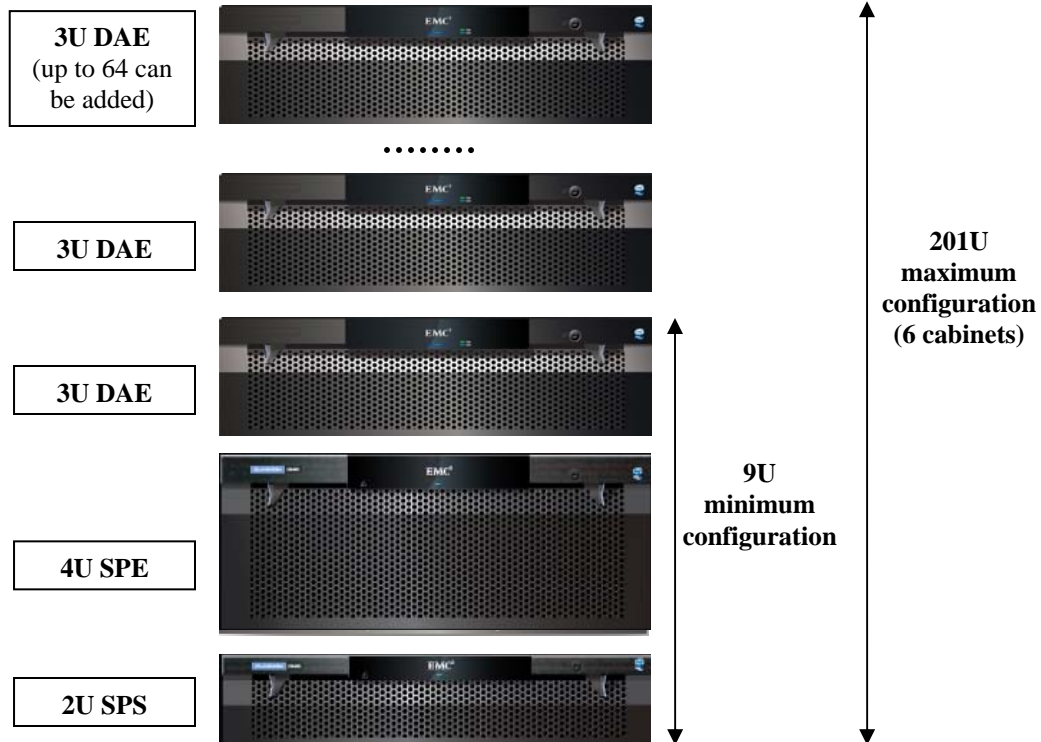
Figure 2. Minimum and maximum CX4 Model 960 configurations

The dual SPS, SPE, and DAE assemblies are rackmounted for efficiency, and provide you with many different configuration options. The CLARiiON 40U cabinet—with industry-standard 19-inch racks—can house different configurations of CX4 Model 960 systems, as well as 1, 2, or 4 Gb/s Fibre Channel switches (1U and/or 2U) and/or Ethernet network switches. The standard 40U cabinet comes with four Power Distribution Units (PDUs) and four Power Distribution Panels (PDPs). Power supplies on the left side of the cabinet use the left PDU; power supplies on the right use the right PDU. Additionally, all CLARiiON storage systems can be installed in non-EMC industry-standard cabinets.

CX4 Model 960 storage processor

Each CX4-960 SP contains two 2.33 GHz Quad-Core Intel® Xeon® processors. This dual-storage processor architecture provides the power for enhanced performance, stability, and reliability in the CX4-960 storage system. Each CX4-960 SP has 16 GB of system memory. There is a PCI Express-x8 CMI channel between the storage processors that is used for communication and messaging between the storage processors as well for mirroring data that is written to the portion of memory designated for write cache on the storage system.

Figure 3. CX4 Model 960 storage processor and I/O annex area

Figure 2 shows a CX4 Model 960 storage processor enclosure. LEDs provide indications of SP power, boot progress, and fault status. Separate link-port LEDs indicate the speed at which the front- and back-end ports are running – green indicates 2 Gb/s and blue indicates 4 Gb/s. Each CX4 Model 960 SP has both iSCSI and Fibre Channel front-end ports.

Each SP connects to at least eight 4 Gb/s Fibre Channel front-end (FE) ports. These ports, which are small-form-factor pluggable (SFP) optical transceivers, are customer replaceable and have a default setting of **auto-negotiate**. Using Navisphere Manager or CLI, you can change the settings from **auto-negotiate** to 1, 2, or 4 Gb/s. These front-end ports may be connected to a 1, 2, or 4 Gb/s transceiver on a switch, or they may be directly connected to a 1, 2, or 4 Gb/s HBA on a server/host.

Each CX4-960 SP connects to at least two 1 Gb/s iSCSI front-end (FE) ports. Using Navisphere Manager or CLI, you can change the settings on each 1 Gb/s iSCSI front-end (FE) port from **auto-negotiate** to 10/100/1000 Mb/s. These front-end ports may be connected to a 10/100/1000 Mb/s port on an Ethernet switch, or they may be directly connected to a 10/100/1000 Mb/s NIC or iSCSI HBA on a server/host.

Each SP also connects to four (or eight) 4 Gb/s Fibre Channel back-end ports, which, along with the peer SP, form four (or eight) redundant FC back-end loops for disk connectivity and capacity expansion.

CPU Module   (4) I/O Slots
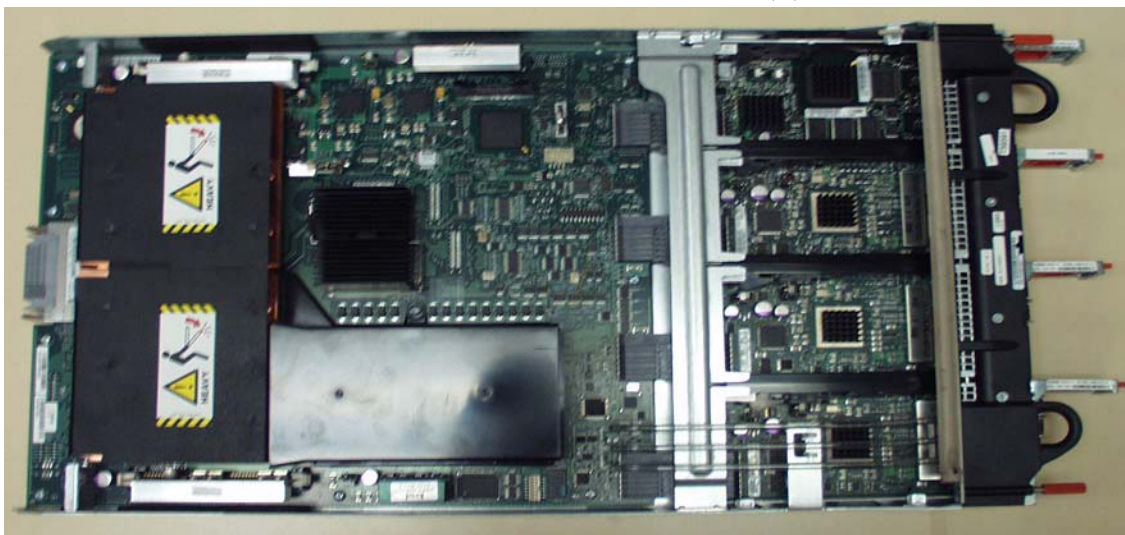
Figure 4. CX4 Model 960 I/O and CPU modules

Figure 4 shows the CPU module and the four I/O module slots for the CX4-960. The CPU module contains the two Quad-Core Intel Xeon processors and the memory DIMMs for each storage processor. Each I/O module slot can be populated with either one FC module or one iSCSI module at initial shipment or post-installation. Each module is a separate field-replaceable unit (FRU), which can be individually replaced should the need arise.

Figure 5. CX4 Model 960 management module

Figure 5 shows the management module for the CX4-960. It has two 10/100/1000 Base-T LAN ports, one for Management and one for Service; two micro-DB9 communication ports, one for serial communication and one for SPS sensing; and one 5V USB port. The Management port is used to access and manage the storage processor with the software interface Navisphere, while the Service port is a *dedicated* port that EMC Customer Service Representatives can use to access the storage processor when they are onsite.

Blower Modules

Power Supply A   Power Supply B

Figure 6. CX4 Model 960 power supplies and cooling

As shown in Figure 6, the CX4-960 SPE has four 24V blower modules and two 1200-watt power supplies. The power supplies and blower modules are front-serviced vertical field-replaceable units (FRUs).

CX4 Model 960 standby power supply

As shown in Figure 7, the CX4-960 SPE uses two 2.4-kilowatt SPSs to maintain power to the storage system during a power loss; this allows a full dump of the write cache to a reserved area on the persistent

disk. In the case of the CX4-960, SPS power output connectors are used to power the SPE as well as to power the first DAE on the first back-end loop.
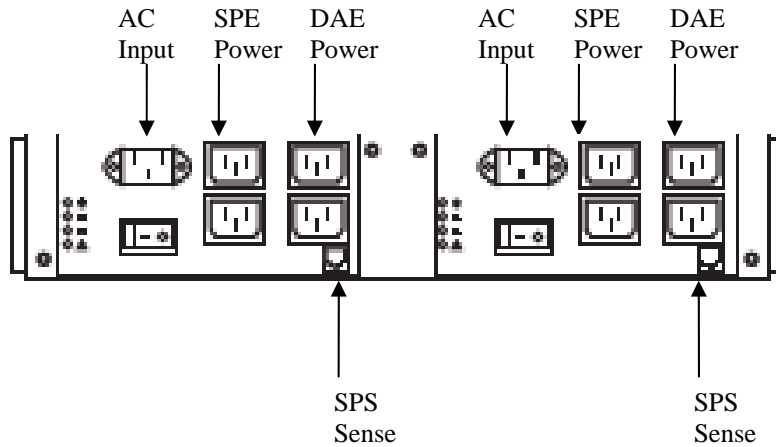
Figure 7. View of the CX4 Model 960 standby power supply (SPS)

It is important to cable each SPS so it connects completely to either the A side or the B side. For example, if you are looking at the SPS from the back, they should be configured as follows:

- SPS on the right: Power-out and sense cables should connect to power supply A and SP A.
- SPS on the left: Power-out and sense cables should connect to power supply B and SP B.

If an SPS is cabled with the SPS sense cable going to SP A and the power-out cable going to power supply B (or vice versa), error conditions are displayed when the SPS is tested or while it is charging.

CX4 Model 480 major subassemblies

The minimum CX4 Model 480 assembly consists of a single 2U storage processor enclosure (SPE), a 1U standby power supply (SPS), and a 3U 4 Gb/s UltraPoint disk-array enclosure (DAE), for a total of 6U. A fully configured CX4-480 consists of the SPE and dual SPS, plus 32 3U DAEs, for a total of 99U, and requires the use of two additional cabinets. Minimum and maximum configurations of the CX4-480 assembly are shown in Figure 8.
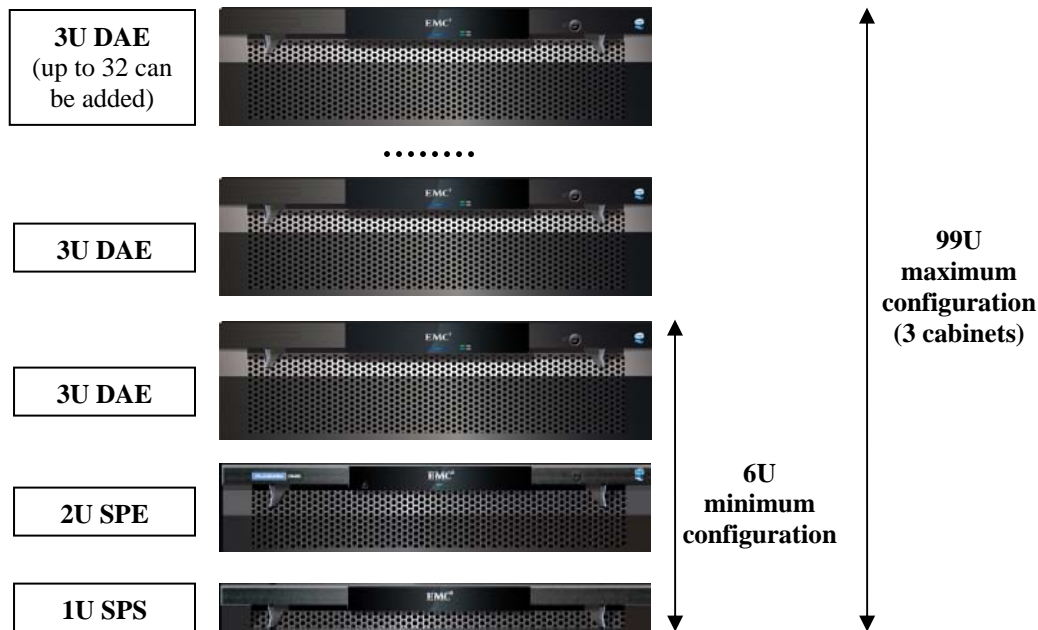
Figure 8. Minimum and maximum CX4 Model 480 configurations

The dual SPS, SPE, and DAE assemblies are rackmounted for efficiency, and provide many different configuration options. The CLARiiON 40U cabinet—with industry-standard 19-inch racks—can house different configurations of CX4-480, as well as 1, 2, or 4 Gb/s Fibre Channel switches (1U and/or 2U) and/or Ethernet network switches. The standard 40U cabinet comes with four Power Distribution Units (PDUs) and two Power Distribution Panels (PDPs). Power supplies on the left side of the cabinet use the left PDU; power supplies on the right use the right PDU. Additionally, all CLARiiON storage systems can be installed in non-EMC industry-standard cabinets.

CX4 Model 480 storage processor

Each CX4 Model 480 SP contains one 2.2 GHz Dual-Core Intel Xeon processor. This dual-storage processor architecture provides the power for enhanced performance, stability, and reliability in the CX4-480 storage system. Each CX4-480 SP has 8 GB of system memory. There is a PCI Express-x4 CMI channel between the storage processors that is used for communication and messaging between the storage processors as well for the mirroring of data that is written to the portion of memory that has been designated for write cache on the storage system.
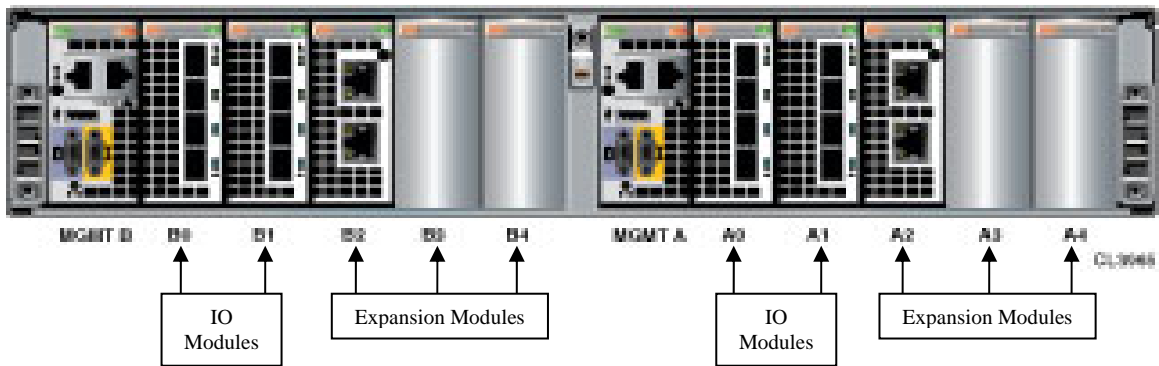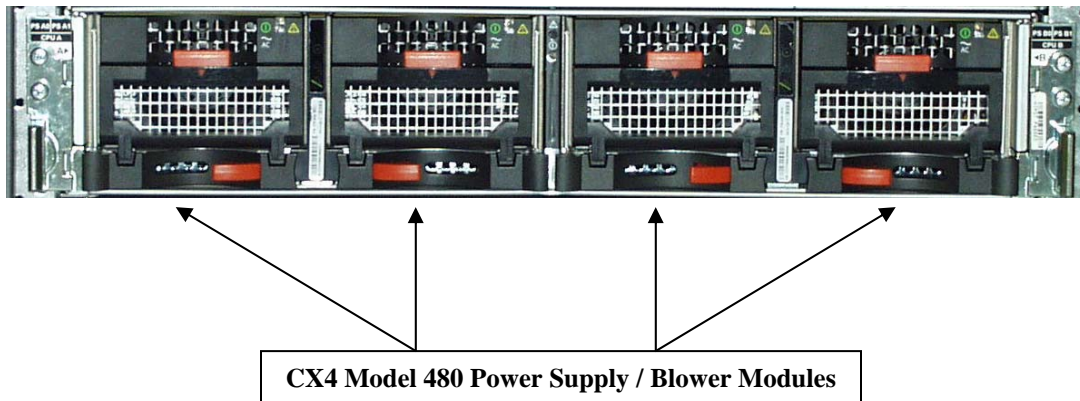
Figure 9. CX4 Model 480 storage processor

Figure 9 shows the air dam for a CX4-480 storage processor. LEDs provide indications of LAN connectivity, SP power, boot progress, and fault status, as well as power supply and blower status.   The LEDs also indicate the speed at which the front- and back-end ports are running – green indicates 2 Gb/s and blue indicates 4 Gb/s. Each CX4 Model 120 SP has iSCSI and Fibre Channel front-end ports.

Each CX4-480 SP connects to at least four 4 Gb/s Fibre Channel front-end (FE) ports. These ports, which are small-form-factor pluggable (SFP) optical transceivers, are customer replaceable and have a default setting of **auto-negotiate**. Using Navisphere Manager or CLI, you can change the settings from **auto-negotiate** to 1, 2, or 4 Gb/s. These Fibre Channel front-end ports may be connected to a 1, 2, or 4 Gb/s transceiver on a switch, or they may be directly connected to a 1, 2, or 4 Gb/s HBA on a server/host.

Each CX4-480 SP connects to at least two 1 Gb/s iSCSI front-end (FE) ports. Using Navisphere Manager or CLI, you can change the settings on each 1 Gb/s iSCSI front-end (FE) port from **auto-negotiate** to 10/100/1000 Mb/s. These iSCSI front-end ports may be connected to a 10/100/1000 Mb/s port on an Ethernet switch, or they may be directly connected to a 10/100/1000 Mb/s NIC or iSCSI HBA on a server/host.

Each CX-480 SP also connects to four 4 Gb/s Fibre Channel back-end ports, which, along with the peer SP, form four redundant FC back-end loops for disk connectivity and capacity expansion.

The CX4-480 SP also has two 10/100/1000 Base-T LAN ports, one for Management and one for Service, as well as two micro-DB9 communication ports, one for serial communication and one for SPS sensing. The Management port is used to access and manage the storage processor via Navisphere, while the Service port is a *dedicated* port used by EMC Customer Service Representatives to access the storage processor when they are onsite.
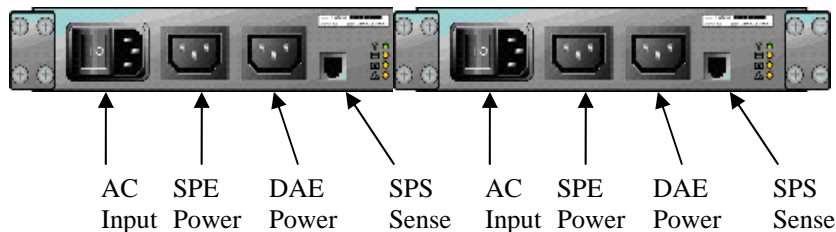
CX4 Model 480 Power Supply / Blower Modules

Figure 10. CX4 Model 480 power supplies and cooling

The CX4-480 SPE uses four 400-watt power supplies supporting N+1 power and N+1 cooling per storage processor. The power supplies contain thermal sensors for Ambient Over-Temperature monitoring. Cooling is achieved through high-speed blowers attached to each power supply module.

A single power supply can power a single storage processor and a single blower can cool a single storage processor. The CX4-480 can run indefinitely with one power supply/blower module faulted or removed on each SP and still maintain high availability.

CX4 Model 480 standby power supply

As shown in Figure 11, the CX4-480 SPE uses two 1-kilowatt SPSs to maintain power to the storage system during a power loss to allow for a full dump of the write cache to a reserved area on persistent disk. In the CX-480, both SPS power output connectors are used to power the SPE as well as the first DAE on the first back-end loop.

| AC | SPE | DAE | SPS | AC | SPE | DAE | SPS |
| Input | Power | Power | Sense | Input | Power | Power | Sense |

Figure 11. View of the CX4 Model 480 standby power supply (SPS)

It is important to cable each SPS so it connects completely to either the A side or the B side. For example, if you are looking at the SPSs from the back they should be configured as follows:

- • SPS on the right: Power-out and sense cables should connect to power supply A and SP A.
- • SPS on the left: Power-out and sense cables should connect to power supply B and SP B.

If an SPS is cabled with the SPS sense cable going to SP A and the power-out cable going to power supply B (or vice versa), error conditions are displayed when the SPS is tested or while it is charging.

CX4 Model 240 major subassemblies

The minimum CX4 Model 240 assembly consists of a single 2U storage processor enclosure (SPE), a 1U standby power supply (SPS), and a 3U 4 Gb/s UltraPoint disk-array enclosure (DAE), for a total of 6U. A fully configured CX4-240 consists of the SPE and dual SPS, plus 16 3U DAEs, for a total of 54U, and requires the use of one additional cabinet. Minimum and maximum configurations of the CX4-240 assembly are shown in Figure 12.
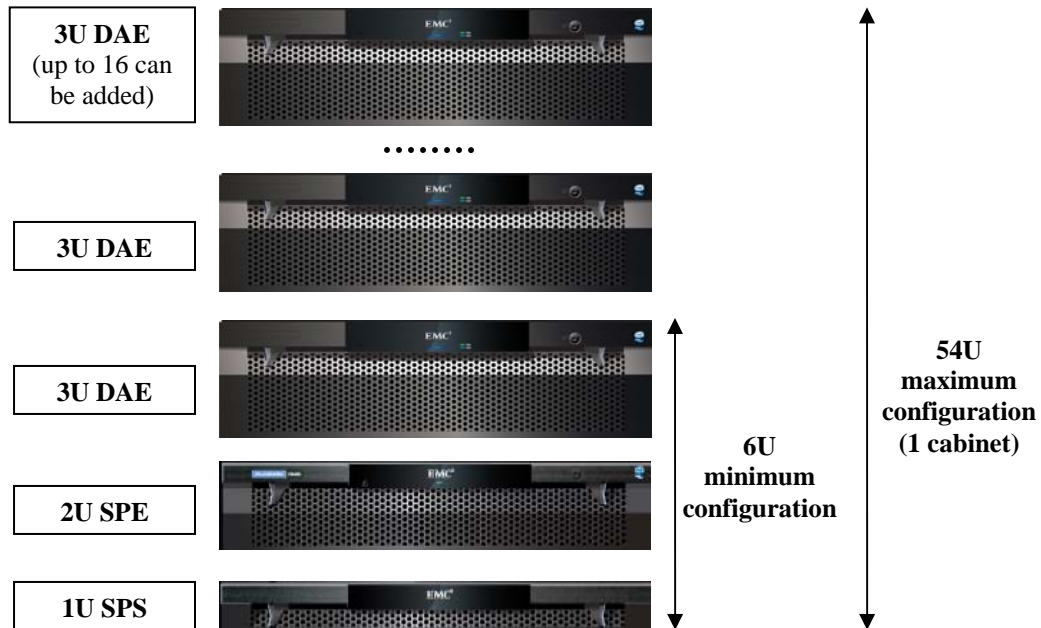

Figure 12. Minimum and maximum CX4 Model 240 configurations

The dual SPS, SPE, and DAE assemblies are rackmounted for efficiency, and provide you with many different configuration options. The CLARiiON 40U cabinet—with industry-standard 19-inch racks—can house different configurations of CX4-240 systems, as well as 1, 2, or 4 Gb/s Fibre Channel switches (1U and/or 2U) and/or Ethernet network switches. The 40U cabinet comes standard with four Power Distribution Units (PDUs) and two Power Distribution Panels (PDPs). Power supplies on the left use the left PDU; power supplies on the right use the right PDU. Additionally, all CLARiiON storage systems can be installed in non-EMC industry-standard cabinets.

CX4 Model 240 storage processor

Each CX4-240 SP contains one 1.6 GHz Dual-Core Intel Xeon processor. This dual-storage processor architecture provides the power for enhanced performance, stability, and reliability in the CX4-240 storage system. Each CX4-240 SP has 4 GB of system memory. There is a PCI Express-x4 CMI channel between the storage processors that is used for communication and messaging between the storage processors as well for the mirroring of data that is written to the portion of memory that has been designated for write cache on the storage system.
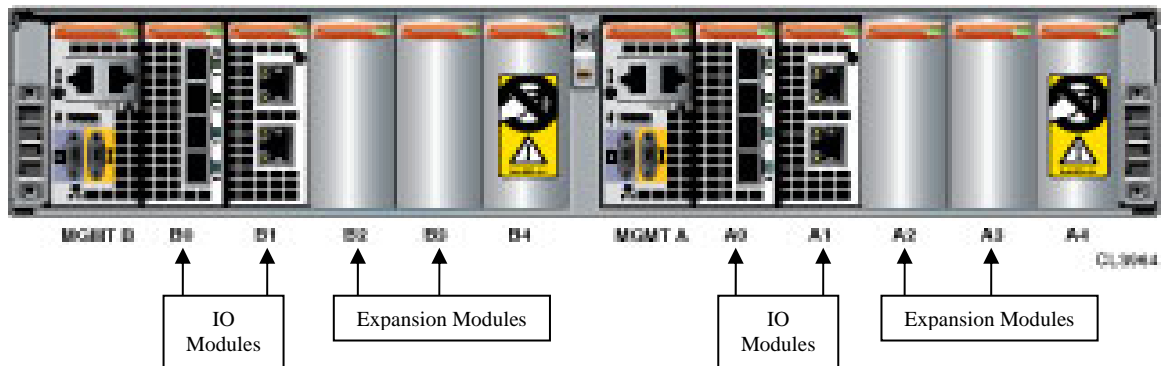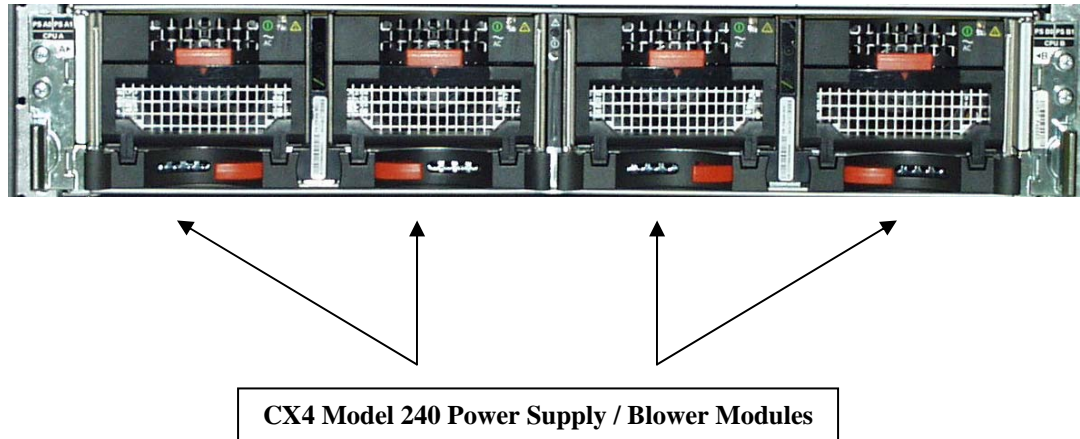
Figure 13. CX4 Model 240 storage processor

Figure 13 shows the CX4 Model 240 storage processor. LEDs provide indications of LAN connectivity, SP power, boot progress, and fault status, as well as power supply and blower status.   The LEDs also indicate the speed at which the front- and back-end ports are running – green indicates 2 Gb/s and blue indicates 4 Gb/s. Each CX4 Model 120 SP has iSCSI and Fibre Channel front-end ports.

Each CX4-240 SP connects to at least two 4 Gb/s Fibre Channel front-end ports. These ports, which are small-form-factor pluggable (SFP) optical transceivers, are customer replaceable and have a default setting of **auto-negotiate**. Using Navisphere Manager or CLI, you can change the settings from **auto-negotiate** to 1, 2, or 4 Gb/s. These front-end ports may be connected to a 1, 2, or 4 Gb/s transceiver on a switch, or they may be directly connected to a 1, 2, or 4 Gb/s HBA on a server/host.

Each CX4-240 SP connects to at least two 1 Gb/s iSCSI front-end (FE) ports. Using Navisphere Manager or CLI, you can change the settings on each 1 Gb/s iSCSI front-end (FE) port from **auto-negotiate** to 10/100/1000 Mb/s. These iSCSI front-end ports may be connected to a 10/100/1000 Mb/s port on an Ethernet switch, or they may be directly connected to a 10/100/1000 Mb/s NIC or iSCSI HBA on a server/host.

Each CX-240 SP also connects to two 4 Gb/s Fibre Channel back-end ports, which, along with the peer SP, form two redundant FC back-end loops for disk connectivity and capacity expansion.

The CX4-240 SP also has two 10/100/1000 Base-T LAN ports, one for Management and one for Service, as well as two micro-DB9 communication ports, one for serial communication and one for SPS sensing. The Management port is used to access and manage the storage processor via Navisphere, while the Service port is a *dedicated* port to be used by EMC Customer Service Representatives, should the need arise to access the storage processor when they are onsite.

CX4 Model 240 Power Supply / Blower Modules

Figure 14. CX4 Model 240 power supplies and cooling

The CX4-240 SPE uses four 400-watt power supplies supporting N+1 power and N+1 cooling per storage processor. The power supplies contain thermal sensors for Ambient Over-Temperature monitoring. Cooling is achieved through high-speed blowers attached to each power supply module.

A single power supply can power a single storage processor and a single blower can cool a single storage processor. The CX4-240 can run indefinitely with one power supply/blower module faulted or removed on each SP and still maintain high availability.

CX4 Model 240 standby power supply

As shown in Figure 15, the CX4-240 SPE uses two 1-kilowatt SPSs to maintain power to the storage system during a power loss to allow for a full dump of the write cache to a reserved area on persistent disk. In the case of the CX4-240, both SPS power output connectors are used to power the SPE as well as the first DAE on the first back-end loop.

AC   SPE   DAE   SPS   AC   SPE   DAE   SPS
Input   Power   Power   Sense   Input   Power   Power   Sense
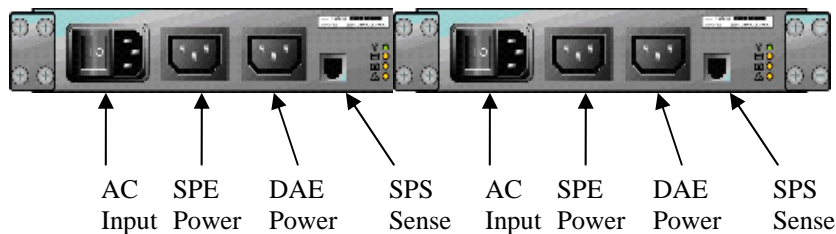
Figure 15. View of the CX4 Model 240 standby power supply (SPS)

It is important to cable each SPS so it connects completely to either the A side or the B side. For example, if you are looking at the SPSs from the back they should be configured as follows:

 • SPS on the right: Power-out and sense cables should connect to power supply A and SP A.

 • SPS on the left: Power-out and sense cables should connect to power supply B and SP B.

If an SPS is cabled with the SPS sense cable going to SP A and the power-out cable going to power supply B (or vice versa), error conditions are displayed when the SPS is tested or while it is charging.

CX4 Model 120 major subassemblies

The minimum CX4 Model 120 assembly consists of a single 2U storage processor enclosure (SPE), a 1U standby power supply (SPS), and a 3U 4 Gb/s UltraPoint disk-array enclosure (DAE), for a total of 6U. A fully configured CX4-120 consists of the SPE and dual SPS, plus eight 3U DAEs, for a total of 30U. Minimum and maximum configurations of the CX4 Model 120 assembly are shown in Figure 16.
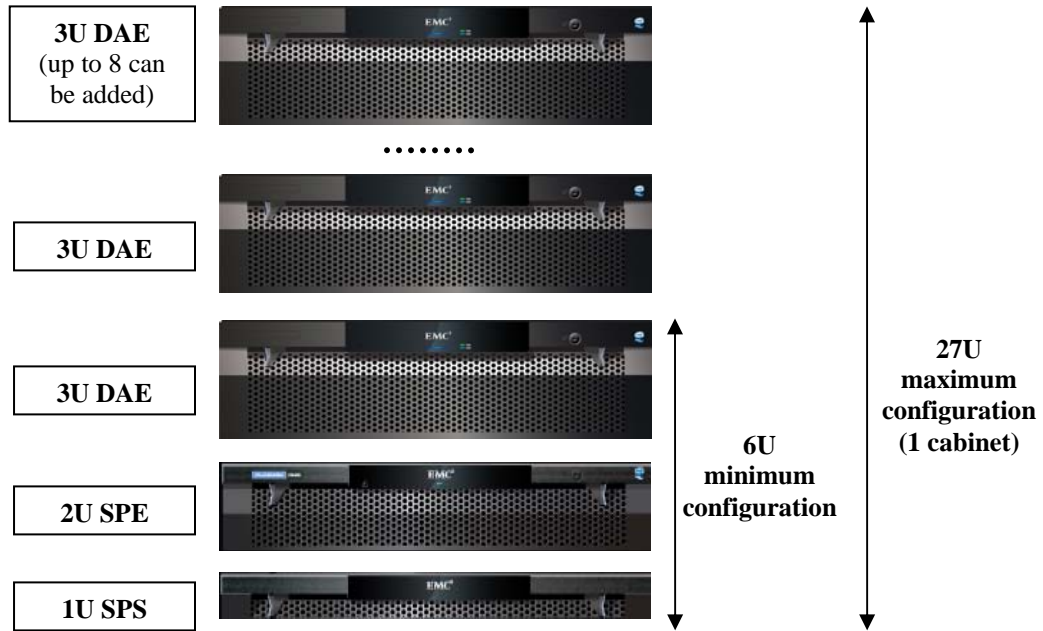
Figure 16. Minimum and maximum CX4 Model 120 configurations

The dual SPS, SPE, and DAE assemblies are rackmounted for efficiency, and provide you with many different configuration options. The CLARiiON 40U cabinet—with industry-standard 19-inch racks—can house different configurations of CX4-120 systems, as well as 1, 2, or 4 Gb/s Fibre Channel switches (1U and/or 2U) and/or Ethernet network switches. The 40U cabinet comes standard with four Power Distribution Units (PDUs) and two Power Distribution Panels (PDPs). Power supplies on the left use the left PDU; power supplies on the right use the right PDU. Additionally, all CLARiiON storage systems can be installed in non-EMC industry-standard cabinets.

CX4 Model 120 storage processor

Each CX4-120 SP contains one 1.2 GHz Dual-Core Intel Xeon processor   This dual-storage processor architecture provides the power for enhanced performance, stability, and reliability in the CX4-120 storage system. Each CX4-120 SP has 3 GB of system memory. There is a PCI Express-x4 CMI channel between the storage processors that is used for communication and messaging between the storage processors as well for the mirroring of data that is written to the portion of memory that has been designated for write cache on the storage system.
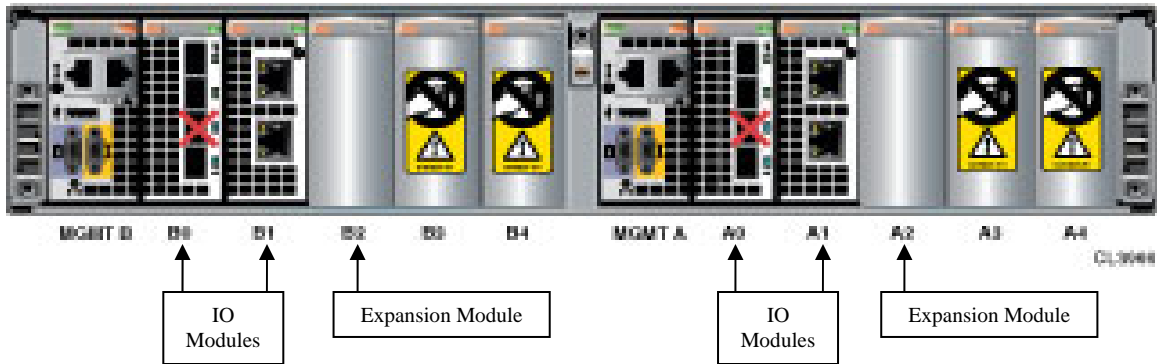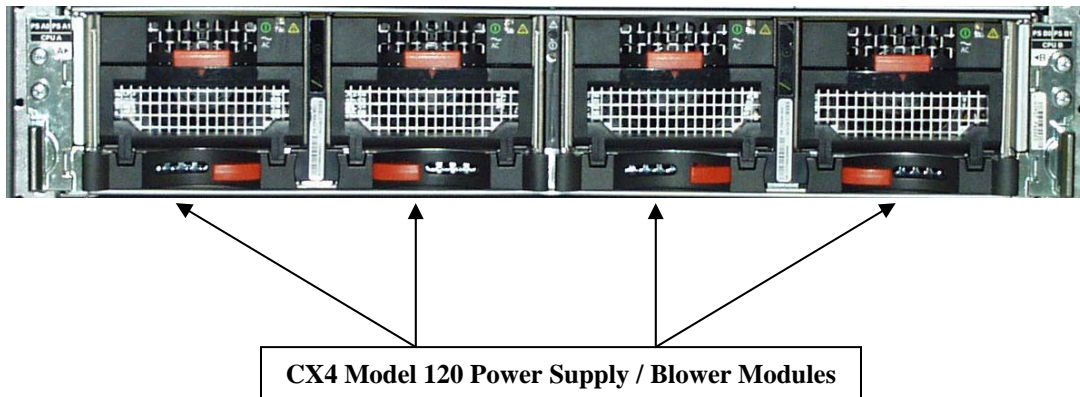
Figure 17. CX4 Model 120 storage processor

Figure 17 shows the CX4 Model 120 storage processor. LEDs provide indications of LAN connectivity, SP power, boot progress, and fault status, as well as power supply and blower status.   The LEDs also indicate the speed at which the front- and back-end ports are running – green indicates 1 or 2 Gb/s and blue indicates 4 Gb/s. Each CX4 Model 120 SP has both iSCSI and Fibre Channel front-end ports.

Each CX4-120 SP connects to at least two 4 Gb/s Fibre Channel front-end ports. These ports, which are small-form-factor pluggable (SFP) optical transceivers, are customer replaceable and have a default setting of **auto-negotiate**. Using Navisphere Manager or CLI, you can change the settings from **auto-negotiate** to 1, 2, or 4 Gb/s. These front-end ports may be connected to a 1, 2, or 4 Gb/s transceiver on a switch, or they may be directly connected to a 1, 2, or 4 Gb/s HBA on a server/host.

Each CX4-120 SP connects to at least two 1 Gb/s iSCSI front-end (FE) ports. Using Navisphere Manager or CLI, you can change the settings on each 1 Gb/s iSCSI front-end (FE) port from **auto-negotiate** to 10/100/1000 Mb/s. These iSCSI front-end ports may be connected to a 10/100/1000 Mb/s port on an Ethernet switch, or they may be directly connected to a 10/100/1000 Mb/s NIC or iSCSI HBA on a server/host.

Each CX-120 SP also connects to one 4 Gb/s Fibre Channel back-end port which, along with the peer SP, forms one redundant FC back-end loop for disk connectivity and capacity expansion.

The CX4-120 SP also has two 10/100/1000 Base-T LAN ports, one for Management and one for Service, as well as two micro-DB9 communication ports, one for serial communication and one for SPS sensing. The Management port is used to access and manage the storage processor via Navisphere, while the Service port is a *dedicated* port to be used by EMC Customer Service Representatives when they are onsite.

**Figure 18. CX4 Model 120 power supplies and cooling**

The CX4-120 SPE uses four 400-watt power supplies supporting N+1 power and N+1 cooling per storage processor. The power supplies contain thermal sensors for Ambient Over-Temperature monitoring. Cooling is achieved through high-speed blowers attached to each power supply module.

A single power supply can power a single storage processor and a single blower can cool a single storage processor. Either storage processor can have a single power supply/blower module fault and still maintain write caching. The CX4-120 can run indefinitely with one power supply/blower module faulted or removed on each SP and still maintain high availability (HA).

CX4 Model 120 standby power supply

As shown in Figure 19, the CX4-120 SPE requires one 1-kilowatt SPS to maintain power to the storage system during a power loss to allow for a full dump of the write cache to a reserved area on persistent disk. An additional SPS can be added for further redundancy.

When only one SPS is used in the CX4-120, the power output connectors for the SPS supply power to SP A and the first DAE on the first back-end loop. The power for SP B and the remaining power to the first DAE on the first back-end loop are supplied by the PDU within the CLARiiON 40U rack. When two SPSs are used, the power output connectors from the additional SPS power both SPB and the first DAE.
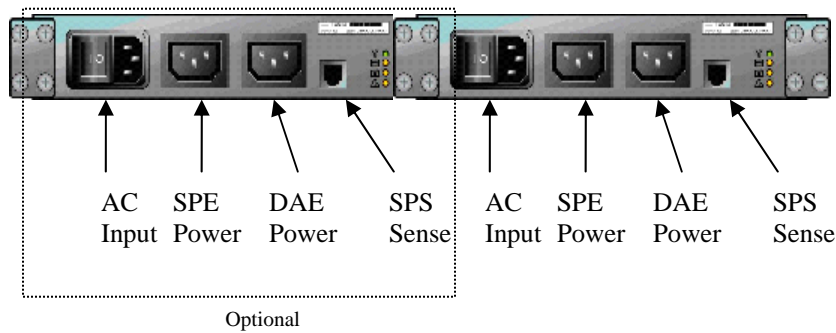
**Figure 19. View of the CX4 Model 120 standby power supply (SPS)**

It is important to cable each SPS so it connects completely to either the A side or the B side. For example, if you are looking at the SPSs from the back they should be configured as follows:

- SPS on the right: Power-out and sense cables should connect to power supply A and SP A.
- SPS on the left: Power-out and sense cables should connect to power supply B and SP B (optional).

If an SPS is cabled with the SPS sense cable going to SP A and the power-out cable going to power supply B (or vice versa), error conditions are displayed when the SPS is tested or while it is charging.

CX4 series 4 Gb/s UltraPoint DAE

The CX4 series has a separate enclosure for the storage processors, while the first DAE contains the drives where the configuration, cache vault, and boot images are stored. The DAE enclosure has room for up to fifteen 2 Gb/s or 4 Gb/s drives. Drive 0 is at the farthest left side of the enclosure, and drive 14 is at the farthest right side of the enclosure.
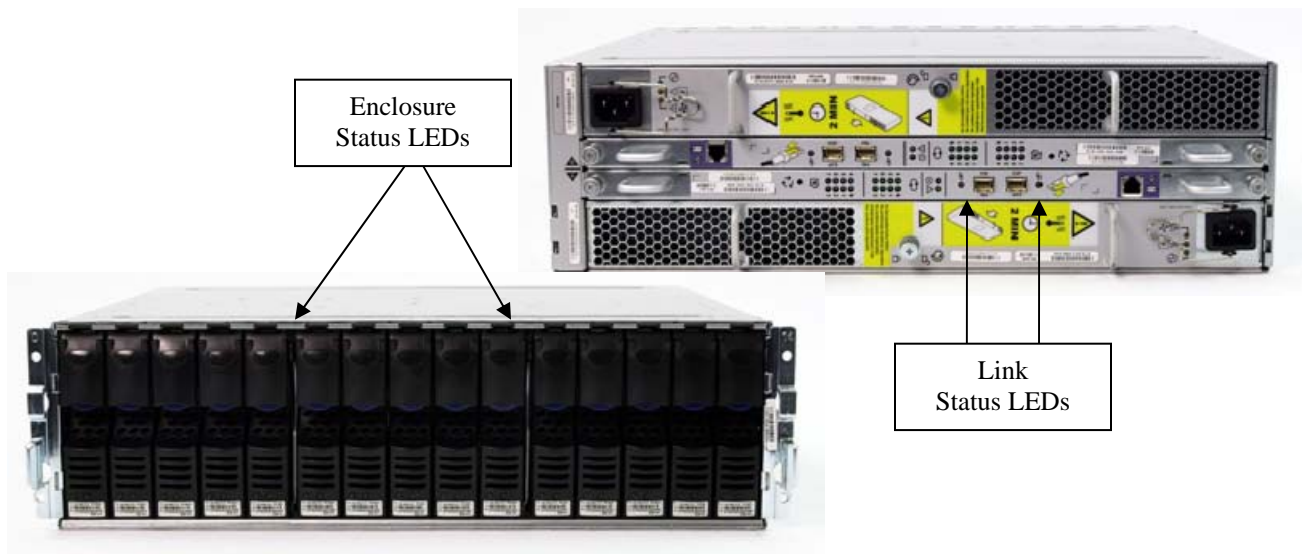
Figure 20. Front and back view of the 4 Gb/s UltraPoint DAE

The 4 Gb/s UltraPoint DAE has two link control cards (LCCs) that are capable of running at 2 or 4 Gb/s. The LED on the left-front of the enclosure indicates fault status. The LED on the right-front of the enclosure has three states of operation: **Off**, **Green**, and **Blue**. **Off** indicates that the unit is not powered on. **Green** and **Blue** indicate that the enclosure and drives are operating at 2 and 4 Gb/s, respectively. You

can determine the speed at which the enclosure is operating by looking at the LED on the front of the enclosure or the link status on the back of the enclosure.

**Table 3. Components housed within a 4 Gb/s UltraPoint DAE**

4 Gb/s UltraPoint DAE
Two link control cards (LCCs)
Two power supply/blower assemblies
Fifteen 2 Gb/s or 4 Gb/s Fibre Channel / 3 Gb/s SATA-II disk drives

Software on CX4 series storage systems

The CX4 series is designed to focus on intelligent storage management functions that operate in both direct-attach and SAN environments. The CX4 series is capable of incorporating a full range of intelligent storage functions, such as logical unit number (LUN) masking and storage replication applications.

Vault area on CX4 series storage systems

All CX4 series drives have an area reserved for configuration information. Additionally, the first five disks in the first enclosure on the first back-end loop have areas reserved that are used for software images and a write cache dump (the *vault* area). To provide space to support these features, user space starts at 62 GB on the first five drives and starts at 34 MB on all the other drives, as shown in Figure 21.

Reserved Space = 62 GB

User Space

First Five Drives

Reserved Space = 34 MB

User Space

All Other Drives
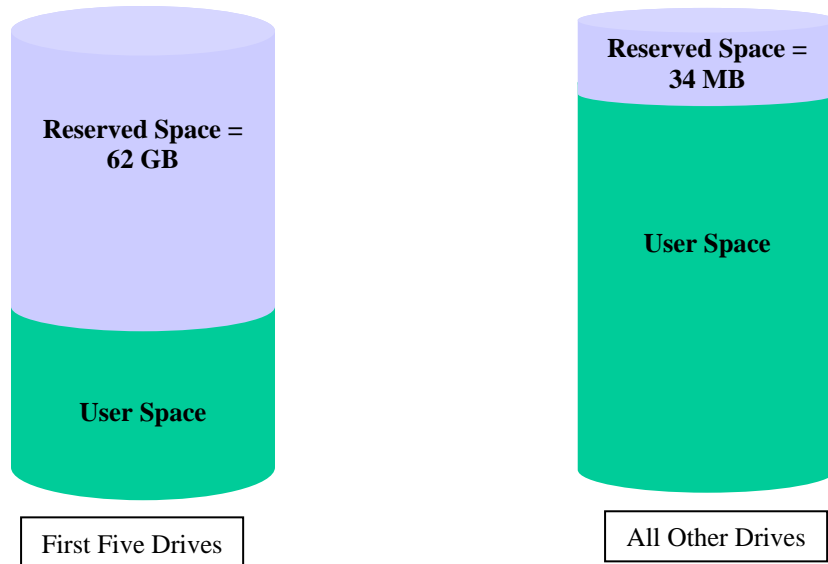
Figure 21. CX4 series disk layout showing the private space usage (picture not to scale)

Navisphere Management Suite

You can manage your CX4 storage system with Navisphere Manager, which runs on the storage system and can be accessed anywhere you have network connectivity to the storage processors. With Navisphere Manager, you can manage storage systems on the same subnet as well as manage multiple storage systems in separate storage system domains. Remote management is also supported.

MetaLUNs

With Navisphere Manager, the CX4 storage system can utilize the LUN expansion feature, in which the base LUN is expanded in size to create a metaLUN. The metaLUN is a combination of more than one LUN joined together by either striping or concatenation. For more information, refer to the white paper *EMC CLARiiON MetaLUNs: Concepts, Operations, and Management* on EMC Powerlink®. See Table 3 for the metaLUN features available on CX4 models.

Table 4. MetaLUN features supported on CX4 series storage systems

Feature	CX4 Model 120	CX4 Model 240	CX4 Model 480	CX4 Model 960
Maximum number of metaLUNs per storage system	512	512	1024	2048
Maximum LUN size (base or metaLUN)	2 TB or more	2 TB or more	2 TB or more	2 TB or more
Maximum component LUNs (striping/concatenation) per metaLUN	16	16	16	16

Virtual LUN technology

The virtual LUN technology (LUN migration) feature is managed using either Navisphere Manager or Navisphere CLI (Command Line Interface). This Navisphere software allows the storage administrator to migrate data from a source LUN or metaLUN to another LUN or metaLUN within the storage system, while keeping the source LUN's data online.

LUN migration is useful when:

1. Changing drive types:

    - Migrating from 2 Gb/s Fibre Channel to 4 Gb/s Fibre Channel
    - Migrating from 4 Gb/s Fibre Channel to 2 Gb/s Fibre Channel
    - Migrating from SATA-II to Fibre Channel
    - Migrating from Fibre Channel to SATA-II

2. Changing performance characteristics:

    - Migrating to less utilized disks
    - Changing RAID type

During a LUN migration, the storage system copies the data from the source LUN to a destination LUN. After the migration is complete, the destination LUN assumes the identity (World Wide Name and other IDs) of the source LUN and the source LUN is destroyed. Please see the white paper *EMC Virtual LUN Technology - A Detailed Review* on EMC Powerlink for more information.

Access Logix (included with Navisphere Management Suites)

Access Logix™ is an easy-to-use Navisphere tool that provides LUN masking between the storage processors and the host's Fibre Channel HBA. Access Logix is enabled from within Navisphere, and provides heterogeneous host connectivity between hosts and the CX4. It provides users with a user-friendly way to define *storage groups.* Storage groups control which hosts have access to which LUNs.

For an up-to-date list of platforms supported by Access Logix, see the *EMC Support Matrix* on EMC Powerlink.

Table 5. Access Logix features on CX4 series storage systems

Feature	CX4 Model 120	CX4 Model 240	CX4 Model 480	CX4 Model 960
Max storage groups per storage system	128	256	512	1024
Max LUNs per storage group	256	256	256	256

SnapView snapshots and clones (optional)

SnapView snapshots

SnapView allows you to create a snapshot of a source LUN on a production server that may be viewed by a secondary server. A snapshot represents a point-in-time copy of the source LUN. During a SnapView session, the production server continues to write to the source LUN and modify data. The snapshot may be used by decision support applications or, using Navisphere CLI, you can write a script for a third-party backup application that uses the snapshot as a backup for the LUN. In the case of a source corruption, contents of the snapshot can be rolled back onto the source LUN. Table 6 shows the SnapView features available on CX4 series storage systems.

Table 6. SnapView snapshots supported on CX4 series storage systems

Feature	CX4 Model 120	CX4 Model 240	CX4 Model 480	CX4 Model 960
Snapshot sessions per source LUN	8	8	8	8
Snapshots per source LUN	8	8	8	8
Snapshots per storage system	512	512	1024	2048
Source LUNs per storage system	128	128	256	512
Reserved LUNs per storage system[5]	128	128	256	512

SnapView clones

A SnapView clone is a complete copy of a source LUN, equal in size to the source LUN. Once created, this full copy can be fractured from the source LUN and mounted on a different host for processing by backup applications without affecting the production data on the source LUN.

A source LUN can have up to eight clones in a *clone group*; a clone group consists of all the clones that are created for a particular source LUN. In the case of source corruption, the contents of any clone in the clone group can be reverse-synchronized to the source LUN, thus minimizing downtime. See Table 7 for the clone features available on the CX4 storage systems.

Table 7. SnapView clones supported on CX4 series storage systems

Feature	CX4 Model 120	CX4 Model 240	CX4 Model 480	CX4 Model 960
Clones per source LUN	8	8	8	8
Clone source LUNs	128	256	512	1024
Clone images per storage system (Note: This number does not does not include the source LUN)	256	512	1024	2048

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[5] At least one reserved LUN is required for each source LUN.

MirrorView/A and MirrorView/S (optional)

MirrorView/A and MirrorView/S are software applications that maintain copies (or mirrors) of LUNs at separate locations. The production image (the one mirrored) is called the primary image; the copy of the image is called the secondary image. MirrorView provides backup for disaster recovery, that is, one image is preserved and is accessible if a serious accident or natural disaster disables the other image. A primary LUN can have up to two mirrors (each mirror must be on a separate storage system) with MirrorView/S and one mirror with MirrorView/A. Additionally, any given storage system can participate in MirrorView connections with up to four other storage systems. Should connectivity be lost between the primary LUN and one or all of its mirrors, a log is kept of the data written to a LUN, so that subsequent synchronizations can be incremental (that is, only the data that changed while the mirror was unreachable is transferred once the mirror regains connectivity). See Table 8 and Table 9 for MirrorView features available on the CX4 storage systems.

Table 8. MirrorView/S devices supported on CX4 series storage systems

Feature	CX4 Model 120	CX4 Model 240	CX4 Model 480	CX4 Model 960
MirrorView/S images per storage system (includes primary and secondary images, as well as clone/source images in the total count)	128	256	512	512

Table 9. MirrorView/A devices supported on the CX4 UltraScale series storage systems

Feature	CX4 Model 120	CX4 Model 240	CX4 Model 480	CX4 Model 960
MirrorView/A source LUNs per storage system (total source LUN count shared with source LUNs participating in SnapView sessions and/or participating in an incremental SAN Copy session)	100	100	100	100

SAN Copy (optional)

SAN Copy is a software application that rapidly copies LUNs within a CX4 storage system, or between a CX4 storage system and another storage system. When moving LUNs between storage systems, the CX4 can serve as the source or destination server; in other words SAN Copy can copy a LUN from a CX4 or to a CX4. SAN Copy also provides incremental sessions, which maintain incremental tracking of copies, so that only the data that has changed on the source LUN is copied to the destination LUN. SAN Copy (including incremental) can be used to copy LUNs between a CX4 and number of storage systems, including a Symmetrix®, CX3, CX200, CX300, CX400, CX500, CX600, CX700, AX100, AX150, AX4, and third-party storage systems. See Table 10 for the SAN Copy features available on the CX4 storage systems.

Table 10. SAN Copy devices supported on CX4 series storage systems

Feature	CX4 Model 120	CX4 Model 240	CX4 Model 480	CX4 Model 960
Simultaneous SAN Copy sessions per storage system	8	8	16	16
SAN Copy destinations per storage system	50	50	100	100

PowerPath

EMC PowerPath® is host-resident software that works with both CLARiiON and Symmetrix storage systems to deliver intelligent I/O path management. Using PowerPath, administrators can improve the server's ability to manage heavy storage loads through continuous and intelligent I/O balancing; PowerPath automatically configures multiple paths and dynamically tunes for performance as the workload changes. PowerPath also adds to the high-availability capabilities of the CLARiiON and Symmetrix storage systems by automatically detecting and recovering from server-to-storage path failures.

Online Upgrade

Online Upgrade provides a transparent upgrade mechanism for the CX4 product line. This feature, when coupled with PowerPath failover software, allows you to upgrade storage system software, including the core software, without disrupting host access to data. During the online upgrade process, one SP is upgraded and rebooted, while PowerPath or other failover software redirects I/O through the alternate SP. Write cache remains enabled throughout this process to ensure full system performance.

Conclusion

The CX4 is the fourth generation of the CX series and continues EMC's commitment to maximizing customers' investments in CLARiiON technology by ensuring that existing resources and capital assets are optimally utilized as customers adopt new technology. The CX4 series with UltraFlex technology is based on a new, breakthrough architecture and extensive technological innovation, providing a midrange storage solution that cannot be matched by any competitor. The CX4 series with UltraFlex technology delivers industry-leading application performance, and new levels of scalability, reliability, flexibility, and affordability. It also introduces new levels of ease of use, making the CX4 easy to install, manage, and scale.

The CLARiiON CX4 series with UltraFlex technology is now the preferred choice to provide maximum capabilities from a midrange storage platform. The unique combination of a breakthrough architecture design and advanced software capabilities enables the CX4 series to meet the growing IT challenges of today's midsize and large enterprises—scaling system capacity and performance, simplifying management in complex environments, and delivering increasing levels of information availability and protection for critical applications and data.

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