



Technical Report

Introduction to NetApp E-Series E2700 with SANtricity 11.20

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Abstract

The NetApp® E-Series E2700 storage system is an excellent choice for wide-ranging data center storage requirements. This report provides detailed information about the multiple system configuration options. It is also a great starting point to introduce system details to sales engineers, partners, service providers, and customers who are purchasing the product.

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1 E-Series E2700 Storage Systems with SANtricity 11.20

NetApp E2700 storage systems address wide-ranging data storage requirements with balanced performance that is equally adept at handling sequential I/O for video and backup applications and random small I/O, high IOPS requirements for small and medium-sized enterprise transactional databases. The E2700 brings together the following advantages:

- Modular host interface flexibility (SAS, FC, and iSCSI)
- Excellent storage density (4U/60-drive shelf)
- High reliability (99.999% reliability)
- Intuitive management: simple administration for IT generalists, detailed drill-down for storage specialists

Together, these features create an entry to a midrange storage system that is perfectly suited for data-intensive solutions requiring affordable capacity, high bandwidth-intensive streaming applications, transaction-intensive workloads, and high-performance file system requirements without sacrificing simplicity and efficiency. In addition, its fully redundant I/O paths, advanced protection features, and extensive diagnostic capabilities deliver a high level of availability, integrity, and security.

1.1 Primary Use Cases

The flexible host interface options and wide range of drive choices make E2700 storage systems an ideal storage platform for small and medium-sized enterprises to purchase powerful systems that offer easy growth strategies at the lowest possible initial investment. This system will scale up for dedicated workloads such as:

- Business-critical backup environments for any size enterprise
- Video applications and video surveillance environments
- Common IT applications such as Microsoft® Exchange and SQL Server® for small and medium enterprises
- Mixed workload environments supporting small and medium enterprises

1.2 E2700 System Options

The E2700 controller is available with three shelf options: E2760, E2724, and E2712. These options support both spinning media and solid-state drives (SSDs) to meet a wide range of customer performance and application requirements.

Note: SSDs are not supported in the E2712 shelf (DE1600), but they are supported in mixed shelf systems when the E2712 is used as the controller-drive shelf and at least one expansion-drive shelf supports SSDs.

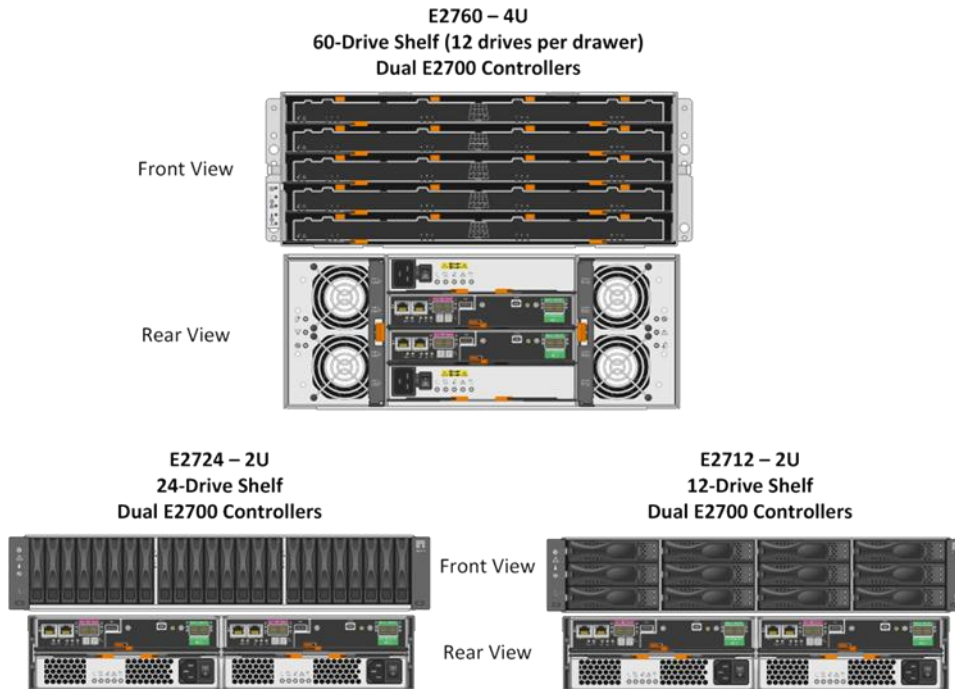
All three shelf types support dual controller packs, dual power supplies, and dual fan units for redundancy. It is also possible to have the E2724 and E2712 systems in a simplex controller configuration. The shelves are sized to hold 60 drives, 24 drives, or 12 drives, respectively, as shown in Figure 1.

Note: This document uses the following terms interchangeably with the terms used in the NetApp SANtricity® management software and E-Series technical publications:

- Shelf = shelf enclosure
- Drive shelf = drive tray
- Drive = disk
- Module = canister

The term drawer is used only to describe the five drawers in the DE6600 shelf and does not apply to other shelf models.

Figure 1) E2700 shelf options (simplex not shown).



Each E2700 controller (E2724 and E2712 simplex controller systems are supported) has a combination of on-board storage-side SAS drive expansion ports and add-on host interface ports. The host port protocol is determined by the type of host interface card (HIC) and one of two software ID codes called the submodel ID (SMID), as shown in Table 1.

Table 1) E2700 SMIDs and associated protocols.

SMID	Supported Protocol
214	FC, SAS, IB
250	iSCSI

The SMID for each controller can be viewed by using SANtricity Storage Manager and must match or else the system will not start up. When required, the SMID can be changed from the factory setting by using SANtricity Storage Manager to change the controller feature pack. Feature pack changes are automatically applied to both controllers in a storage system.

Note: Changing the host protocol requires significant planning because the storage system must be taken completely out of service to implement the change. As a result, changing the host interface protocol is much more complicated if the storage system already has active connections and LUNs for a host. For additional details, see NetApp knowledge base article [KB-1014848](#).

2 SANtricity 11.20 Enhancements

E-Series systems have a rock-solid reputation for reliability and availability. The SANtricity 11.20 release builds on that legacy by adding new reliability, availability, and serviceability (RAS) features; faster host interfaces; and more drive choices.

2.1 SANtricity Storage Manager 11.20

E-Series storage systems are managed by using the SANtricity Storage Manager application, which offers both GUI management and CLI management interfaces for out-of-band and in-band system management. NetApp generally recommends out-of-band management; however, in-band management is useful for cases in which there is no IP network access to remote storage systems, but there are in-band traffic connections to the storage system from a local host.

SANtricity Storage Manager is based on the Oracle® Java® framework and can be installed on a Microsoft Windows®, Solaris, or Linux® operating system (OS) platform. The NetApp best practices configuration for managing storage systems is to use an out-of-band management host that does not participate in the data delivery workload.

Note: Refer to the “Initial Configuration and Software Installation Guide for SANtricity Storage Manager 11.20” in the [SANtricity Storage Manager](#) product documentation for additional management configuration options.

SANtricity Storage Manager 11.20 (sometimes referred to as the *storage management software*) is supported on 64-bit OS platforms and enables storage administrators to perform the following tasks:

- Set up network connections.
- Commission new storage systems.
- Configure NetApp AutoSupport™ (ASUP™) settings and preferences.

Note: For ASUP to function properly, one management station must have the monitor service running. You will be prompted during the SANtricity Storage Manager, management station installation procedure to automatically start the monitor if the management station reboots.

- Provision volumes and map the storage to hosts.
- Set up and manage storage features such as NetApp Snapshot® copies, volume copy, synchronous mirroring, asynchronous mirroring, and SSD read cache.
- Perform hardware and software maintenance activities to manage E-Series storage systems.

When the SANtricity management client is installed on a desktop OS, the following limitations apply:

- Simultaneous user sessions are limited to eight sessions.
- Desktop systems cannot run the host agent and send I/O traffic to the E-Series storage system.

SANtricity Storage Manager software has two windows that provide management functionality and offer a graphical representation of the storage system:

- **Enterprise management window (EMW).** When SANtricity Storage Manager is initiated, the EMW appears first. The EMW is used to add the storage systems that will be managed and monitored through SANtricity Storage Manager.
- **Array management window (AMW).** From the EMW, the AMW can be launched to access summary views and detailed information about individual storage systems. The AMW is used to configure, maintain, and manage a storage system and its components.

Figure 2 and Figure 3 show the EMW and AMW, respectively. In addition, the script editor for a storage system can be opened from the EMW, and configuration of the system can be accomplished by using a saved configuration or a custom script.

Note: The storage system is referred to as the *storage array* in the SANtricity GUI.

Figure 2) SANtricity Storage Manager 11.20 EMW.

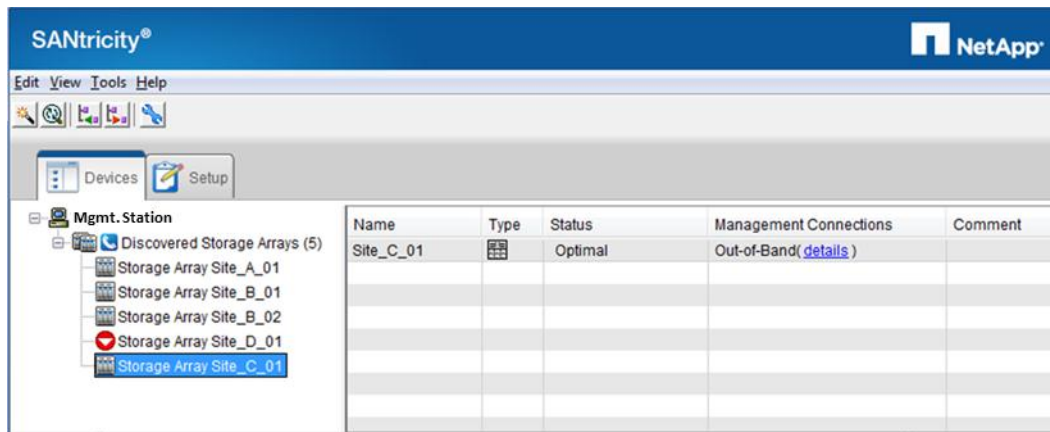
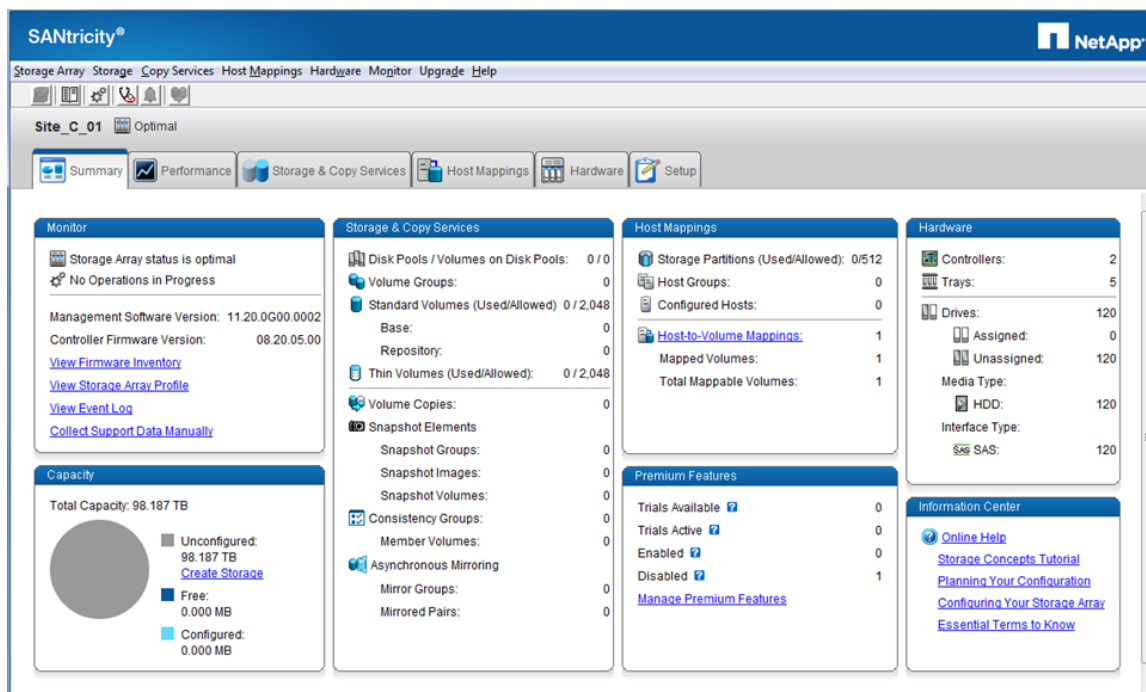


Figure 3) SANtricity Storage Manager 11.20 AMW storage system Summary tab view.



E2700 storage systems are shipped preloaded with the SANtricity 11.20 OS software. The SANtricity Storage Manager software, however, must be downloaded separately from the NetApp Support site and loaded on the management server prior to discovering storage systems running the SANtricity 11.20 OS.

Note: For first-time customers, the Support site registration process can take from three to five business days to complete. New customers should register for Support site access well in advance of the initial product installation date.

2.2 SANtricity Management Integration

E-Series storage systems easily integrate into most physical data center environments, but leveraging the SANtricity plug-ins, APIs, providers, and utilities with applications such as Oracle and SQL Server and OSs such as Windows, Linux, and VMware® enables the adoption of E-Series storage systems without the need for weeks of training or recreating day-to-day operations to administer the systems.

The available software packages are located on the NetApp Support site under the Downloads tab and are available to anyone with an active Support site account and current E-Series product support agreement. The available packages include:

- **Oracle Enterprise Manager plug-in.** Storage volume to database mapping, monitoring, and performance reporting.
- **SQL Server Management Studio plug-in.** Performance monitoring and tuning for SQL Server database storage, volume and Snapshot copy creation for SQL Server databases.
- **VMware vCenter™ plug-in.** Configuration, management, monitoring, and datastore to LUN mapping in VMware vSphere® client. Current version is 2.7; web client will be supported in the next version (3.0).
- **VMware Site Recovery Manager adapter.** Automate DR failover and enable DR plan testing in VMware environment.
- **VMware APIs for Storage Awareness (VASA) Provider.** Reporting of storage volume capabilities to vSphere for SLO management.
- **System Center Operations Manager (SCOM) Management Pack.** Monitor health status and send storage alerts to Microsoft System Center.

For scripting and custom integration into other management tools, the following are available on the NetApp Support site:

- **SANtricity Web Services Proxy.** Web APIs that provide a collection of REST interfaces to configure, manage, and monitor E-Series systems.
- **SANtricity Toolkit for Microsoft Windows PowerShell®.** More than 100 cmdlets enabling storage administration of E-Series systems. Available in the ToolChest on the NetApp Support site.

See <http://mysupport.netapp.com/NOW/cgi-bin/software/> and select E-Series/EF-Series SANtricity Management Plug-ins for the plug-ins and web services software and documentation. The PowerShell toolkit is available at http://mysupport.netapp.com/NOW/download/tools/santricity_powershell_toolkit/.

2.3 Enhanced Reliability, Availability, and Serviceability Features

New functionality available with SANtricity 11.20 uses intelligent monitoring to identify and to help minimize the impact associated with all drive failures, and especially large 4TB and 6TB NL-SAS drive failures, before a complete drive failure actually occurs. This, combined with support for enhanced Ethernet or data center bridging (DCB) and enhancements to the NetApp Support site tools, adds to an already impressive list of reliability, availability, and serviceability (RAS) features and capabilities offered with the E-Series portfolio.

Drive Evacuator

The new drive evacuator feature constantly monitors the health of all drives in the system by using a process called *predictive failure analysis*. When a drive displays characteristics indicative of a failing drive, the SANtricity software automatically initiates movement of the data blocks on that drive to a spare drive or to another drive in the pool in the case of a Dynamic Disk Pool (DDP). If the drive in question completely fails during the drive evacuation process, the rebuild of the data associated with the failed drive picks up from the point where the evacuator feature stopped.

DCBX Support

Data Center Bridging Exchange (DCBX) is an enhancement to the Ethernet protocol that allows IP network administrators to set priorities for packet flow across their Ethernet networks based on the type of I/O. Ideally this would consistently prioritize IP voice traffic from video traffic, iSCSI traffic, and other traffic types in the network. The goal of the protocol enhancement is to dramatically reduce packet loss when devices are very busy.

In SANtricity 11.20, E-Series systems support DCBX and provide new report content to notify users of irregularities associated with the settings. The new report content can be found in the SANtricity Storage Manager, in the AMW > Monitor > Health > iSCSI Statistics > DCBX Operational State Statistics view, as shown in Figure 4.

Figure 4) New DCBX information in iSCSI statistics report.

If you set the baseline for the iSCSI statistics, the baseline will be set for all statistics types.

iSCSI Statistics Type

- ☐ Ethernet MAC statistics
- ☐ Ethernet TCP/IP statistics
- ☐ Target (protocol) statistics
- ☐ Local initiator (protocol) statistics
- ☒ DCBX operational state statistics
- ☐ LLDP TLV statistics
- ☐ DCBX TLV statistics

Options

No additional options available

DCBX Operational State Statistics

[View Legend for table headings](#)

Operational states:

iSCSI Host Port	Priority Group	Priority-Based Flow Control	iSCSI Feature	FCoE Bandwidth	No FCoE/FIP Map Mismatch
Controller B, port 1	Disabled	Disabled	false	Disabled	false
Controller B, port 2	Disabled	Disabled	false	Disabled	false
Controller B, port 3	Disabled	Disabled	false	Disabled	false
Controller B, port 4	Disabled	Disabled	false	Disabled	false
Controller A, port 1	Disabled	Disabled	false	Disabled	false
Controller A, port 2	Disabled	Disabled	false	Disabled	false
Controller A, port 3	Disabled	Disabled	false	Disabled	false
Controller A, port 4	Disabled	Disabled	false	Disabled	false

Data gathered on: 12/10/14 10:24:40 PM

[Refresh](#) [Save As...](#) [Close](#) [Help](#)

Drive Firmware Upgrade

Periodically, drive suppliers issue firmware updates for their drives to resolve field issues and to implement new features and functionality. As a result, NetApp receives the updates from the drive suppliers, and then we certify the update before posting the associated firmware and documentation. The links to the [E-Series/EF-Series drive firmware packages](#) are located on the NetApp Support site at Downloads > Software > E-Series/EF-Series Storage Manager.

E-Series storage systems support the ability to upgrade drive firmware by using one of two methods: parallel upgrades and online upgrades. Both methods use the same drive firmware download; however, the state of a drive can affect the ability to upgrade firmware on that drive because some nonoptimal states result in loss of access to the drive.

If a drive is bypassed or offline, the drive is considered inaccessible by the controller, so drive firmware upgrade is not allowed. Drive firmware upgrade is allowed for all other drive states (optimal, failed, PFA, loss of redundancy, uncertified, and replaced) unless the drive transitions to the replaced state after the start of a download. If any drive with an incompatible state is associated with a download image, the storage system generates error logs in the event monitor that provide additional information about the condition.

Parallel Drive Firmware Upgrade

The parallel upgrade method has been supported for several releases, and NetApp still recommends this method to update drive firmware. It is the fastest method because the drives are upgraded simultaneously offline. All I/O to the drives being upgraded must be stopped and remain stopped for the duration of the upgrade activity. SANtricity 11.20 adds the improvement that I/O is required to be stopped only to the drives that are being upgraded, rather than requiring that I/O be stopped to the entire storage array.

Note: When a volume group, disk pool, or drive is in a nonoptimal state, the parallel method is the only supported method to upgrade drive firmware. It is also the only way to upgrade RAID 0 volumes.

This method can be used to upgrade individual drives, drives associated with a particular volume group or disk pool, drives used as hot spares, or unassigned drives.

Online Drive Firmware Upgrade

Online drive upgrade is a new feature with SANtricity 11.20 and can be used to upgrade drive firmware for drives in optimal status, hot spare drives, and unassigned drives. The procedure does not require customers to stop all I/O, but the procedure should be used during periods of low I/O, especially periods of low write activity. System performance is affected during the upgrade period.

The online upgrade procedure takes one drive at a time offline, upgrades the firmware, reconstructs writes that occurred while the drive was being upgraded, and places the drive back in service before moving to the next drive in the set to be upgraded. During this time, do not make any configuration changes to the storage system. Disruptions that cause a controller reset can cause the system to place the currently updating drive in a degraded state, and all data on that drive will be reconstructed. In this case, the upgrade process stops. This can be especially disruptive when using large-capacity drives with RAID 5, RAID 6, or DDP because the reconstruction time could exceed 24 hours. Therefore, always make sure that the storage system is stable before initiating the online drive upgrade procedure.

Support Tool Enhancements

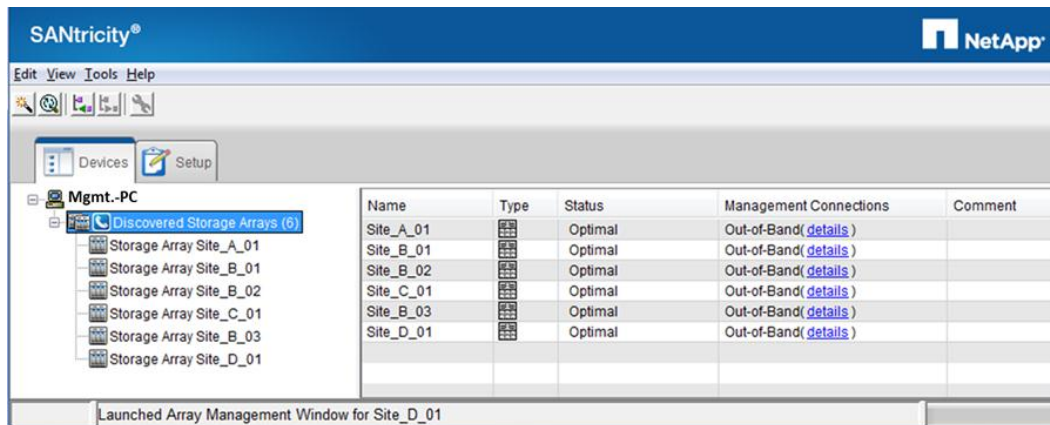
Improving the customer experience is the central goal of NetApp enablement tools. To continue the legacy of prioritizing enablement tools, several key enhancements have been implemented. The first is My AutoSupport for E-Series. This allows customers to tailor their support experience for E-Series systems just like they do for FAS systems. My AutoSupport includes accessing tools such as Config Advisor for E-Series and EF-Series systems to easily analyze any implementation and look for opportunities to change or improve the setup to better meet customer expectations.

NetApp AutoSupport

NetApp AutoSupport (ASUP) is an integrated and efficient monitoring and reporting technology that constantly checks the health of NetApp storage systems. It is one of the most important and effective troubleshooting tools for customers and for NetApp Customer Success Services (CSS).

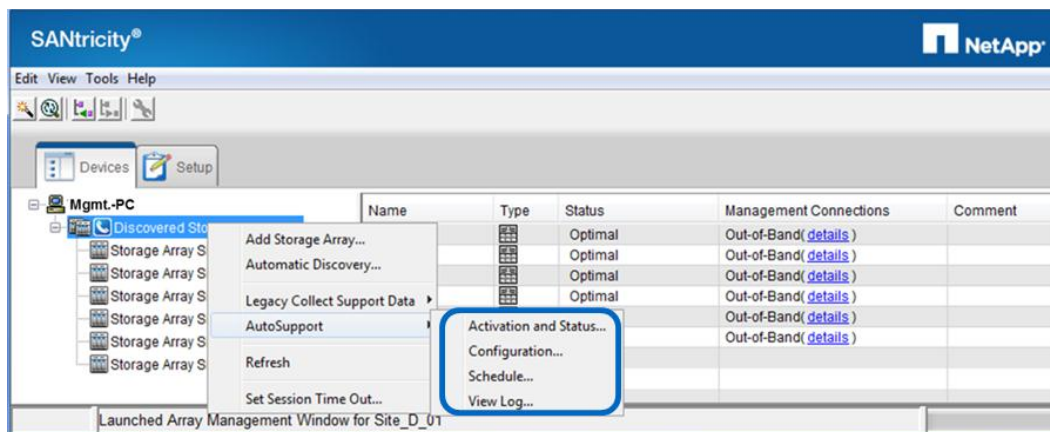
ASUP includes a scheduling mechanism for status and error reporting, and its messages contain configuration data, status data (such as available capacity and whether subsystems are up or down), system log files, and performance metrics. This data is used in a variety of critical ways to aid in troubleshooting and system trend-analysis activities. Figure 5 shows the EMW Devices tab with the ASUP icon selected.

Figure 5) EMW Devices tab with ASUP icon selected.



ASUP is enabled by default on all E-Series storage systems from the factory; however, the support bundle delivery configuration must be completed before support data can be sent to NetApp. This feature can be managed globally from the EMW, or individual storage systems can be managed from the AMW. Figure 6 shows the management options available from the EMW.

Figure 6) EMW ASUP settings and options.



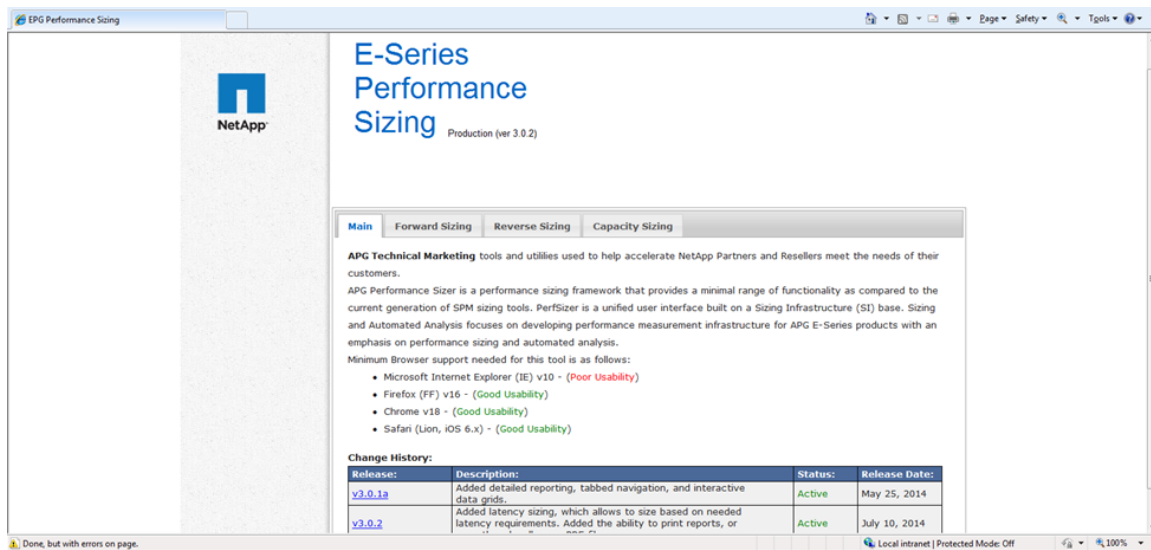
Note: ASUP can be enabled or disabled from the AMW for an individual storage system. All other ASUP settings are accessed from the EMW.

For more information about the ASUP feature, refer to the “Concepts Guide for SANtricity Storage Manager Version 11.20” in the [SANtricity Storage Manager](#) documentation page in the NetApp Documentation library.

E-Series Sizer

There are new enhancements to the [E-Series Performance Sizing](#) tool, which provides sales engineers and partners with the ability to predict performance ranges associated with their proposed configuration. The reverse sizing capability adds to the existing forward sizing ability, which prompts for performance information and quickly provides a set of configurations that meet the given set of requirements. The third sizing approach in the tool, capacity sizing, takes into consideration overhead for specific RAID and other configurations to provide guidance on the total capacity required to meet the full set of objectives (primary capacity, RAID overhead, and spare drive capacity). Figure 7 shows the landing page for the E-Series sizing tool.

Figure 7) E-Series Performance Sizing tool.



Host Utilities

When customers implement E-Series with Windows and Linux OSs, the new [Host Utilities Kits](#) support settings to properly configure each host that uses E-Series storage, according to the latest Interoperability Matrix Tool (IMT) guidance. The kits are on the NetApp Support site at Downloads > Software > Host Utilities—SAN, and then users select the platform. Currently the Linux and Windows kits support E-Series and FAS implementations. Other available kits support FAS implementations.

2.4 SANtricity Software Specifications for E2700 Hardware

Table 2 lists the SANtricity software specifications for E2700-based storage systems.

Table 2) SANtricity software boundaries for E2700-based storage systems.

Components	Maximum
Storage Hardware Components	
Shelves (system and expansion)	16
Drives	192
SSD cache capacity	5TB
Logical Components	
Partitions	128
Volumes	512
Volumes per consistency group	32
Thin volumes per system	512
Disk pools per system	20
Snapshot Copies	
Per Snapshot group	32

Components	Maximum
Per volume	128
Per storage system	512
Snapshot Volumes	
Per Snapshot copy	4
Per system	256
Snapshot Groups	
Per volume	4
Per system	256
Mirrors	
Legacy mirrors per system	16 (synchronous only)
Mirrors per system	32
Mirrors per volume	+1
Mirrors per asynchronous mirror group	32
Asynchronous mirror groups per system	4

2.5 Performance Improvements

Running SANtricity 11.20 in new E2700 storage systems delivers enhanced system performance over the previous generation of E-Series storage systems running SANtricity 11.10. The faster host interfaces and improved SSD performance by using hybrid systems make the E2700 storage system a great choice to support performance-intensive data center workloads. The SANtricity 11.20 software is available for download from the NetApp Support site by anyone with a valid NetApp product support agreement and active Support site account.

New Host Interfaces with SANtricity 11.20

SANtricity 11.20 extends host interface choices on E2700 storage systems with support for the new 4-port 12Gb/sec SAS HIC and a 2-port or 4-port 10Gb optical iSCSI HIC. Both host interfaces are excellent choices for broad data center requirements that use high-speed direct-connect architectures or high-speed Ethernet networks between hosts and storage systems. The 10Gb iSCSI HICs also support direct connection to host servers.

The 12Gb SAS HIC uses wide-port technology, so it actually consists of 4 PHYs, each 12Gb/sec. As a result, the full link speed for the SAS3 link is 48Gb/sec. Both the 12Gb SAS HIC and the 10Gb iSCSI HICs support port speed autonegotiation to accommodate existing 6Gb SAS environments and 1Gb iSCSI environments, respectively.

Hybrid Performance Enhancements

When mixing SSD volume groups or disk pools with HDD volume groups and disk pools, customers who run SANtricity 11.20 on E2700 storage systems can expect a performance improvement of as much as 30% with small random I/O at no additional cost. Enhancements to the 11.20 software optimize I/O associated to SSD volume groups and DDPs while delivering consistent performance for HDD workloads when compared with E-Series E2700 storage systems that run SANtricity 11.10.

New Drives Supported with SANtricity 11.20

New drives in this release include 6TB NL-SAS drives for superdense storage requirements; the 1.8TB 10K HDD, which provides 10K RPM performance with twice the capacity per shelf; and the 1.6TB SSD, which combines enhanced performance with SANtricity for, again, twice the capacity of drives supported by E2700 storage systems that run SANtricity 11.10.

In addition to support for new standard 512B sector drives, E-Series now supports 512e simulation to support physical 4KB sector drives. See the [Hardware Universe](#) for a full list of supported drives per shelf model.

3 Hardware Configurations

E2700 storage systems use a modular approach to hardware configurations. This approach can meet most customer SAN storage requirements for flexible host interfaces and versatile drive choices without sacrificing supportability, ease of implementation, and long-term stability.

3.1 Controller-Drive Shelf Configurations

The E2760 is a 4U shelf that holds up to 60 3.5" or 2.5" drives in 5 horizontal drawers (12 drives per drawer). It features dual RAID controllers, dual power modules, and dual fan modules with two fans in each module.

An E2760-based storage system supports a maximum of 180 drives by using only 60-drive shelves or 192 drives by using a mix of expansion-drive shelf models. A minimum of 20 drives must be installed in the E2760 controller-drive shelf (and in each 60-drive expansion-drive shelf that is added to the system). These drives must be installed in the four front drive slots in each drawer.

Note: Operating the storage system without populating all four front drive slots in each drawer can lead to overheating concerns. On the E2760 shelf, the bezel must be installed during normal operation.

Figure 8 and Figure 9 show the front and rear views, respectively, of the E2760 controller-drive shelf.

Figure 8) E2760 front view without bezel.

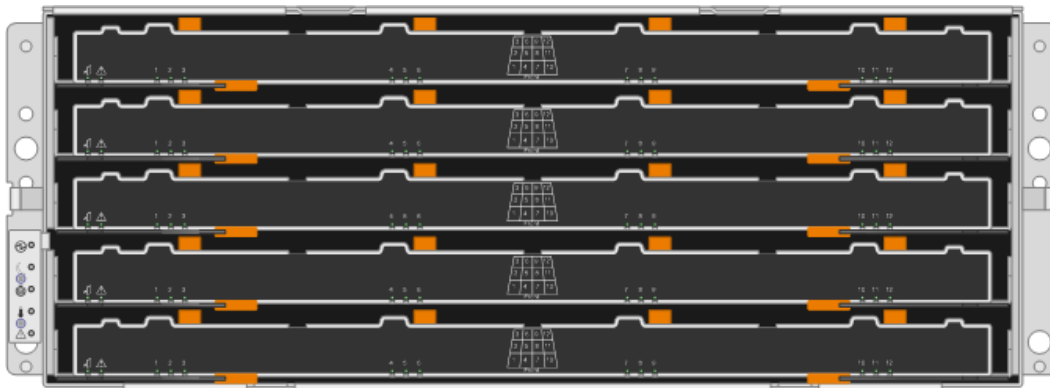
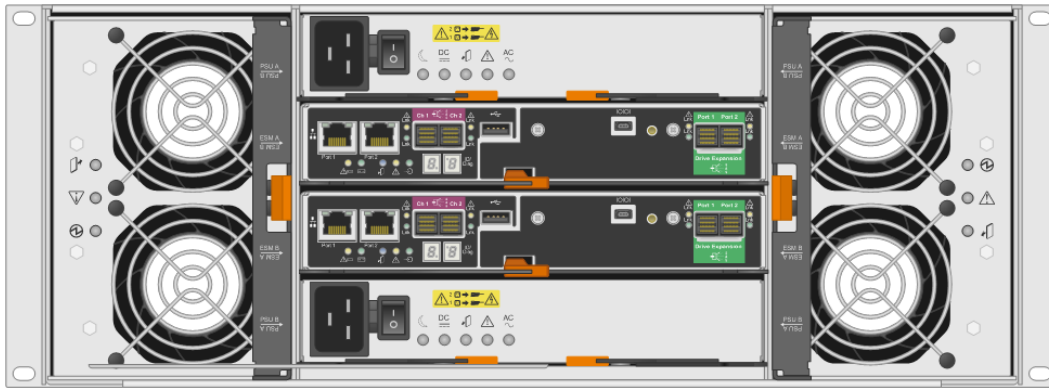


Figure 9) E2760 rear view.



E2724 Controller-Drive Shelf

The E2724 is a 2U shelf that holds up to 24 2.5" drives. It features dual RAID controllers and dual integrated power and fan modules. An E2724-based storage system supports a maximum of 192 drives and a mix of expansion-drive shelf models in a single system. The E2724 has a proven track record of reliability and scalability to satisfy requirements in remote dedicated environments or primary data centers.

Figure 10 and Figure 11 show the front and rear views, respectively, of the E2724 controller-drive shelf.

Figure 10) E2724 front view.



Figure 11) E2724 rear view.



E2712 Controller-Drive Shelf

The E2712 is a 2U shelf that holds up to 12 3.5" drives. It features dual RAID controllers and dual integrated power and fan modules. An E2712-based storage system supports a maximum of 192 drives and a mix of expansion-drive shelf models. The E2712 has a proven track record of reliability in remote dedicated environments.

Figure 12 and Figure 13 show the front and rear views, respectively, of the E2712 controller-drive shelf.

Figure 12) E2712 front view.

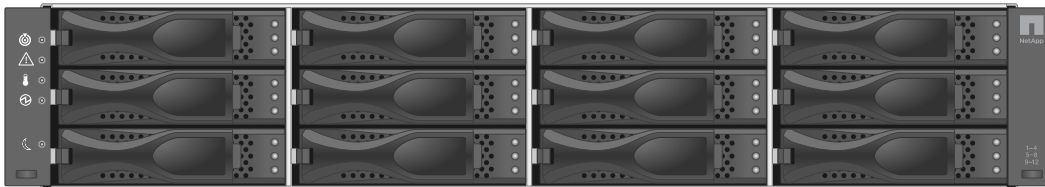
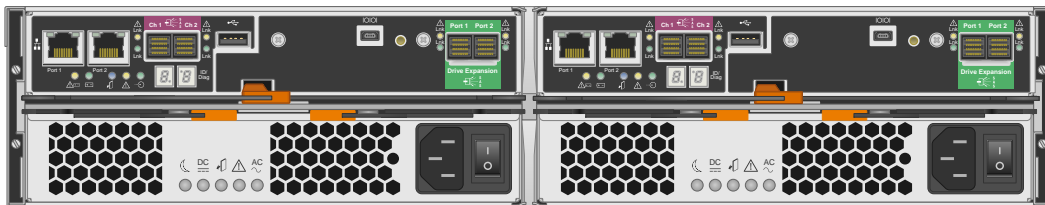


Figure 13) E2712 rear view.



3.2 Controller Host Interface Features

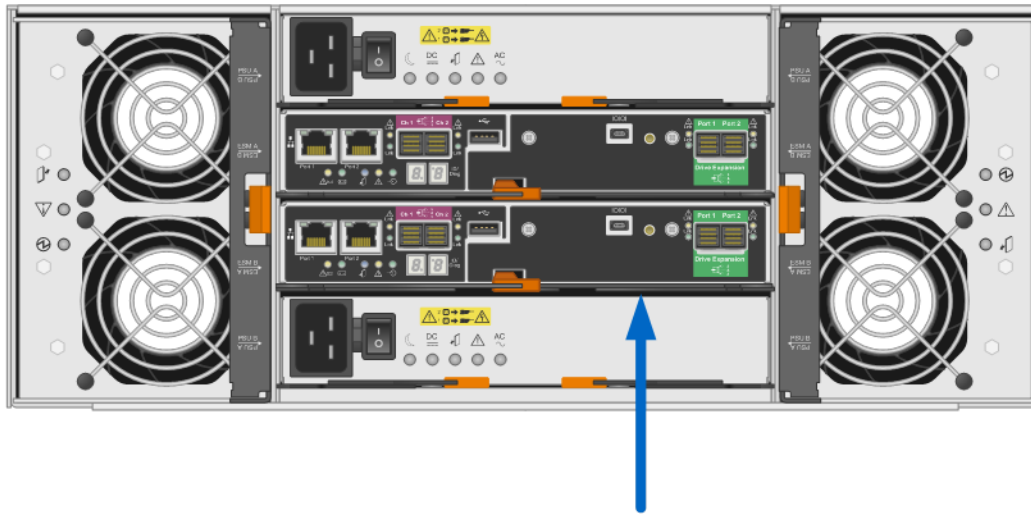
The E-Series E2700 controller supports five HIC options, including:

- 4-port 12Gb SAS (SAS-3 connector)
- 2-port 12Gb SAS (SAS-3 connector)
- 4-port 16Gb FC (optical, SFP+)
- 2-port 16Gb FC (optical, SFP+)
- 4-port 10Gb iSCSI (optical, SFP+)
- 2-port 10Gb iSCSI (optical, SFP+)
- 2-port 10Gb iSCSI (Cat6e/Cat7 RJ45)

E2700 controllers with optical HIC cards that support either FC or iSCSI have a different controller submodel ID (SMID) that determines which protocol is active. The SMID can be changed from the factory setting using SANtricity Storage Manager to change the controller feature pack. The five HIC options are shown in Figure 14.

Figure 14) E2700 with optional HICs.

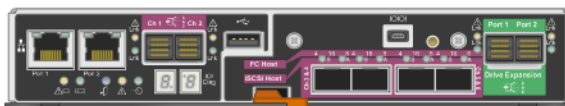
E2760 4U Tray Rear View with Dual E2700 Controllers



E2700 Controller with
4-Port 12Gb SAS HIC Installed



E2700 Controller with
2-Port 12Gb SAS HIC Installed



E2700 Controller with 4-Port Optical 16Gb
FC or 10Gb iSCSI HIC Installed
Note: Must order appropriate SFP for active protocol



E2700 Controller with 2-Port Optical 16Gb
FC or 10Gb iSCSI HIC Installed
Note: Must order appropriate SFP for active protocol



E2700 Controller with
2-Port 10Gb iSCSI HIC Installed
(copper RJ45)

All HIC options support link speed autonegotiation.

3.3 Hardware LED Definitions

The E2700 controller-drive shelf has LED status indicators on the front of the shelf and on the power supply units and fan units installed at the rear of the shelf. The LEDs on the front panel indicate systemwide conditions, and the LEDs on the power supply units and fan units indicate the status of the individual units.

The status LEDs on the front panel of the E2760 controller-drive shelf are visible with or without the bezel installed. Figure 15 shows the LEDs on the front panel of the E2760 controller-drive shelf.

Figure 15) LEDs on front panel of E2760 controller-drive shelf.

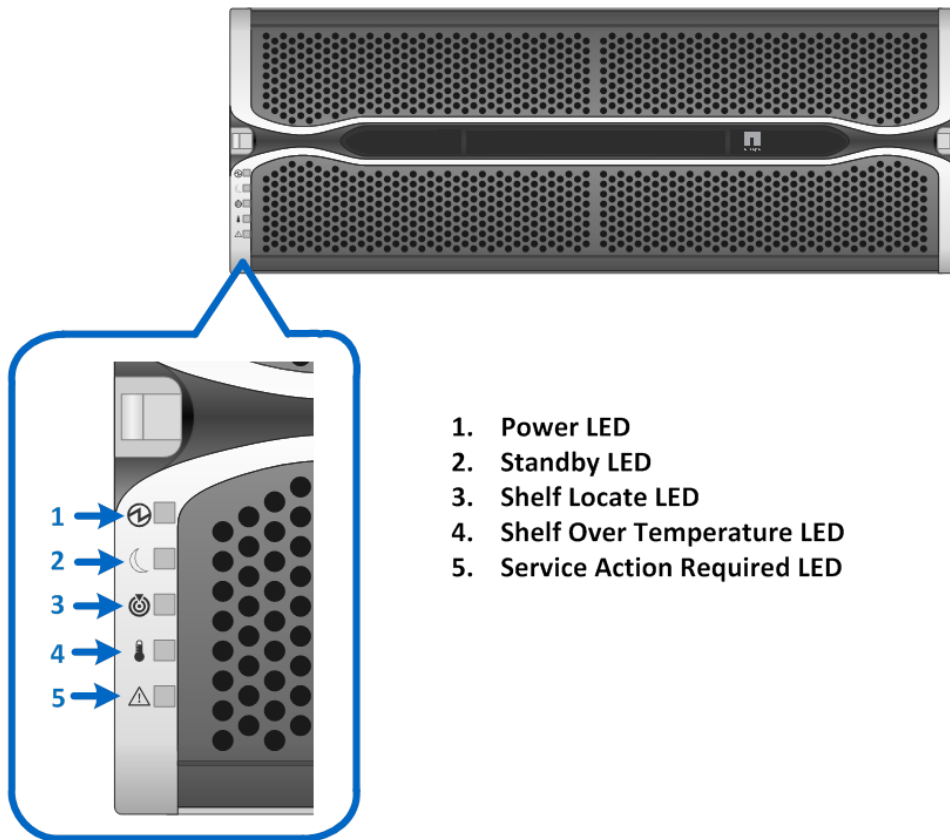
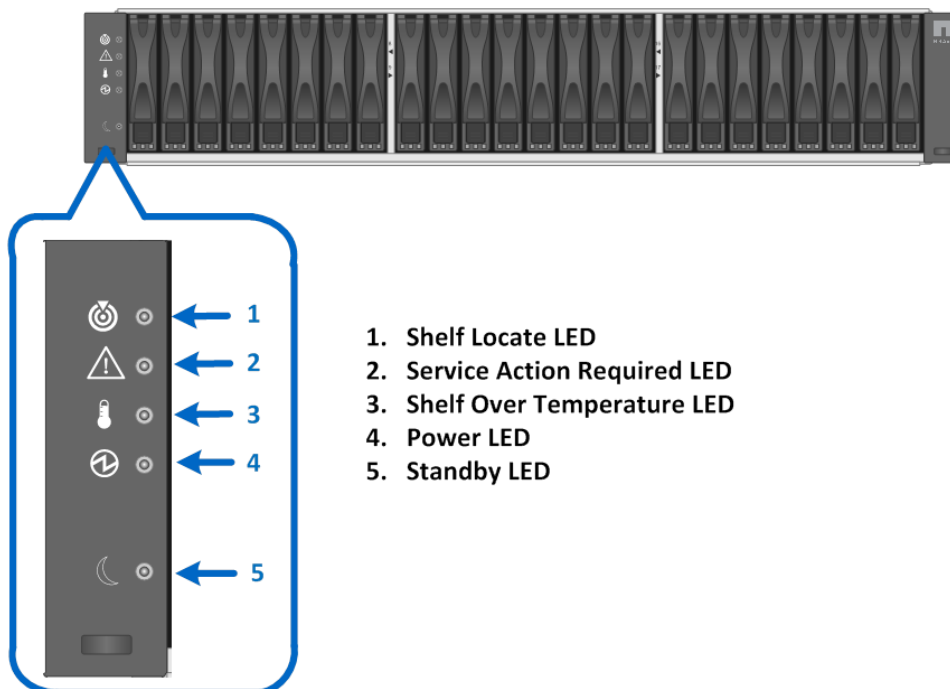


Figure 16 shows the LEDs on the front panel of the E2724 and E2712 controller-drive shelves.

Figure 16) LEDs on front panel of E2724 and E2712 controller-drive shelves.



Note: The LEDs on the front of the E2760 controller-drive shelf are ordered differently from those on the front of the E2724 and E2712 shelves.

Table 3 defines the front panel LEDs on the E2760, E2724, and E2712 controller-drive shelves. The items in the table are listed in the order matching the layout on the E2760 controller-drive shelf.

Table 3) E2700 controller-drive shelf LED definitions (front panel).

LED Name	Color	LED On	LED Off
Power	Green	Power is present.	Power is not present.
Standby	Green	The controller-drive shelf is in standby mode.	The controller-drive shelf is not in standby mode.
Tray locate	White	The LED lights up to make the controller-drive shelf easy to locate in the equipment rack.	Normal status.
Tray over temperature	Amber	The temperature of the controller-drive shelf has reached an unsafe level.	Normal status.
Service action required	Amber	A component in the controller-drive shelf requires attention.	Normal status.

Power Supply and Fan Unit Status LEDs

The E2760 controller-drive shelf supports dual power supplies and fan modules. Each power supply and fan module unit is equipped with status LEDs. Figure 16 shows the LEDs on the rear of the E2760 controller-drive shelf.

Figure 17) LEDs on E2760 power supply and fan unit (rear view).

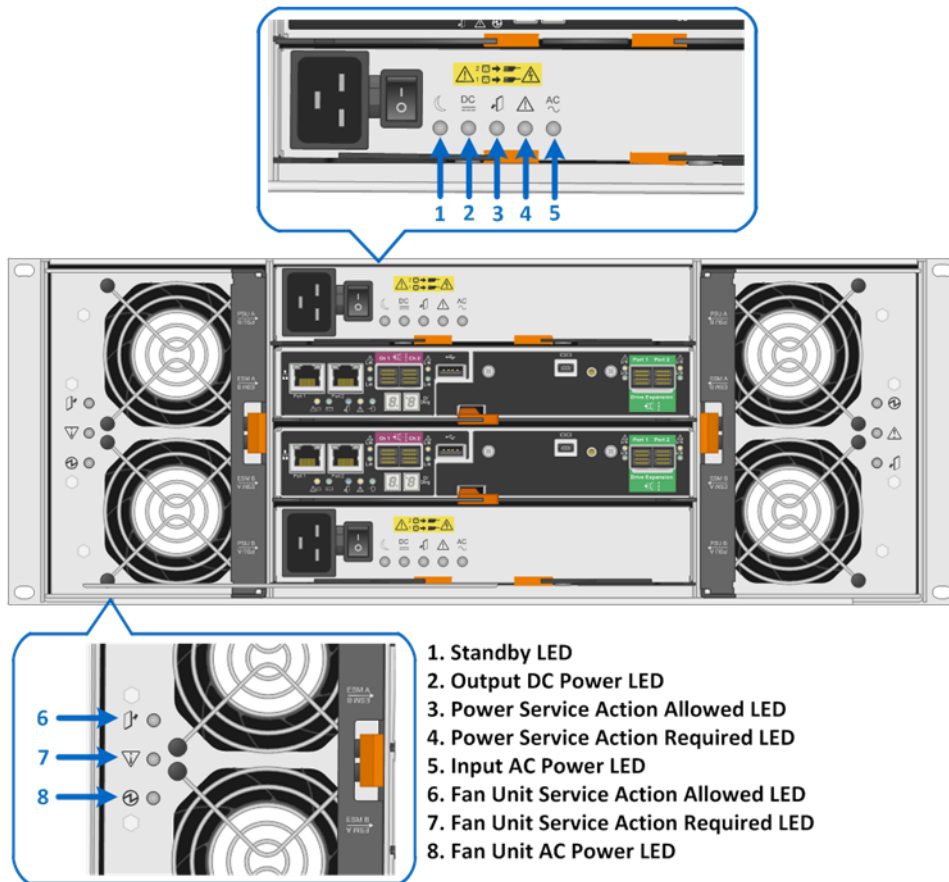


Table 4 defines the integrated power supply and fan unit LEDs on the rear of the E2760 controller-drive shelf.

Table 4) E2760 controller-drive shelf power supply and fan unit LED definitions.

LED Name	Color	LED On	LED Off
Standby	Green	The controller-drive shelf is in standby mode.	The controller-drive shelf is not in standby mode.
Output DC power	Green	DC output power is present.	DC output power is not present.
Power service action allowed	Blue	The controller-drive shelf is in service mode.	The controller-drive shelf is not in service mode.
Power service action required	Amber	A power component in the controller-drive shelf requires attention.	Normal status.
Input AC power	Green	AC power is present.	AC power is not present.
Fan unit service action allowed	Blue	The fan unit is in service mode.	The fan unit is not in service mode.
Fan unit service action required	Amber	The fan unit requires attention.	Normal status.

LED Name	Color	LED On	LED Off
Fan unit AC power	Green	Fan AC power is present.	Fan AC power is not present.

The fan and power supply units for the E2724 and E2712 controller-drive shelves are identical. The power supply LEDs on the rear panel are shown in Figure 18 and are defined in Table 5.

Figure 18) LEDs on E2724 and E2712 power supply unit (rear view).

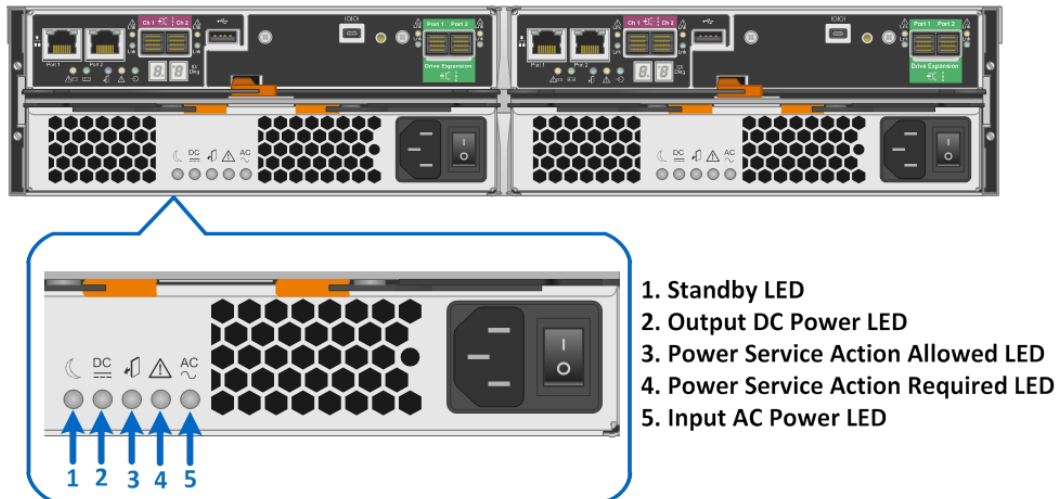


Table 5) E2724 and E2712 controller-drive shelf power supply LED definitions.

LED Name	Color	LED On	LED Off
Standby	Green	The controller-drive shelf is in standby mode.	The controller-drive shelf is not in standby mode.
Output DC power	Green	DC output power is present.	DC output power is not present.
Power service action allowed	Blue	The controller-drive shelf is in service mode.	The controller-drive shelf is not in service mode.
Power service action required	Amber	A power component in the controller-drive shelf requires attention.	Normal status.
Input AC power	Green	AC power is present.	AC power is not present.

E2700 Controller Module LEDs

The E2700 controller module has several LED status indicators. The LEDs on the left side of the module refer to the onboard ports and to the base controller status. The LEDs on the right side of the module refer to the drive expansion ports and to the additional host connectivity interface options that are available with the E2700 controller:

- 4-port and 2-port 12Gb SAS HICs
- 4-port and 2-port 16Gb FC HICs
- 4-port and 2-port 10Gb iSCSI HICs (SFP+, also supports SFP+ to twinax cables)
- 2-port 10Gb iSCSI HIC (copper RJ45 twinax)

Host port status can be verified by directly checking the port LEDs or by using the SANtricity Storage Manager GUI. The Host Interfaces tab of the Controller Properties dialog box, shown in Figure 19, details the status of each host I/O interface that is connected to the storage system.

Figure 19) Controller Properties dialog box.

Channel	Port	Port Status	Max. Rate	Current Rate	Part Type
1	1	Up	6 Gbps	6 Gbps	LSISAS2308 revision 223,036,928
2	2	Up	6 Gbps	6 Gbps	LSISAS2308 revision 223,036,928
3	3	Down	6 Gbps	Not available	LSISAS2308 revision 223,036,928
4	4	Down	6 Gbps	Not available	LSISAS2308 revision 223,036,928

Base Controller Status LEDs

Figure 20 shows the onboard LED status indicators on the left side of the E2700 controller. Most of the LEDs are lit when a fault condition exists; however, the battery charging LED and the cache active LED are lit when the battery is fully charged and the cache is active, respectively. The seven-segment LEDs provide status codes for both normal operation and fault conditions; the dot in the first seven-segment LED is the controller heartbeat indicator, which comes on when an intercontroller communication link has been established.

Figure 20) LEDs on left side of E2700 controller module.

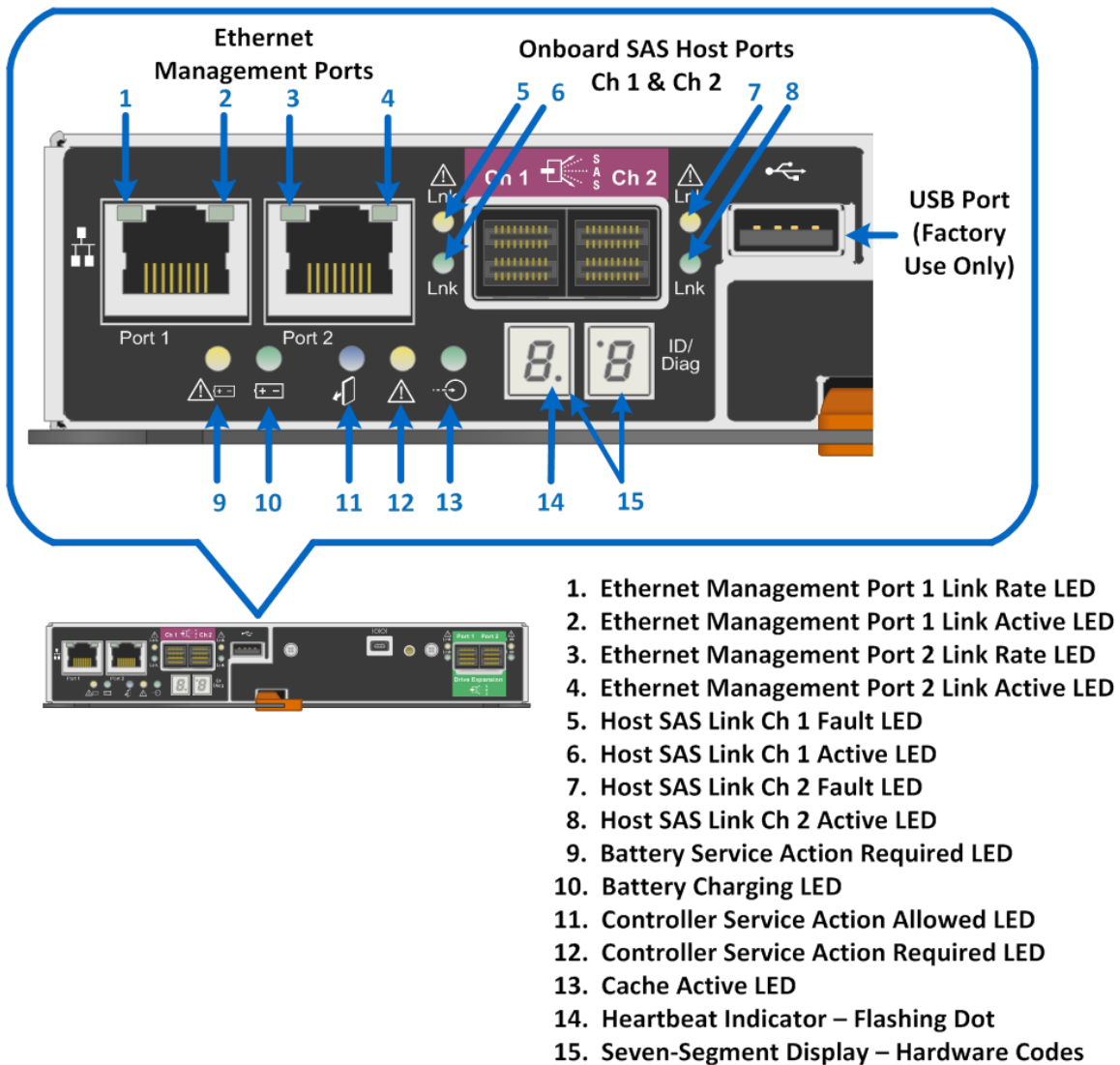


Table 6 defines the Ethernet management port LEDs on the controller (LEDs 1 through 4 in Figure 20).

Table 6) Ethernet management port LED definitions.

LED Name	Color	LED On	LED Off
Ethernet management port link rate (top left corner of management port RJ-45 connectors)	Green	There is a 100BASE-T rate.	There is a 10BASE-T rate.
Ethernet management port link active (top right corner of management port RJ-45 connectors)	Green	<ul style="list-style-type: none"> Solid: The link is up without activity. Blinking: The link is up with activity. 	A link error has occurred.

Table 7 defines the onboard host interface port LEDs (LEDs 5 through 8 in Figure 20). These LEDs indicate the connection status for each link between the storage system and host-side hardware.

Table 7) SAS host port LED definitions.

LED Name	Color	LED On	LED Off
Host link active	Green	<ul style="list-style-type: none"> • Solid: The link is up without activity. • Blinking: The link is up with activity. 	The link is down.
Host link fault	Amber	A link error has occurred.	Normal status.

Table 8 defines the controller status LEDs (LEDs 9 through 15 in Figure 20).

Table 8) Controller base features LED definitions.

LED Name	Color	LED On	LED Off
Battery service action required	Amber	The battery in the controller module has failed.	Normal status.
Battery charging	Green	<ul style="list-style-type: none"> • Solid: The battery is fully charged. • Blinking: The battery is charging. 	The controller module is operating without a battery or the existing battery has failed.
Controller service action allowed	Blue	The controller module can be removed safely from the controller-drive shelf.	The controller module cannot be removed safely from the controller-drive shelf.
Controller service action required	Amber	Some fault exists within the controller module.	Normal status.
Cache active	Green	<ul style="list-style-type: none"> • Solid: The cache is active. • Blinking: After an AC power failure, the cache offload is in process. 	The cache is inactive or the controller module has been removed from the controller-drive shelf.
Dot in lower right corner of first seven-segment LED	Yellow (not amber)	A flashing dot indicates that the controller heartbeat is active.	If the dot is not lit, the controller heartbeat is not active (that is, the controller is not in service).
Two seven-segment LEDs	Yellow (not amber)	<ul style="list-style-type: none"> • If the controller status code equals 99, then the controller is in service. • If the controller status code does not equal 99, then a fault condition exists. Contact Technical Support for further assistance. 	The controller is not powered on.

Note: The battery service action required LED indicates that the battery timer has expired or the battery has failed the automatic battery test. This condition can seriously affect the system write

performance because the write cache feature is automatically disabled when the battery is not functioning normally.

Drive-Side SAS Expansion Port LEDs

The E2700 controller module is equipped with two SAS expansion ports that are used to connect expansion-drive shelves to the E2700 controller-drive shelf. Figure 21 shows the SAS expansion port LEDs.

Figure 21) LEDs for drive expansion ports (without expansion HIC).

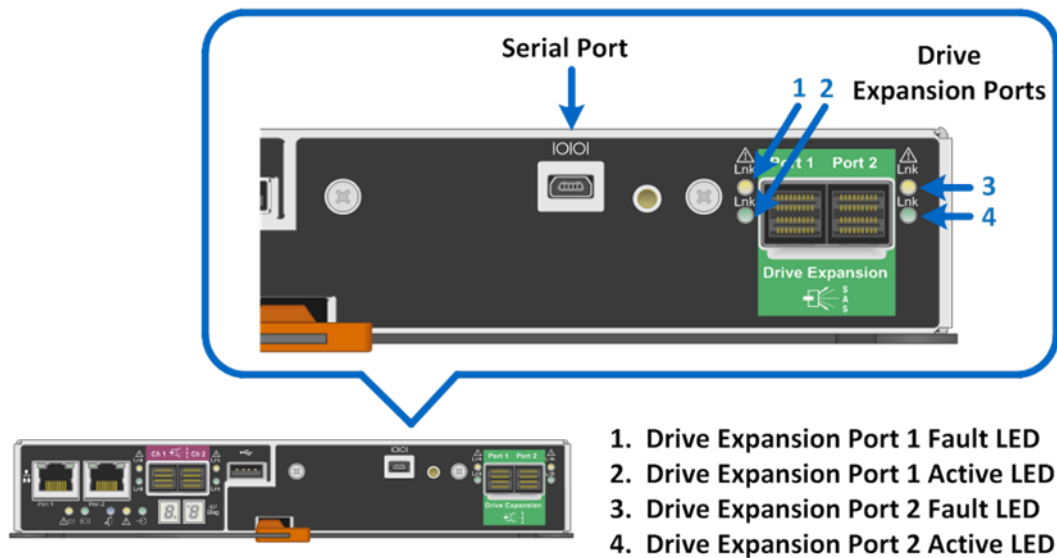


Table 9 defines each drive-side LED.

Table 9) Drive expansion port LED definitions.

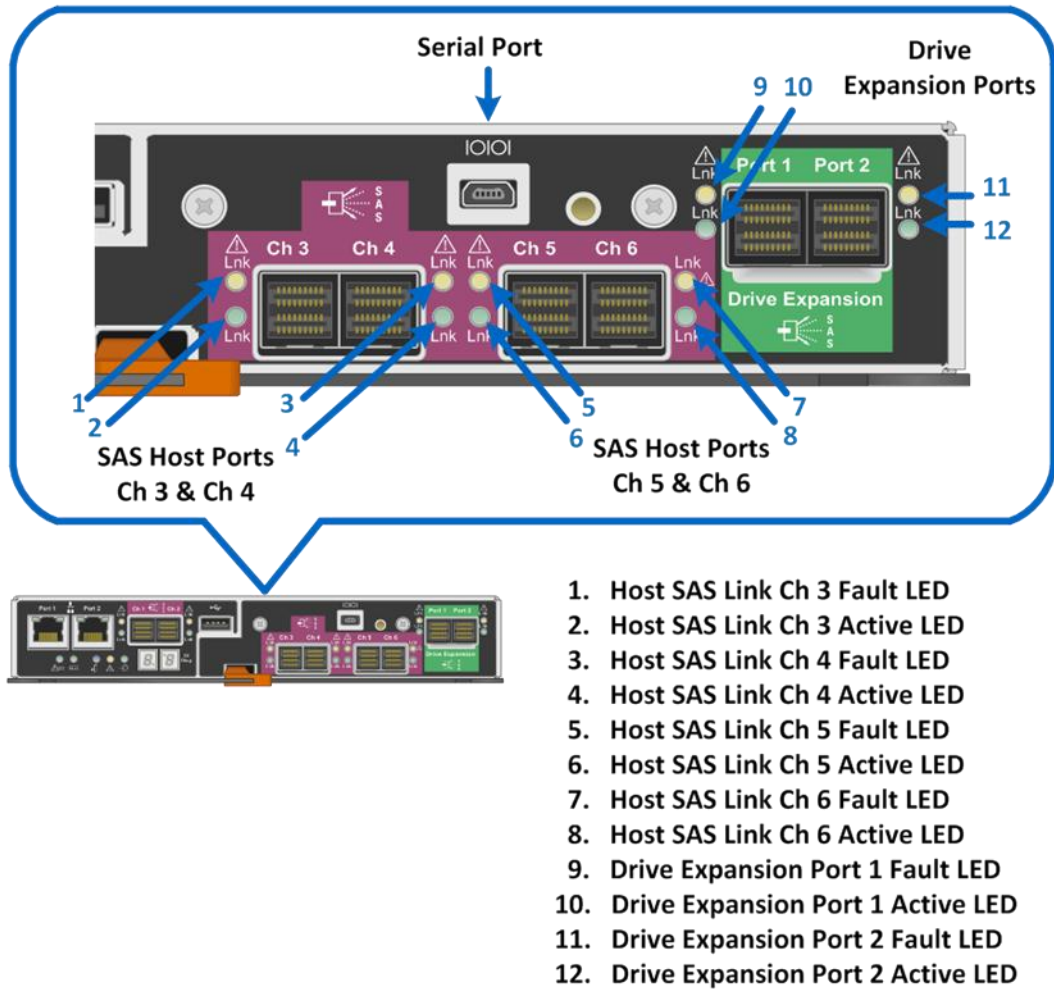
LED Name	Color	LED On	LED Off
Drive expansion link fault (port 1 and port 2)	Amber	At least one of the four PHYs in the output port is working, but another PHY cannot establish the same link to the expansion output connector.	Normal status.
Drive expansion link active (port 1 and port 2)	Green	At least one of the four PHYs in the output port is working, and a link has been established to the device connected to the expansion output connector.	A link error has occurred.

4-Port and 2-Port 12Gb SAS HIC LEDs

The E2700 supports several host interface expansion options, including SAS, FC, and iSCSI. Figure 22 shows the LEDs for the 4-port 12Gb SAS HIC for the E2700 controller.

Note: All E-Series HICs support port speed autonegotiation.

Figure 22) LEDs for 4-port 12Gb SAS HIC.



In addition to the 4-port 12Gb SAS HIC, the E2700 controller also supports a 2-port 12Gb SAS HIC, shown in Figure 23.

Figure 23) LEDs for 2-port 12Gb SAS HIC.

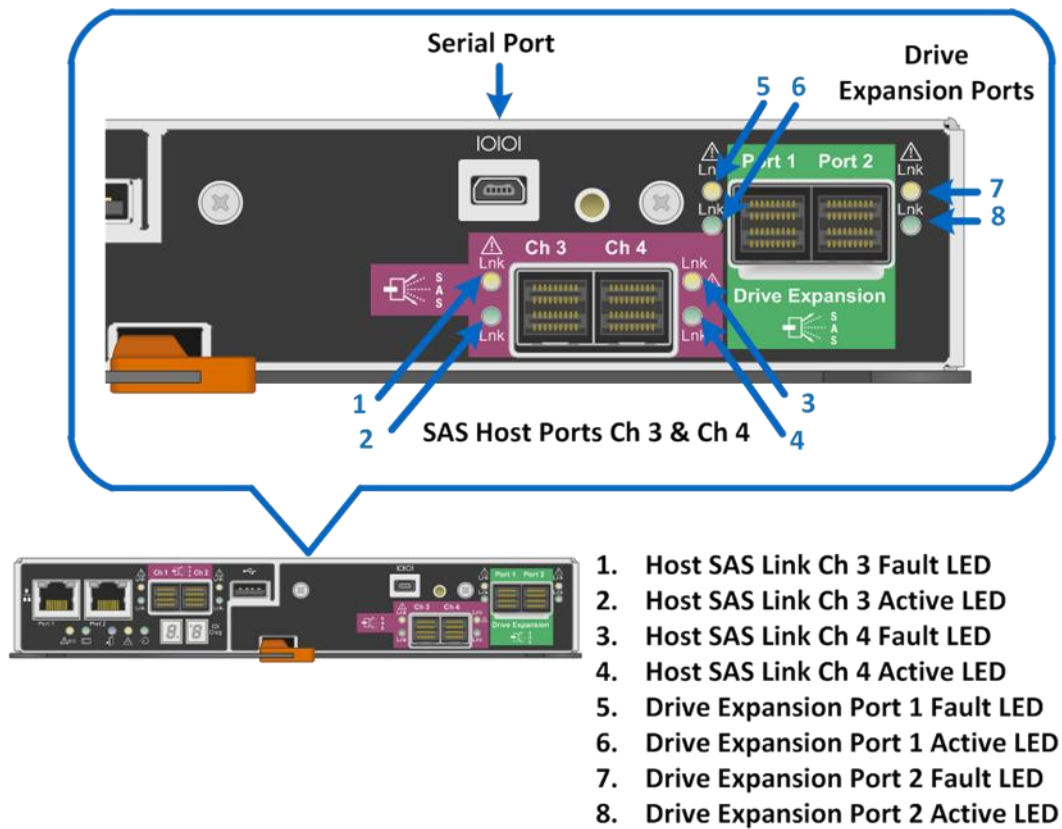


Table 10 defines the LEDs for the 4-port and 2-port 12Gb SAS HICs.

Note: The drive expansion port LEDs (LEDs 9 through 12 in Figure 22 and LEDs 5 through 8 in Figure 23) are defined in Table 9.

Table 10) 4-port and 2-port 12Gb SAS HIC LED definitions.

LED Name	Color	LED On	LED Off
Host link fault	Amber	At least one of the four PHYs is working, but another PHY cannot establish the same link to the device connected to the host input port connector.	Normal status.
Host link active	Green	At least one of the four PHYs in the host input port is working, and a link has been established to the device connected to the input port connector.	A link error has occurred.

4-Port and 2-Port Optical 16Gb FC/10Gb iSCSI Expansion HIC LEDs

In addition to supporting SAS host interfaces, the E2700 supports a 4-port optical HIC that can function using 16Gb FC or 10Gb iSCSI protocols, for a maximum of eight 16Gb FC or eight 10Gb iSCSI ports per E2700 storage system (assuming dual controllers). Figure 24 shows the LEDs for the HIC.

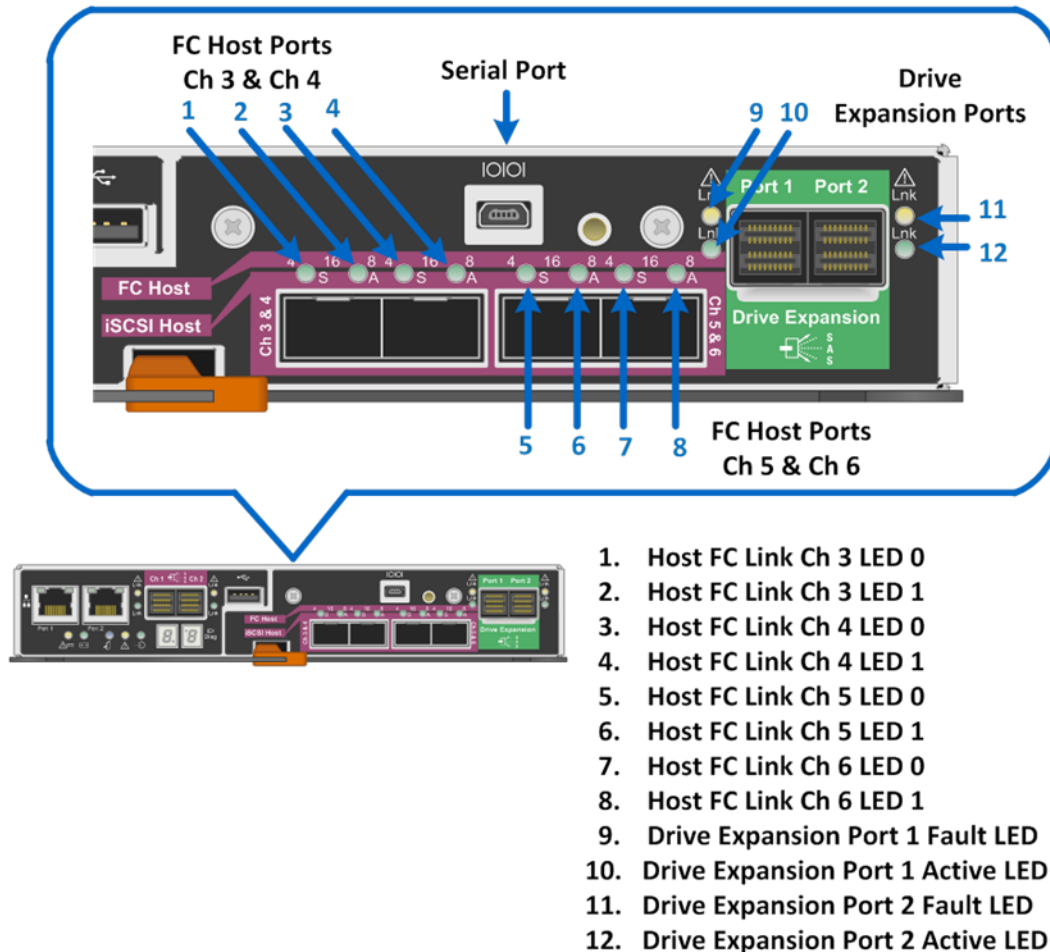
Only one protocol is supported by the HIC at one time and is set using the controller submodel ID (SMID):

- SMID=214: Controller is set for FC when using the optical HIC.
- SMID=250: Controller is set for iSCSI when using the optical HIC.

The optical HIC supports several SFP options, including a 16Gb FC, a 10Gb SFP+, and a unified adapter that supports either 16Gb FC or 10Gb iSCSI. The HIC also supports iSCSI 10Gb copper using a special cable with built-in SFP+ adapters on the HIC end and an RJ45 connector on the host end of the cable. These cables are generally available from NetApp and have a 7m length limitation.

Note: The unified SFP does not support 1Gb iSCSI. It does support 4/8/16Gb FC and 10Gb iSCSI.

Figure 24) LEDs for 4-port 16Gb FC HIC.



The E2700 controller also supports a 2-port optical 16Gb FC/10Gb iSCSI HIC that is functionally the same as the 4-port HIC but with 2 fewer ports to allow extended granularity in the configuration for scaling down FC and iSCSI host interfaces and associated cost. The 2-port optical 16Gb FC/10Gb iSCSI HIC is shown in Figure 25.

Figure 25) LEDs on 2-port combination 16Gb FC/10Gb iSCSI HIC.

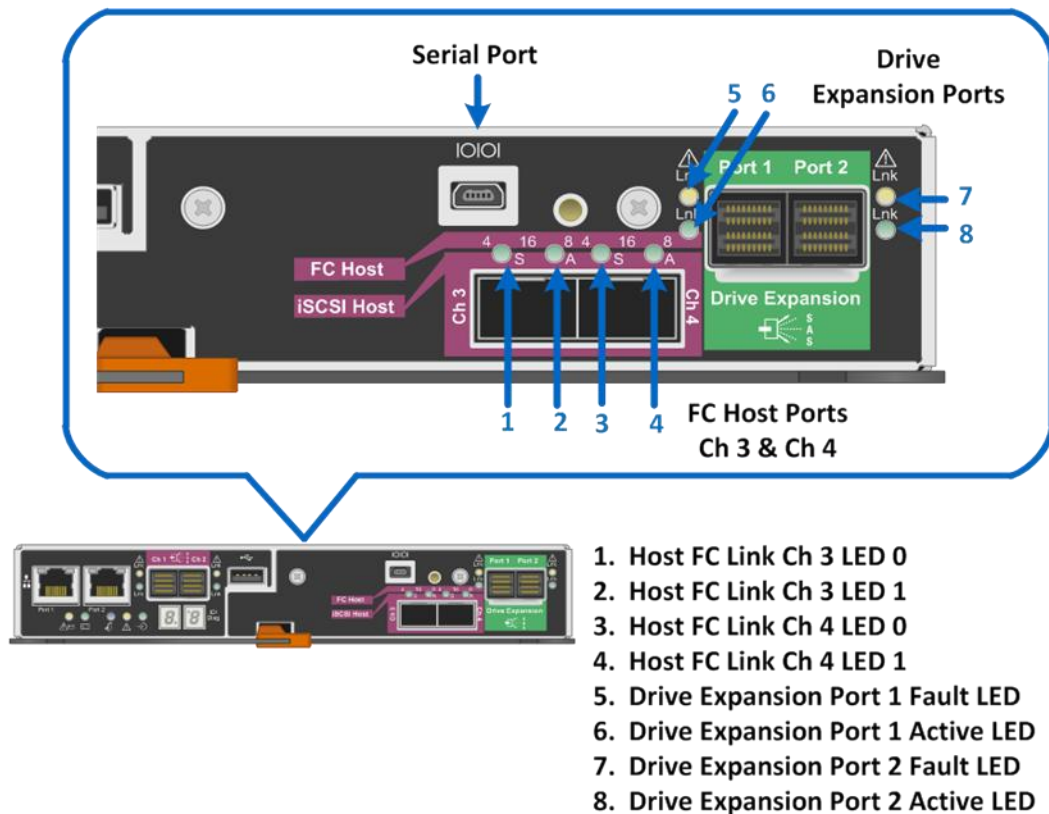


Table 11 defines the LEDs on the 4-port and 2-port combination 16Gb FC/10Gb iSCSI HICs.

Note: The drive expansion port LEDs (LEDs 9 through 12 in Figure 24 and LEDs 5 through 8 in Figure 25) are defined in Table 9.

Table 11) 4-port and 2-port combination 16Gb FC/10Gb iSCSI HIC LED definitions.

LED 0	LED 1	Link Rate	Color
Off	Off	Link down	Green
Off	On	Link operating at 4Gb/sec	Green
On	Off	Link operating at 8Gb/sec or 1Gb/sec iSCSI link up; no activity	Green
On	On	Link operating at 16Gb/sec or 10Gb/sec iSCSI link up; no activity	Green
Blinking	On	10Gb link up; activity in progress	Green
Blinking	Off	1Gb link up; activity in progress	Green

2-Port 10Gb iSCSI HIC LEDs

A second iSCSI host connectivity interface supported by the E2700 is the 2-port 10Gb iSCSI copper HIC. The HIC has two standard RJ-45 connectors, as shown in Figure 26, and uses standard RJ45 twinax cables to connect to switches or directly to hosts.

Figure 26) LEDs on 2-port 10Gb iSCSI HIC.

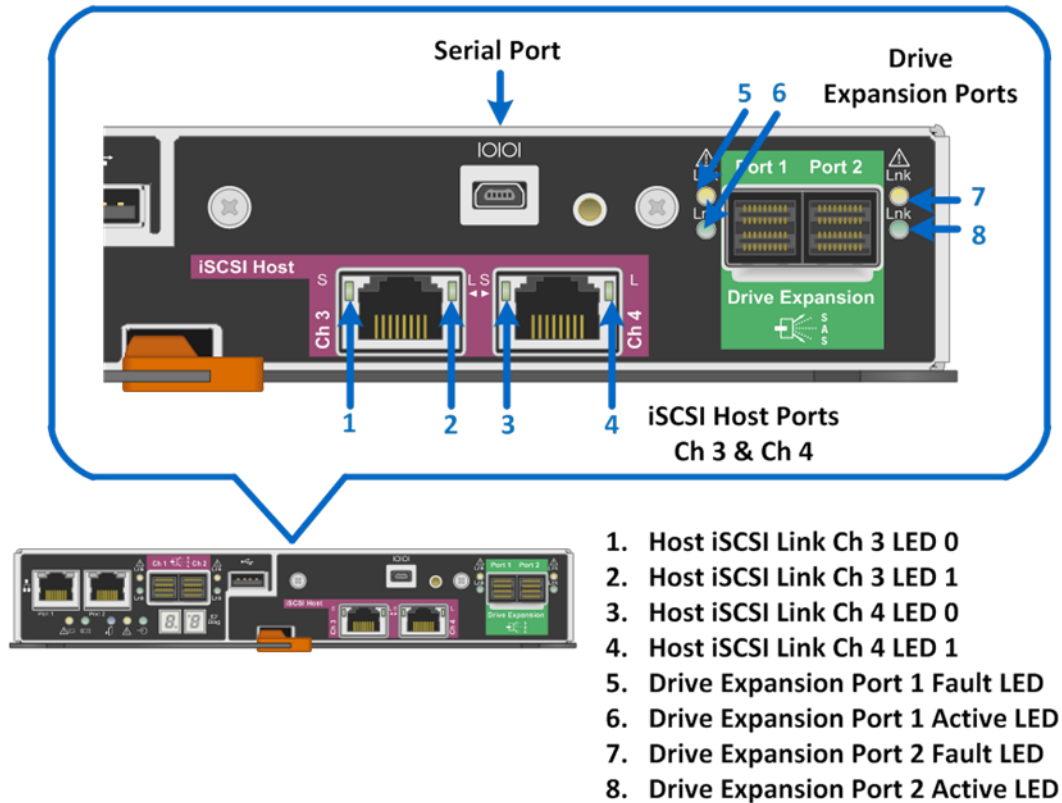


Table 12 defines the LEDs on the 2-port 10Gb iSCSI HIC.

Note: The drive expansion port LEDs (LEDs 5 through 8 in Figure 26) are defined in Table 9.

Table 12) 2-port 10Gb iSCSI HIC LED definitions.

LED 0	LED 1	Link Rate	Color
Off	Off	Link down	Green
On	On	10Gb link up; no activity	Green
On	Off	1Gb link up; no activity	Green
Blinking	On	10Gb link up; activity in progress	Green
Blinking	Off	1Gb link up; activity in progress	Green

For additional information about the E2700 controller and related hardware, refer to the [E2700 Series](#) product documentation located in the NetApp Support site [Documentation](#) library.

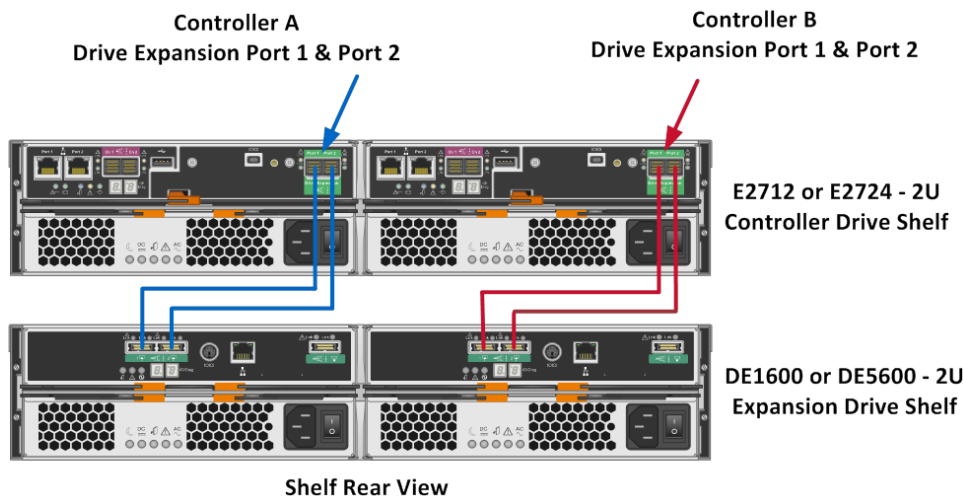
4 Expansion-Drive Shelves

The E2700 controller-drive shelf supports 12, 24, or 60 drives based on the shelf model (DE1600, DE5600, or DE6600, respectively), but the system capacity can be further expanded by adding additional expansion-drive shelves to the controller-drive shelf, up to 16 total shelves for the DE1600 shelf option, up to 8 total shelves for the DE5600 shelf option (maximum 192 drives), and up to 3 total shelves when using the DE6600 shelf option (maximum 180 drives). These drive counts and supported drive types can be further manipulated by mixing shelf types within a single storage system up to the maximum of 192 drives.

4.1 Green Field Installation

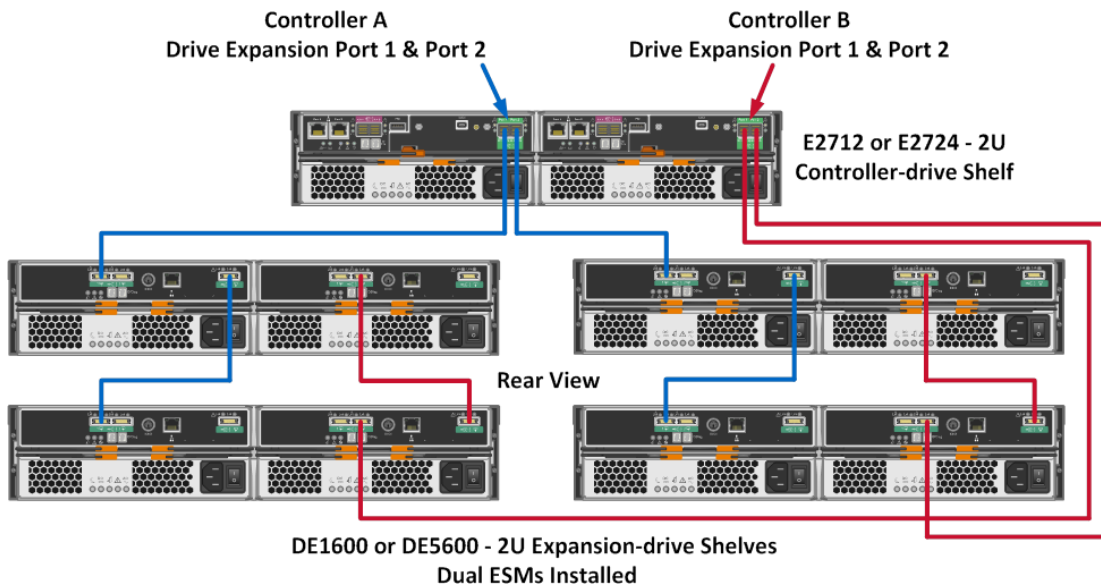
E2700 storage systems utilize two cabling methods: single stack and dual stack. The single-stack method is only used when the storage system has a controller-drive shelf and a single expansion-drive shelf, as shown in Figure 27.

Figure 27) E2700 single-stack system configuration.



For E2700 storage systems with two or more expansion-drive shelves, use the dual-stack cabling method, as shown in Figure 28.

Figure 28) E2700 storage system dual-stack configuration.



For simplex controller systems, use the same cabling methods shown in Figure 27 and Figure 28 (blue paths) for the A-side controller as appropriate based on whether the system has one expansion-drive shelf versus two or more expansion-drive shelves.

To ensure the drive shelf cabling is correct, use the cable report in SANtricity Storage Manager, AMW > Monitor > Reports > Cable Connections, to trace each path, as shown in Figure 29.

Figure 29) SANtricity Storage Manager cable connections report.

The screenshot shows the SANtricity Storage Manager interface with the **Cable Connections** report. The report includes a table showing the connection paths from controllers to expansion-drive shelves. The table has two columns: **From** and **To**. The report also includes a **Save As...** button, a **Close** button, and a **Help** button.

From	To
Controller A, Port 2	Drive Tray 2, ESM B (Right), In 1
Drive Tray 2, ESM B (Right), Out	Drive Tray 0, ESM B (Right), In 2
Drive Tray 0, ESM B (Right), Out	Drive Tray 1, ESM B (Right), In 2
Drive Tray 1, ESM B (Right), Out	Drive Tray 3, ESM B (Right), In 2
Controller A, Port 1	Drive Tray 3, ESM A (Left), In 1
Drive Tray 3, ESM A (Left), Out	Drive Tray 1, ESM A (Left), In 1
Drive Tray 1, ESM A (Left), Out	Drive Tray 0, ESM A (Left), In 1
Drive Tray 0, ESM A (Left), Out	Drive Tray 2, ESM A (Left), In 1
Controller B, Port 2	Drive Tray 2, ESM B (Right), In 2
Controller B, Port 1	Drive Tray 3, ESM A (Left), In 2

Failure to cable expansion-drive shelves correctly can lead to a semilockdown state on the storage system that does not allow changes to the system configuration until the cabling issue is resolved.

Best Practice

When initially powering on an E-Series storage system that includes expansion-drive shelves, power on the expansion-drive shelves first and wait one to two minutes per drive shelf before powering on the controller-drive shelf.

4.2 Expansion-Drive Shelf Hot-Add

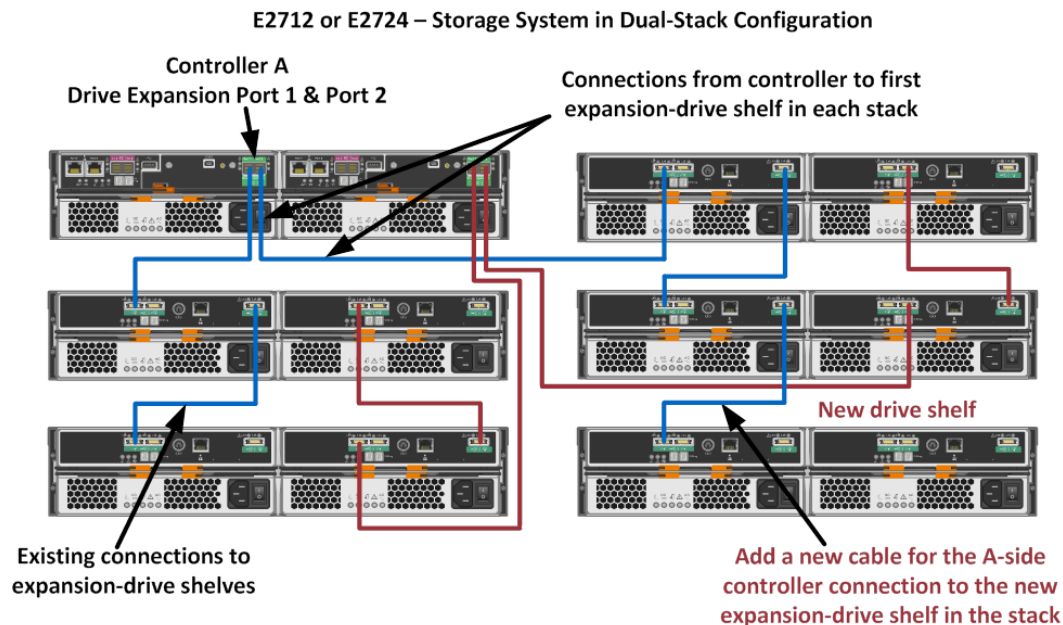
E-Series storage systems support the addition of expansion-drive shelves and drive capacity to running storage systems. To prevent the loss of data availability to existing drive shelves when new drive shelves are added, the storage system must be cabled according to the cabling best practices that NetApp recommends. Two independent SAS channel paths must be available to the drive shelves so that one path can be interrupted when a drive shelf is added to the storage system while the other path maintains data availability to existing shelves.

The SANtricity Cable Connections report can be used to verify that the current system drive cabling is configured appropriately. After additional drive shelves have been successfully added to a storage system, SANtricity can be used to add capacity to existing volume groups and disk pools or to create new volume groups and disk pools.

Note: When adding an expansion-drive shelf to an existing E-Series storage system, it is critical to follow the specific hot-add installation steps in the order specified by the deployment procedures. For more information and assistance with adding an expansion-drive shelf to an existing production E-Series system, contact NetApp Customer Success Services.

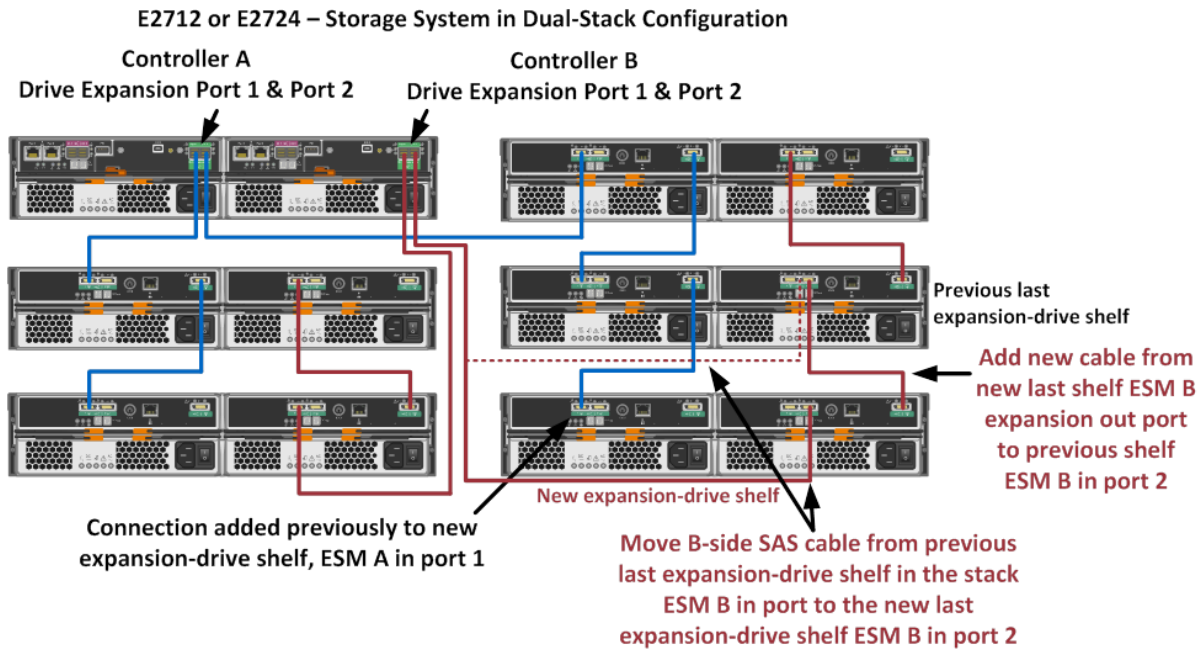
Figure 30 and Figure 31 show the hot-add connectivity when an expansion-drive shelf is added as the last shelf in the system.

Figure 30) Drive shelf hot-add A-side cabling.



Use the SANtricity Cable Connections report to verify the new shelf and drives are discovered and new system alarms are only associated to the loss of path to the B-side ESM on the new drive shelf before moving the B-side drive expansion cables from the last preexisting expansion-drive shelf.

Figure 31) Drive shelf hot-add B-side cabling.



Note: The dotted red line in Figure 31 indicates where the B-side drive expansion cable was previously located before moving it to the new shelf, ESM B input port 2.

Best Practice

Plan carefully for any drive shelf hot-add activity on production storage systems. Verify that the following conditions are met:

- The existing power infrastructure can support the additional hardware.
- The cabling plan for the new shelf does not simultaneously interrupt the SAS expansion paths for controller A and controller B.

Note: Failure to preserve one active path to existing drive shelves during the procedure can cause host servers to lose access to their LUNs.

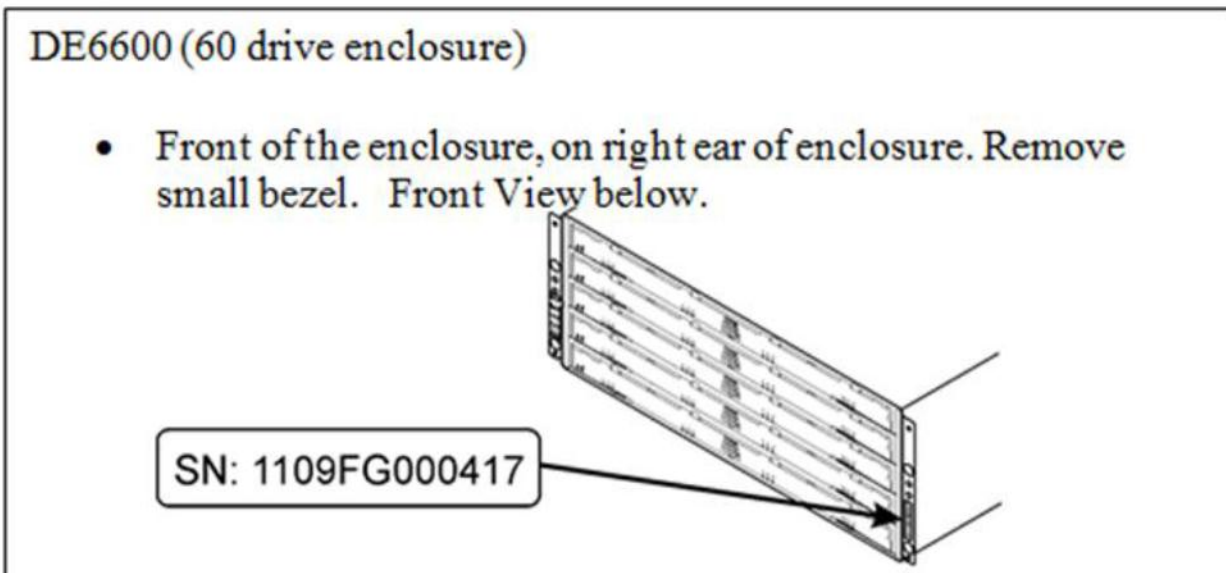
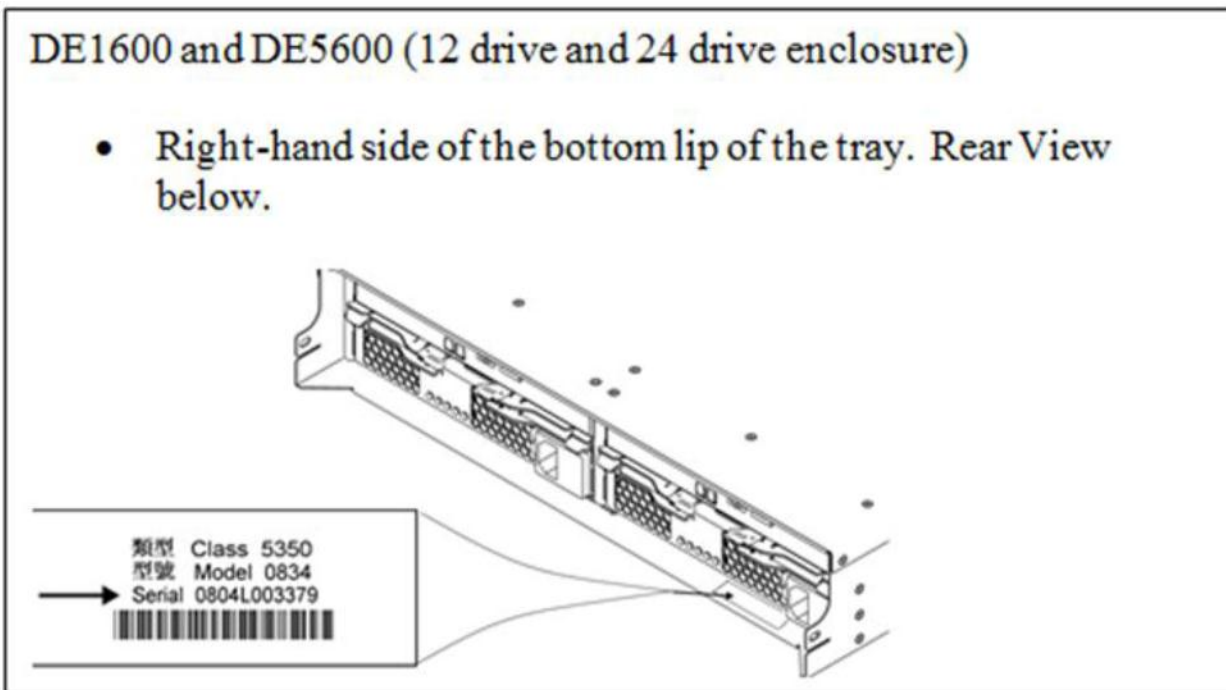
5 E-Series Product Support

NetApp E-Series storage systems are identified by the serial number (SN) of the E-Series system shelf, not the SNs of the individual controllers within the E-Series system shelf. The correct SN must be registered for an E-Series system because only the SN of the E-Series system shelf can be used to log a support case with NetApp.

5.1 Controller-Drive Shelf Serial Number

E-Series storage systems are shipped preconfigured from the factory (controllers have HICs and batteries installed, and controllers are installed in the controller-drive shelf). The shelf SN is printed on a silver label affixed to the controller-drive shelf, and its location can vary depending on the chassis. The shelf SN is identified by the text "Serial" or "SN," which is shown in Figure 32 for different system types.

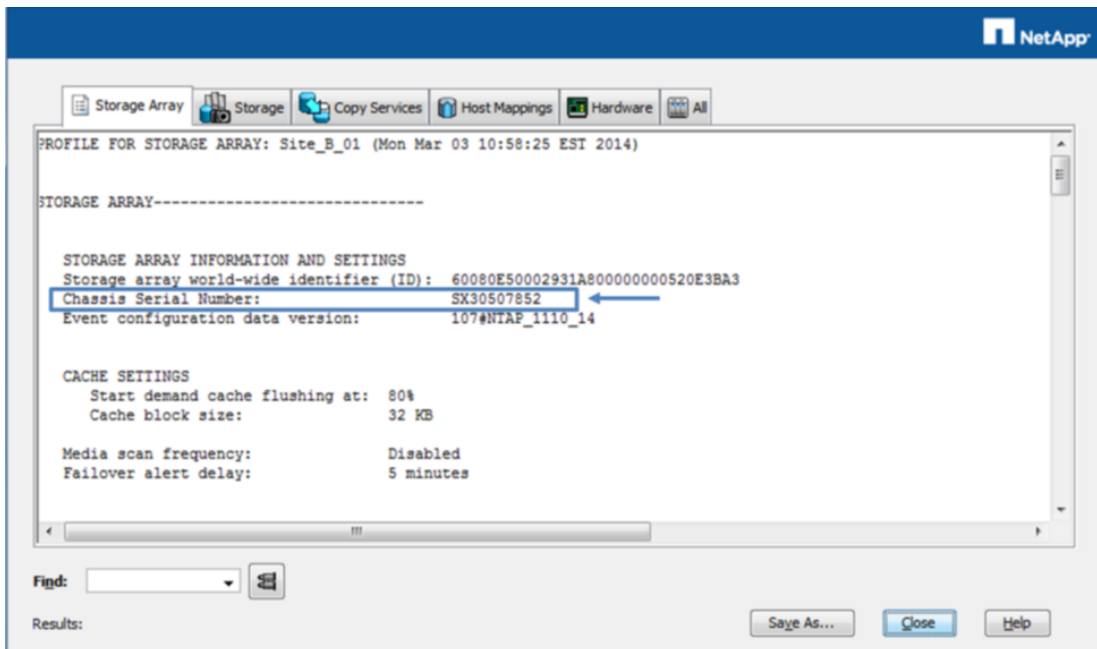
Figure 32) Controller-drive shelf SN.



The shelf SN is also included on the shelf UL sticker; however, this sticker is often not visible after the shelves are installed in a rack.

On a running storage system, the SN is also available through SANtricity Storage Manager by viewing the storage array profile shown in Figure 33.

Figure 33) SANtricity Storage Manager AMW storage array profile.



5.2 License Keys

Drive security is the only premium feature in SANtricity 11.20; it requires a license key file to activate the functionality. License keys for premium features are system specific and can be purchased by sending a request to a sales representative. The request must include the feature-enable identifier that is listed in the Premium Features and Feature Pack Information dialog box (shown in Figure 34) and the storage system serial number (the serial number of the E-Series controller-drive shelf).

Figure 34) SANtricity 11.20 Premium Features and Feature Pack Information dialog box.

NetApp

[How do I manage Premium Features and Feature Packs?](#)

Enable a Premium Feature

Obtain a key file by contacting your customer support representative. After you have saved the key file, use it to enable the premium feature associated with the key.

Feature Enable Identifier: 313936353620323132303320525FE694

Use Key File...

Premium Features

Show:

- ☒ Trials Available (0)
- ☒ Trials Active (0)
- ☒ Enabled (0)
- ☒ Disabled (1)

Premium Features:

Drive Security Feature Key File Required

Disabled

Feature Pack

Current Feature Pack installed on the storage array:

E5500

Change...

Close Help

When the license key for the drive security feature has been purchased and the order has been processed in the NetApp order system, the key file can be generated by using the [NetApp Storage Array Premium Feature Activation tool](#). The tool requires two types of information to generate license key files: the key activation code and the feature-enable identifier.

The 11-digit key activation code is system generated for purchased licenses and is attained by logging in to [NetApp Support](#) and viewing the system details under My Support > Software Licenses. The storage system controller-drive shelf serial number should be used to access the specific system details and key codes.

The feature-enable identifier is a 32-digit code that is unique to a storage system. It can be located by using SANtricity to access the Premium Features and Feature Pack Information dialog box for the storage system.

Customers must have a valid Support site account login and password to access, generate, and download the license key file.

Note: First-time users who apply for a new Support site account will have access to their system details and to the license key site delayed for up to five business days while the registration information is validated and the user account is created. For this reason, NetApp recommends that customers create their Support site accounts as soon as their purchase order has been received by NetApp.

For issues with accessing license key files, open a support ticket with NetApp Support by using the serial number of the registered controller-drive shelf for the storage system that matches the feature-enable identifier.

6 Summary

The NetApp E2700 storage system allows customers to cut operational costs with ultradense drive shelves for capacity-hungry applications while improving storage utilization with the intuitive, easy-to-learn SANtricity Storage Manager and popular application management integration software.

E2700 storage systems offer balanced performance for backup environments and other sequential workloads, but they also support demanding IOPS workloads in small and medium enterprise data centers. The wide choice of drive speeds, capacities, and storage features combined with multiple host connectivity interface options makes the E2700-based storage system the perfect choice for environments where simplicity, seamless integration with wide-ranging workloads, and a streamlined price/performance product focus are the key elements to customer success.

References

The following references were used in this TR:

- E-Series E2700 Datasheet:
<https://fieldportal.netapp.com/Core/DownloadDoc.aspx?documentID=107326&contentID=170884>,
December 2014
- E-Series SANtricity Storage Manager 11.20 GUI and online help
- E-Series SANtricity 11.20 product documentation available in the documentation library on the NetApp Support site listed under the E-Series product model (for example, [E2700 Series](#)), under [SANtricity Storage Manager](#), and under [SANtricity Storage Management Plug-ins](#)
- E-Series 11.20 scope of work and various product design specification documents not publicly available

Refer to the [Interoperability Matrix Tool \(IMT\)](#) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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