Technical Report

Introduction to NetApp E-Series E2700

Feature Overview with SANtricity 11.25

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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.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 E-Series E2700 Storage Systems with SANtricity 11.25

NetApp E-Series 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 small random I/O requirements for small and medium-sized enterprise mixed workloads. 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-level storage system with the flexibility and performance capabilities to support enterprise workloads without sacrificing simplicity and efficiency. In addition, the E2700 storage system's fully redundant I/O paths, advanced protection features, and extensive diagnostic capabilities deliver a high level of availability, data integrity, and security.

Note: This document uses the following terms interchangeably with the terms used in NetApp SANtricity® Storage Manager and in the technical publications for the product:

- Tray = shelf = enclosure.
- Drive tray = drive shelf.
- Drive = disk.
- Canister = module.
- SANtricity OS = controller firmware.
- SANtricity Storage Manager = storage management software.
- Storage system = storage array.
- Drawer = one of the five drawers in the DE6600 shelf. This term does not apply to other shelf models.
- SANtricity 11.25 = SANtricity Storage Manager 11.25 plus SANtricity OS 8.25.
- SANtricity OS 8.25 = Controller firmware 8.25, the associated NVSRAM software, and matching environmental services module firmware.

1.1 E2700 Primary Use Cases

The flexible host interface options and wide range of drive choices make E-Series E2700 storage systems an ideal storage platform for enterprises that want to purchase powerful storage systems that offer easy growth strategies at the lowest possible initial investment. E2700 storage systems 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
- Efficient block storage behind virtualization platforms such as FlexArray®

1.2 E2700 System Options

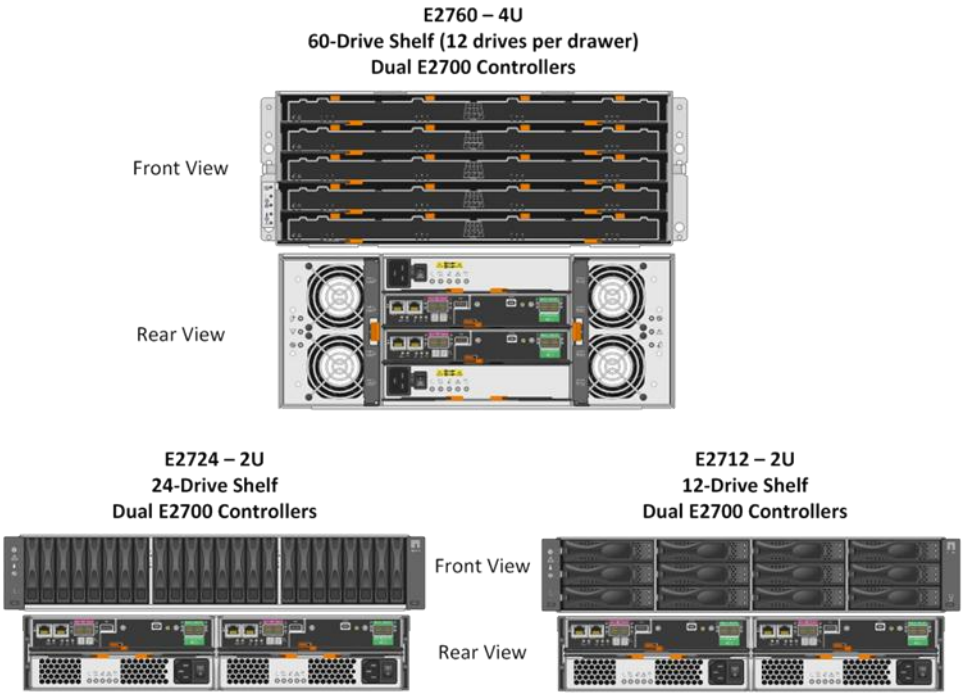
As shown in Table 1, the E2700 is available in three shelf options, which support both hard-disk drives (HDDs) and solid-state drives (SSDs) that meet a wide range of performance and application requirements.

Table 1) E2700 controller shelf and drive shelf models.

Controller Shelf Model	Drive Shelf Model	Number of Drives	Type of Drives
E2760	DE6600	60	2.5” and 3.5” SAS drives (HDDs and SSDs)
E2724	DE5600	24	2.5” SAS drives (HDDs and SSDs)
E2712	DE1600	12	3.5” SAS drives (HDDs only)

All three shelf options support one or two controller modules, dual power supplies, and dual fan units for redundancy (the 12-drive and 24-drive shelves have integrated power and fan modules). The shelves are sized to hold 60 drives, 24 drives, or 12 drives, as shown in Figure 1.

Figure 1) E2700 shelf options (duplex configurations shown).



Each E2712 or E2724 controller shelf includes one or two controllers, and each E2760 controller shelf includes two controllers. Each E2700 controller provides two Ethernet management ports for out-of-band management. The system also supports in-band management access and has two 6Gbps wide-port SAS drive expansion ports for redundant drive expansion paths. The E2700 controllers also include two built-in 12Gbps SAS host ports, but additional host interface cards (HICs) can be installed in each controller:

Note: In a duplex configuration, both controllers must be identically configured.

- 4-port 12Gb SAS (SAS-3 connector)
- 2-port 12Gb SAS (SAS-3 connector)
- 4-port optical HIC (SFP+), which can be factory-configured as either 16Gb Fibre Channel or 10Gb iSCSI
- 2-port optical HIC (SFP+), which can be factory-configured as either 16Gb Fibre Channel or 10Gb iSCSI

Note: A software feature pack can be applied in the field to change the host protocol of the optical HICs from FC to iSCSI or from iSCSI to FC.

- 2-port 10Gb iSCSI (Cat6e/Cat7 RJ45)

For optical connections, the appropriate SFPs must be ordered for the specific implementation. Consult the Hardware Universe for a full listing of available host interface equipment. Figure 13 provides a close-up view of the E2700 HIC options.

For detailed instructions on changing protocols, go to the Upgrades/Hardware Upgrades section at https://mysupport.netapp.com/eseries.

2 SANtricity Storage Manager 11.25

E-Series systems are managed by the SANtricity Storage Manager desktop application. Simple to download and install, SANtricity Storage Manager provides an intuitive, wizard-led GUI as well as full support for a CLI. 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.

2.1 Application Details

SANtricity Storage Manager supports both out-of-band and in-band system management, but NetApp generally recommends using an out-of-band management host that does not participate in the data delivery workload. In-band management is useful for cases in which there is no IP network access to remote storage systems, but it requires in-band traffic connections to the storage system from a SAN-connected host where SANtricity Storage Manager is installed.

SANtricity Storage Manager 11.25 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, the event monitor service (also known as SMmonitor or persistent monitor) must be running on the primary SANtricity management server. NetApp does not recommend running the monitor service on multiple management servers/PCs.

- 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, including upgrades 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 for in-band management and send I/O traffic to the E-Series storage system.

SANtricity Storage Manager 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, as shown in Figure 2. The EMW is used to add the storage systems that are 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, as shown in Figure 3. The AMW is used to configure, maintain, and manage a storage system and its components.

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. Refer to https://mysupport.netapp.com/eseries for instructions on installing, configuring, and using SANtricity Storage Manager 11.25.

Figure 2) SANtricity Storage Manager 11.25 EMW.

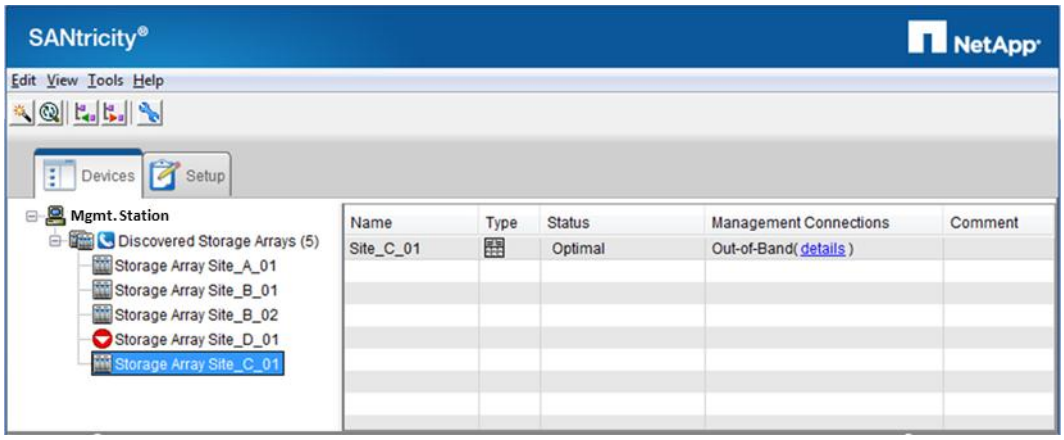
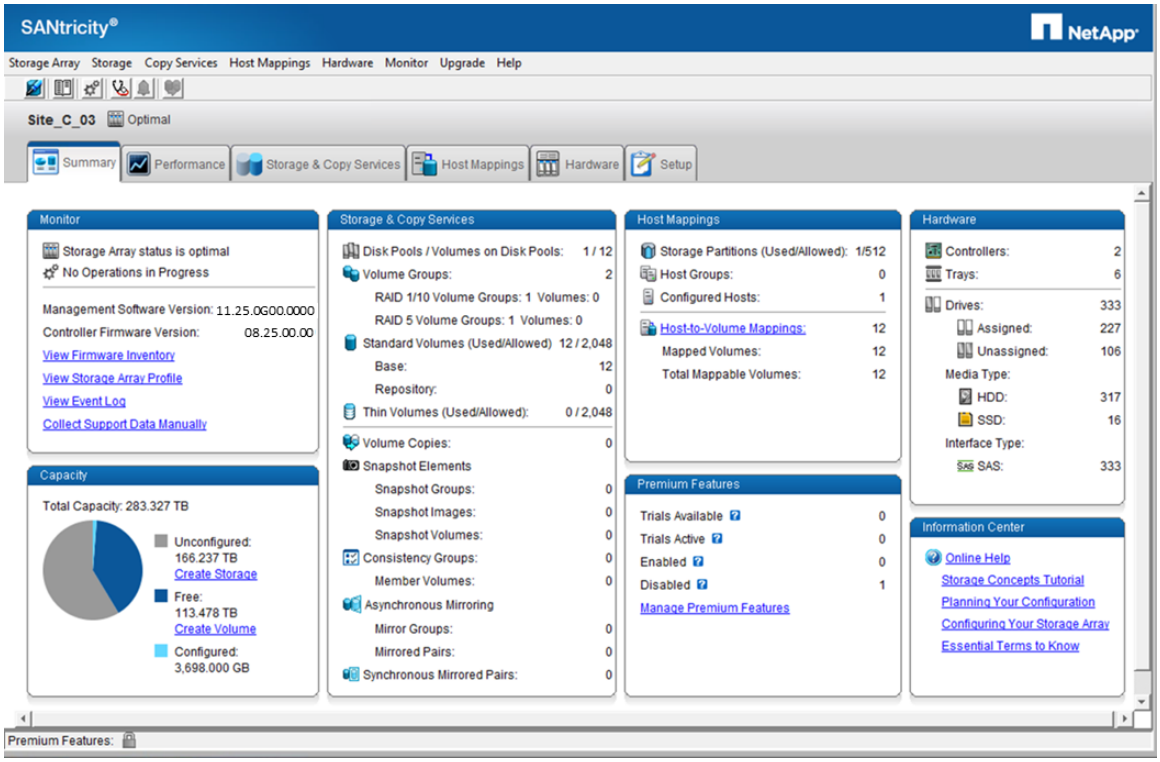


Figure 3) SANtricity Storage Manager 11.25 AMW: Summary tab view of a storage system.



E2700 storage systems are now shipped preloaded with the SANtricity OS 8.25. The SANtricity Storage Manager software version 11.25 must be downloaded from the NetApp Support site and loaded on the management server before discovering storage systems running SANtricity OS 8.25. Previous versions of

SANtricity Storage Manager do not manage the E2700 arrays running SANtricity OS 8.25, but the SANtricity Storage Manager version 11.25 manages the new E2700 arrays and all of the previous E-Series array software versions from the last five years.

Note: Creating an account on the NetApp Support site can take 24 hours or more for first-time customers. New customers should register for Support site access well in advance of the initial product installation date.

2.2 SANtricity Management Integration

While E-Series and storage systems are easily installed in most physical data center environments, implementing a new system can sometimes require weeks of training and necessitate recreating day-to-day system administration operations. To expedite the adoption of E-Series storage systems, NetApp recommends leveraging the benefits of various SANtricity plug-ins; APIs; providers; and utilities for applications such as Oracle and SQL Server and OSs such as Windows, Linux, and VMware.

Table 2 shows the software packages available to anyone with an active NetApp Support site account and current E-Series product support agreement. Go to http://mysupport.netapp.com/NOW/cgi-bin/software/ and select E-Series/EF-Series SANtricity Management Plug-ins for the plug-ins.

Table 2) Available software packages for SANtricity Management integration.

Software Package	Use
SANtricity plug-in for VMware vCenter	Configure, manage, monitor, and perform datastore to LUN mapping in vSphere client or web client.
SANtricity storage replication adapter for VMware vCenter Site Recovery Manager	Automate management of replicated datastores and disaster recovery, including testing DR plans.
SANtricity VASA provider (VMware APIs for storage awareness)	Report storage volume capabilities to vSphere for SLO management.
SANtricity add-in for Microsoft SQL Server Management Studio (SSMS)	Monitor and tune performance for SQL Server database storage and show mapping of volumes to SQL Server databases.
SANtricity plug-in for Oracle EM	Perform storage volume to database mapping, monitor and report on performance.
SANtricity Management Pack for Microsoft System Center Operations Manager	Monitor health status and send storage alerts to Microsoft System Center.

Table 3 shows the SANtricity APIs and toolkits that can be used for scripting and custom integration into other management tools: Go to http://mysupport.netapp.com/NOW/cgi-bin/software/ and select E-Series/EF-Series SANtricity Management Plug-ins for the web services software and documentation. Go to http://mysupport.netapp.com/NOW/download/tools/santricity_powershell_toolkit for the PowerShell toolkit.

Table 3) SANtricity APIs and toolkits.

APIs and Toolkits	Description
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.

Table 4 provides a list of third platform plug-ins that leverage E-Series storage systems as storage building blocks in cloud storage environments. The SANtricity web services proxy is available on the NetApp Support site at http://mysupport.netapp.com/NOW/download/software/eseries_webservices/1.3/. In most cases, the plug-ins listed are available on the various provider websites. Contact your NetApp sales representative for more information about third platform integration with E2700 storage systems.

Table 4) Third platform plug-ins that leverage the SANtricity web services proxy.

Software Package	Use
NetApp Cinder driver	Cinder for E-Series leverages SANtricity web services proxy for configuration of E-Series storage.
OpenStack Swift on E-Series storage	E-Series provides high-quality, efficient, block storage that enables large OpenStack environments to operate at a lower overall cost of ownership as compared to similar white box environments.
Custom Puppet module	Puppet agent uses the SANtricity web services proxy for configuration of E-Series storage.
SANtricity plug-in for CHEF	CHEF agent uses the SANtricity web services proxy for configuration of E-Series storage.
SANtricity performance application for Splunk	Display and monitor tool to report on configuration and performance aspects of multiple E-Series systems in one interface.
SANtricity plug-in for Nagios	Custom plug-in for monitoring E-Series storage arrays within Nagios framework.

3 SANtricity Features

E-Series systems have a rock-solid reputation for reliability, availability, simplicity, and security. The SANtricity 11.25 release builds on that legacy by adding new reliability, availability, and serviceability (RAS) features; additional security options; and new drive choices.

3.1 New Features with SANtricity 11.25

New functionality available with SANtricity 11.25 adds to an already impressive list of RAS features and capabilities offered with the E-Series portfolio.

Improvement to Drawer Loss Protection

Drawer loss protection for a dynamic disk pool can now be achieved with one 60-drive (five-drawer) drive tray. Drawer loss protection requirements are met when a disk pool includes drives from all five drawers, and the pool includes an equal number of drives from each drawer.

Data Assurance (T10 PI) Usability Improvements

The user experience in the existing data assurance (DA) feature has been significantly improved in the SANtricity 11.25 release:

- If the associated drives support DA, the DA feature is enabled by default when volumes are created. Previously, the system did not determine if the HICs supported DA. As a result, if the array had iSCSI HICs, you needed to delete DA volumes if you forgot to manually disable DA. In SANtricity 11.25, the system automatically disables the DA feature if it determines that the HICs do not support it.

- When DA detects a data integrity error, the previous behavior was to lock down the storage array. Accessing the array again required engagement with NetApp Support. In SANtricity 11.25, some data integrity issues now cause the storage array to enter a safe mode that allows the administrator to access information and collect support data.

Note: Some data integrity issues still cause the storage array to enter lock-down mode when the data in question cannot be recovered using the DA feature tools.

Simple Network Time Protocol (SNTP)

The Simple Network Time Protocol (SNTP) is a time-maintenance feature that is used to keep the clocks in the E-Series storage array synchronized with a central SNTP server instead of the SANtricity management server. When this feature is enabled, the SANtricity OS periodically queries the configured SNTP server and uses it to synchronize the clock in each E-Series controller.

Federal Information Processing Standards (FIPS) Drive Support

The full disk encryption (FDE) feature offers a higher level of assurance with Federal Information Processing Standards (FIPS) 140-2 level 2 validated drives. These FIPS-compliant drives are a type of secure-capable drive, similar to FDE drives, that have an extra level of security, including tamper-resistant seals on the drive casing and other FIPS-approved protocols that are different than standard FDE drives.

How FIPS Drives Work with SANtricity 11.25

When FIPS drives are secure-enabled in an E2700 storage array, an initialization process is performed in accordance to the specific drive model's FIPS security policy. There is nothing preventing the user from mixing drive types within a volume group or disk pool. However, in order for a volume group or disk pool to be FIPS compliant, all the drives must be FIPS drives. Table 5 shows how FIPS drives operate, based on to what type of volume group or disk pool they are added.

Table 5) Operation modes for FIPS drives.

If a FIPS Drive Is Added to a …	It Operates In This Mode …
Nonsecure-capable volume group or disk pool	Nonsecure mode (like any other drive in that volume group or pool).
Secure-capable volume group or disk pool containing FDE drives and FIPS drives	Nonsecure mode until security is enabled for the volume group or disk pool. However, the volume group or disk pool is not FIPS compliant.
Secure-capable volume group or disk pool containing all FIPS drives	Nonsecure mode until security is enabled for the volume group or disk pool. After that, the volume group or disk pool is considered FIPS compliant.

Note: All FIPS-compliant drives are FDE drives, but not all FDE drives are FIPS 140-2 level 2–compliant drives.

After an all-FIPS drive volume group or disk pool is created, only FIPS drives can be added to that volume group or pool, both for replacing a failed drive and for growing the volume group or disk pool capacity.

To enable security for secure-capable drives, the drive security premium feature license must be purchased, and the associated license key file must be loaded on the storage system. After this is installed, security can be enabled for specific volumes using SANtricity Storage Manager. This automatically activates FIPS if the associated physical drives are FIPS compliant.

FIPS Drive Considerations with SANtricity 11.25 Features

FIPS drives can be used with most SANtricity features, including:

- Synchronous/asynchronous mirroring
- SANtricity Snapshot
- Volume copy
- SSD read cache (not FIPS compliant in secure mode)
- Dynamic Disk Pools or Standard RAID

While FIPS drives can function as nonsecure drives, there are multiple other system interactions that take on unique characteristics or require specific limitations when FIPS drives are used in the secure-enabled mode. For example, FDE drives with security enabled can be reprovisioned in the storage system and repurposed without providing the security key. In contrast, the security key is required to erase data from or repurpose a secure activated FIPS drive.

Note: There is a manual process to erase drives when the key is unknown, but it requires both physical access and system administration access to accomplish the task. Full details are available in the SANtricity Storage Manager online help.

For a complete description of FIPS drive functionality in E-Series arrays, contact your NetApp or partner sales representative.

AutoSupport OnDemand

NetApp AutoSupport 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 Support Delivery (CSD).

The new AutoSupport OnDemand feature in SANtricity 11.25 shifts control of AutoSupport delivery to the NetApp support back-end servers. Anytime an E-Series storage array prepares to deliver an ASUP message, it checks first with the ASUP back end for permission to deliver.

OnDemand introduces the ability for an E-Series storage array to check in periodically with the ASUP back end to determine if there are any pending ASUP actions for the storage array. OnDemand also allows NetApp technical support to request retransmission of a particular ASUP message or request that a new ASUP message be collected and sent to NetApp. The storage array is informed of the pending action the next time it checks in with the NetApp back-end servers.

For more information about the ASUP feature, go to http://mysupport.netapp.com/eseries and click the Review Storage Concepts link.

3.2 SANtricity Standard and Premium Features

E-Series systems ship with significant storage management features that can be simply activated from SANtricity Storage Manager, but there is one premium feature offered with E2700 storage systems:

- Drive security

For premium feature activation, contact your NetApp or partner sales representative to purchase the required license keys.

Table 6 provides a consolidated list of E2700 standard features when running SANtricity 11.25.

Table 6) E2700 standard features using SANtricity 11.25.

E2700 Standard Features with SANtricity 11.25
Storage partitions. Individual host without shared LUNs to host groups with shared LUNs or a combination of both.
Thin provisioning. Overcommit storage and add capacity when you actually need it.
SSD read cache. Accelerate 90% or higher random read workloads using a few SSDs. Recommended to accelerate 90% or higher random read workloads.
Secure SSD read cache. The SSD read cache can be secured with a nonsecure base volume or a secure base volume (FDE or FIPS drive). However, when there is a FIPS-secure base volume, the storage management software alerts you that the SSD read cache does not have the same security capabilities as the base volume. **Note:** If drive security is enabled and the SSD is secure-capable, the SSD read cache can be secured only upon creating the SSD read cache.
Data assurance (T10 PI). Makes sure of data integrity to the drive, which is especially important with large capacity drives.
Nondisruptive controller firmware upgrade. Using ALUA host type with multiple paths to hosts combined with a wizard-driven upgrade process that activates one controller at a time, makes sure that upgrades do not affect host-to-LUN access.
Online drive firmware upgrade. Upgrades one drive at a time and tracks writes to the affected drives during the upgrade window; should only be used during very low write I/O periods. **Note:** Parallel drive firmware upgrades are supported offline to more quickly upgrade multiple drives during a maintenance window.
Proactive drive monitor and data evacuator. Nonresponsive drives are automatically power-cycled to see if the fault condition can be cleared. If the condition cannot be cleared, the drive is flagged as failed. For predictive failure events, the evacuator feature starts to remove data from the affected drive in an effort to move the data before the drive actually fails. If the drive fails, rebuild picks up where the evacuator was disrupted, thus reducing the rebuild time.
Drive encryption (full disk encryption [FDE]). Encryption for data at rest; no external key management required and a minimal performance impact. **Note:** Drive encryption for data at rest requires the purchase and activation of the drive security premium feature. Contact your NetApp sales representative for purchase details.
Standard AutoSupport. E-Series has supported basic AutoSupport for several releases.
Changing host protocol. Supported using new feature pack keys; go to https://mysupport.netapp.com/eseries (Upgrades >Hardware) to obtain the free license keys and detailed instructions for each starting and ending protocol.

Table 7 provides a comprehensive list of standard copy services features with E2700 storage arrays.

Table 7) SANtricity 11.25 copy services features.

Standard SANtricity Copy Services Features
SANtricity Snapshot copies. Point-in-time Snapshot copies.
Synchronous mirroring. Real-time mirroring to a remote site (usually within 10km).

Standard SANtricity Copy Services Features
Asynchronous mirroring. Mirroring to a remote site where RPO = 0 is not a requirement.
Volume copy. Used to spin off volumes for test/dev or analytics purposes.

See technical report: Deploying NetApp E-Series and EF-Series Copy Services with Oracle and SQL Server Databases for additional details and use case information using SANtricity copy services features.

4 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.

4.1 Config Advisor

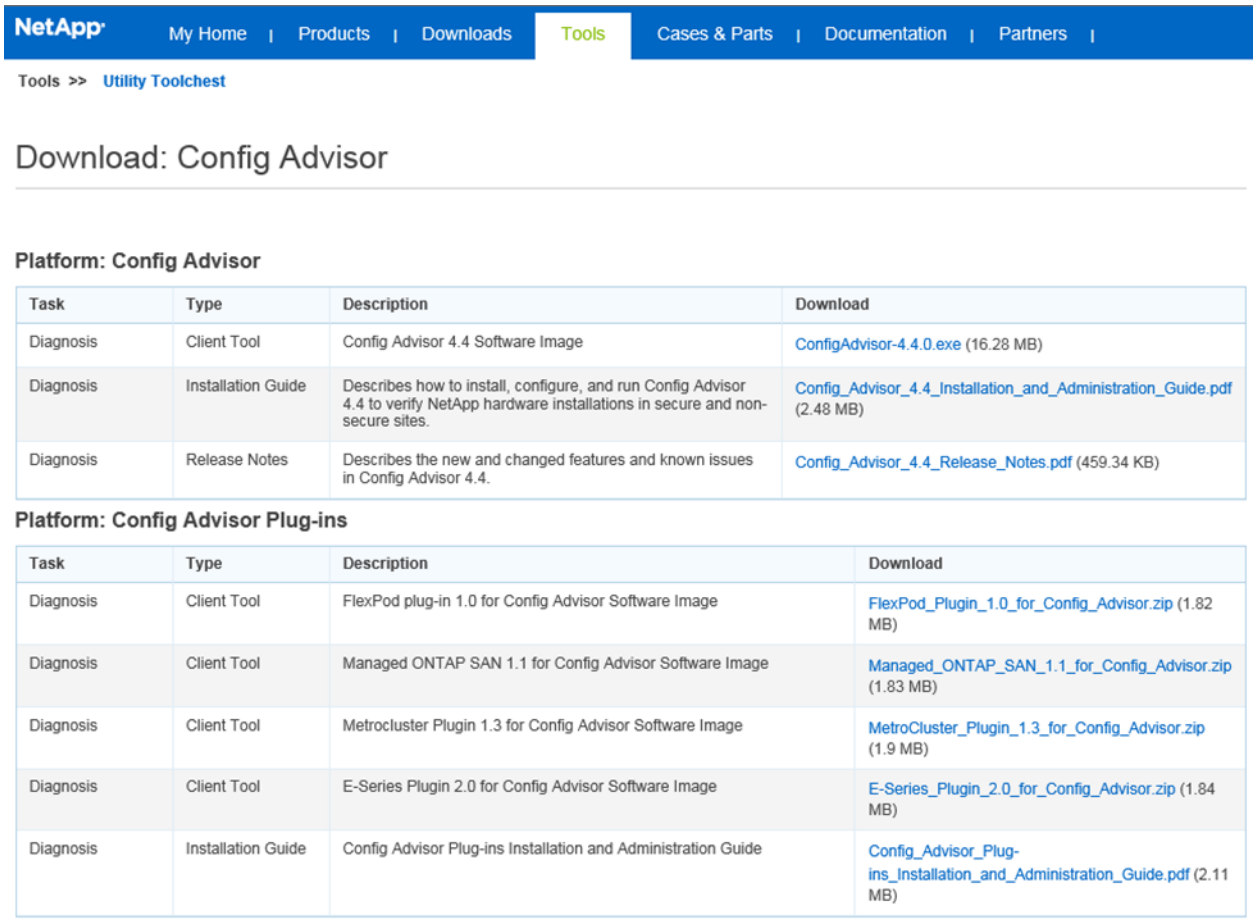
Config Advisor is a configuration validation and health check tool for NetApp systems. Config Advisor can be used to check a NetApp system for the correctness of hardware installation and conformance to NetApp recommended settings. It collects data and runs a series of commands on the hardware, then checks for cabling, configuration, availability, and best practice issues.

Config Advisor 4.4 release enables support for E-Series host-side checks and E-Series configuration checks in addition to the standard checks.

Config Advisor creates PDF, Word, and Excel reports on the system configuration summary and health check results. It also sends Config Advisor AutoSupport data back to NetApp over HTTP; this data can be viewed through SmartSolve.

To download the Config Advisor tool, the additional plug-in for E-Series, and associated installation documentation for both software packages (see Figure 4), use the Config Advisor link, acknowledge the EULA, and select Continue. For general installation instructions, use the Config Advisor 4.4 Installation and Administration Guide; for details on how to install the E-Series plug-in, use the Config Advisor Plug-Ins Installation and Administration Guide.

Figure 4) Config Advisor download site landing page.



Config Advisor Workflow and Key Features

Config Advisor has three major components:

- **Data collector.** The data collector supports multiple data input methods, including support for secure site data collection.
- **Analysis engine.** The analysis engine takes the collected data and performs a series of configuration validation and best practices checks. The analysis engine checks for at-risk systems, checks for systems that require firmware updates, and performs network switch checks. It also performs specific checks for clustered Data ONTAP®, Data ONTAP operating in 7-Mode, MetroCluster™, FlexPod®, and E-Series systems.
- **Presentation layer.** The presentation medium is very flexible; users can view the output using Config Advisor's intuitive UI, or they can generate PDF, Excel, or MS Word reports for these contents.

4.2 E-Series Sizer

The E-Series Performance Sizing tool allows sales engineers and partners to make sure that specific customer architectures are properly sized to meet customer performance requirements.

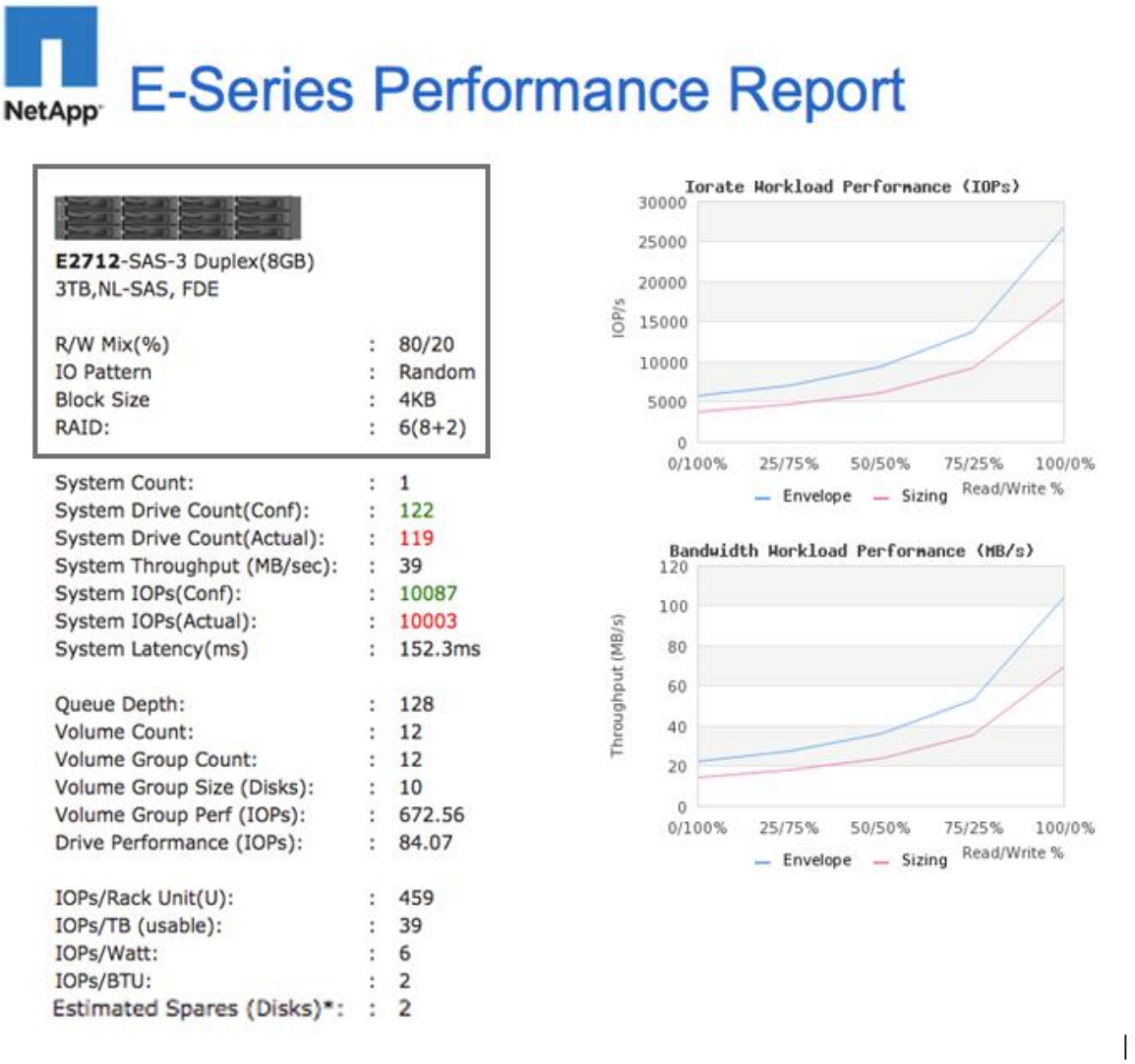
The E-Series Sizer tool is available for NetApp employees and is also open for partner access.

Note: If you are unable to access this tool, contact your NetApp or partner sales representative.

Figure 5 shows a performance sizing report, which includes four major sections:

- **Hardware and workload.** The boxed area in Figure 5 represents the hardware and workload section where users enter the expected hardware and workload.
- **Sizing.** The next section shows the sizing output.
  - The numbers in red show the actual system drive count and the actual system IOPS. These values are used to determine the drive count needed to meet the performance and IOPS target.
  - The numbers in green show the configured system drive count and the configured system IOPS. These values are used to determine the drive count needed based on RAID group size and IOPS performance.
- **Metrics.** This section shows various metrics such as volume group performance, drive performance, and IOPS/rack unit.
- **Charts.** The charts on the right side of the report present performance as two sets of data points: envelope is the performance curve representing a fully configured system, and sizing is the performance curve representing the sized solution.

Figure 5) Performance sizing report.



4.3 Synergy

NetApp Synergy is a NetApp tool used for accurately designing NetApp configurations. An emphasis is placed on showing realistic capacity yield and environmental details. Advantages of using Synergy over traditional spreadsheets or alternative tools include automatic product updates, best practices enforcement, alignment to the sales workflow, and data sharing with users and tools.

Note: If you are unable to access this tool, contact your NetApp or partner sales representative.

Synergy 6, the latest release, is a full web-accessible experience that is compatible with mainstream browsers such as Microsoft Internet Explorer, Google Chrome, and Mozilla Firefox.

Note: The Synergy User Guide is located here: https://forums.netapp.com/docs/DOC-14888https://forums.netapp.com/docs/DOC-14888.

4.4 Hardware Universe

Hardware Universe (HWU) is a web-based tool that provides a visual presentation of the complete NetApp line of hardware products.

Hardware Universe provides the information needed to make side-by-side comparisons of the various NetApp platforms in terms of capacity, memory size, maximum spindle count, and other features.

Note: If you are unable to access this tool, contact your NetApp or partner sales representative.

HWU has three components:

- **HWU poster** is a one-stop location to find specifications for all NetApp products.
- **HWU application** provides the complete NetApp hardware portfolio in a web application.
- **HWU mobile application** represents the complete NetApp hardware portfolio in a mobile application for iPhone or Android.

Note: The Hardware Universe User Guide is located at http://hwu.netapp.com/Resources/hwu_ug.pdf.

4.5 Host Utilities

When customers implement E-Series with Windows and Linux operating systems, they can use the settings in the Host Utilities Kits to properly configure each host, according to the latest Interoperability Matrix Tool (IMT) guidance. The kits are on the NetApp Support site at Downloads > Software > Host Utilities—SAN. Currently, the Linux and Windows kits support E-Series and FAS implementations. Other available kits support FAS implementations only.

5 SANtricity Software Specifications for E2700 Hardware

Table 8 lists the SANtricity software specifications for E2700-based storage systems.

Table 8) 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	

Components	Maximum
Partitions	128
Volumes per partition	256
Volumes	512
Thin volumes per system	512
Disk pools per system	20
Consistency Groups	
Volumes per consistency group	32
Consistency groups per system	16
Snapshot Copies	
Per Snapshot group	32
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

6 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.

6.1 Controller-Drive Shelf Configurations

E2700 controllers can be paired with all three E-Series shelves, and the shelves can be mixed in the same storage system. The following sections provide detailed information about each shelf configuration.

E2760 Controller-Drive Shelf

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

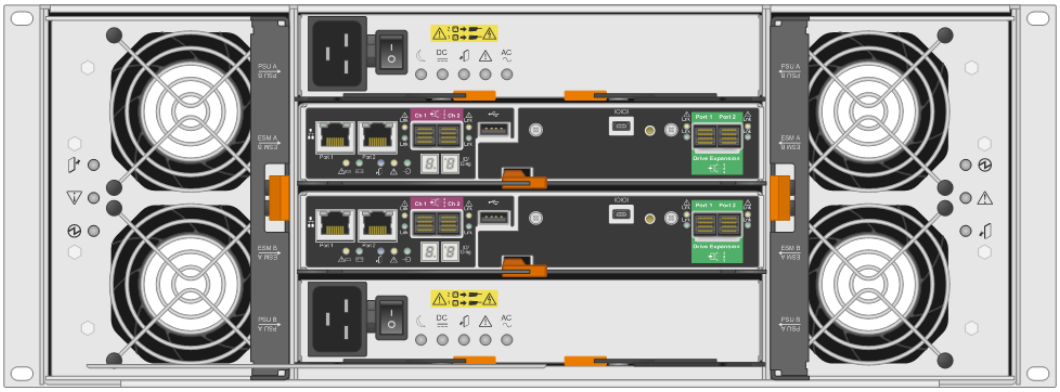
An E2760-based storage system supports a maximum of 180 drives when using only 60-drive shelves or a maximum of 192 drives when using a mix of expansion-drive shelf models. A minimum of 20 drives must be installed in the E2760 controller-drive shelf and in each 60-drive expansion-drive shelf. For purposes of airflow, 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. In addition, the shelf bezel must be installed during normal operation.

Figure 6 and Figure 7 show the front and rear views of the E2760 controller-drive shelf.

Figure 6) E2760 front view without bezel.

Figure 7) E2760 rear view.



E2724 Controller-Drive Shelf

The E2724 is a two-rack-unit-high (2U) shelf that holds up to twenty-four 2.5" drives. It features dual RAID controllers and dual power supplies with integrated fans. 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 8 and Figure 9 show the front and rear views of the E2724 controller-drive shelf.

Figure 8) E2724 front view.

Figure 9) E2724 rear view.

E2712 Controller-Drive Shelf

The E2712 is a 2U shelf that holds up to twelve 3.5" drives. It features dual RAID controllers and dual power supplies with integrated fans. 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 10 and Figure 11 show the front and rear views of the E2712 controller-drive shelf.

Figure 10) E2712 front view.

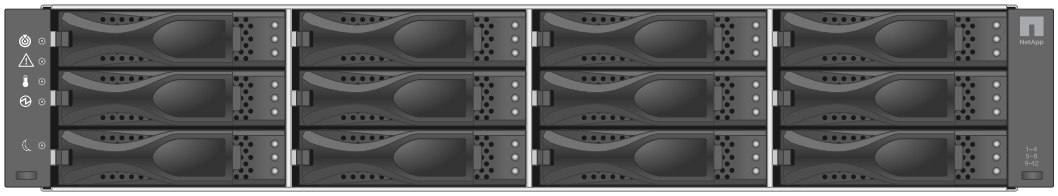
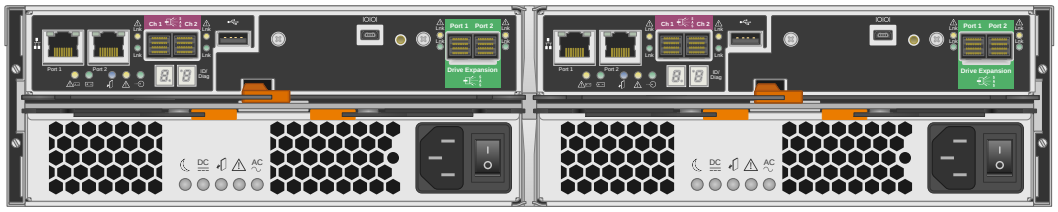


Figure 11) E2712 rear view.



E2700 Hardware Specifications

The E2700 controller has the following base hardware features:

- Dual Ethernet ports for management-related activities
- SAS, FC, or iSCSI ports for host connection
- SAS drive expansion ports to attach expansion-drive shelves

Note: The E2700 controller has two 12Gbps onboard SAS ports, so unlike the E5600 and EF560 controllers, adding an optional HIC is only needed if you want to use a protocol other than SAS or you need more than two SAS ports per controller.

Table 9 lists the physical characteristics of the E2760, E2724, and E2712 controller-drive shelves.

Table 9) E2700 physical characteristics.

Dimensions and Weight	E2760 Controller-Drive Shelf (DE6600 Shelf with 6TB HDD)	E2724 Controller-Drive Shelf (DE5600 Shelf with 1.8TB HDD)	E2712 Controller-Drive Shelf (DE1600 Shelf with 6TB HDD)
Height	7.0" (17.78cm)	3.47" (8.81cm)	3.4" (8.64cm)
Width	19" (48.26cm)	19" (48.26cm)	19" (48.26cm)
Depth	32.5" (82.55cm)	19.6" (49.78cm)	21.75" (55.25cm)
Weight (max.)	237lb (105.2kg)	59lb (26kg)	61lb (27kg)

Table 10 lists both the typical power specifications and the equipment-rated power specifications of the three E2700 controller-drive shelves. The table assumes that the shelves are in a dual-controller configuration and fully loaded with drives.

Table 10) E2700 maximum power specifications per shelf fully loaded with listed drive type.

E2700 Controller-Drive Shelf	Typical Operating Power			Equipment-Rated Power		
	kVA	Watts (AC)	BTU/Hr	kVA	Watts (AC)	BTU/Hr
E2760 with HIC: 6TB 7.2K RPM drives fully populated	.996	986	3,364	1.205	1,193	4,072
E2724 with HIC: 1.8TB 10K RPM drives fully populated	0.436	432	1,472	0.586	580	1,979
E2712 with HIC: 6TB 7.2K RPM drives fully populated	0.361	358	1,220	0.516	511	1,744

Table 11 lists the technical specifications for the E2700-based storage systems.

Table 11) E2700 technical specifications.

Specification	E2760	E2724	E2712
Maximum raw system capacity	1440TB	1536TB	1536TB
Maximum number of drives per system	180 (with 3 x DE6600 shelves)	192	192
Shelf form factor	4U, 60 drives	2U, 24 drives	2U, 12 drives
SSD drive types (FDE drives are also supported)	3.2TB, 1.6TB, or 800GB 2.5" SSD (25 per shelf max., 120 per storage system max.)	3.2TB, 1.6TB, or 800GB 2.5" SSD (120 per storage system max.)	Not supported
HDD drive types supported (FIPS and FDE drives are also supported)	1.8TB, 1.2TB, 900GB, or 600GB 2.5" 10K RPM SAS	1.8TB, 1.2TB, 900GB, or 600GB 2.5" 10K RPM SAS	600GB 3.5" 15K RPM SAS (restricted to add-on for existing system only—EOL)

Specification	E2760	E2724	E2712
	8TB, 6TB, 4TB, 3TB, or 2TB 3.5" 7.2K RPM SAS	Not supported	8TB, 6TB, 4TB, 3TB, or 2TB 3.5" 7.2K RPM SAS
Memory	4GB or 8GB per controller: simplex system		
	8 GB or 16GB per duplex system		
Onboard host I/O	4-port 12Gb SAS (2-port 12Gb SAS per controller)		
Host I/O (controllers must match; a software feature pack can be applied to convert the 4-port FC to 4-port iSCSI or iSCSI back to FC)	8-port 12Gb SAS (4-port 12Gb SAS [wide-port] per E2700 controller)		
	8-port 16Gb FC (4-port 16Gb FC per E2700 controller)		
	8-port 10Gb iSCSI (4-port 10Gb iSCSI per E2700 controller)		
Drive shelves supported for expansion-drive offerings	DE6600 (4U, 60 drives): 2 expansion shelves max.; supports the same drive types as E2760 controller-drive shelf		
	DE5600 (2U, 24 drives): 15 expansion shelves max.; supports the same drive types as E2724 controller-drive shelf		
	DE1600 (2U, 12 drives): 15 expansion shelves max.; supports the same drive types as E2712 controller-drive shelf		
High-availability (HA) features	Dual active controllers with automated I/O path failover		
	Support for RAID 0, 1 (10 for 4 drives or more), 5, and 6		
	Redundant, hot-swappable storage controllers, disk drives, power supplies, and cooling fans		
	SANtricity proactive drive health monitoring with the drive evacuator feature to identify problem drives and begin removing data before hard failures occur		
	Automatic drive fault detection, failover, and rebuild by using global hot spare drives for standard RAID and spare pool capacity in the case of DDP		
	Mirrored data cache with battery backup and destage to flash		
	Online controller firmware and NVSRAM upgrade		
	Online ESM firmware and drive firmware upgrade (consult CSD for guidance before performing ESM upgrades)		
	Online drive firmware upgrades (consult CSD for guidance before performing drive firmware upgrades)		
	SANtricity event monitor and AutoSupport, for making periodic copies of the storage system configuration		

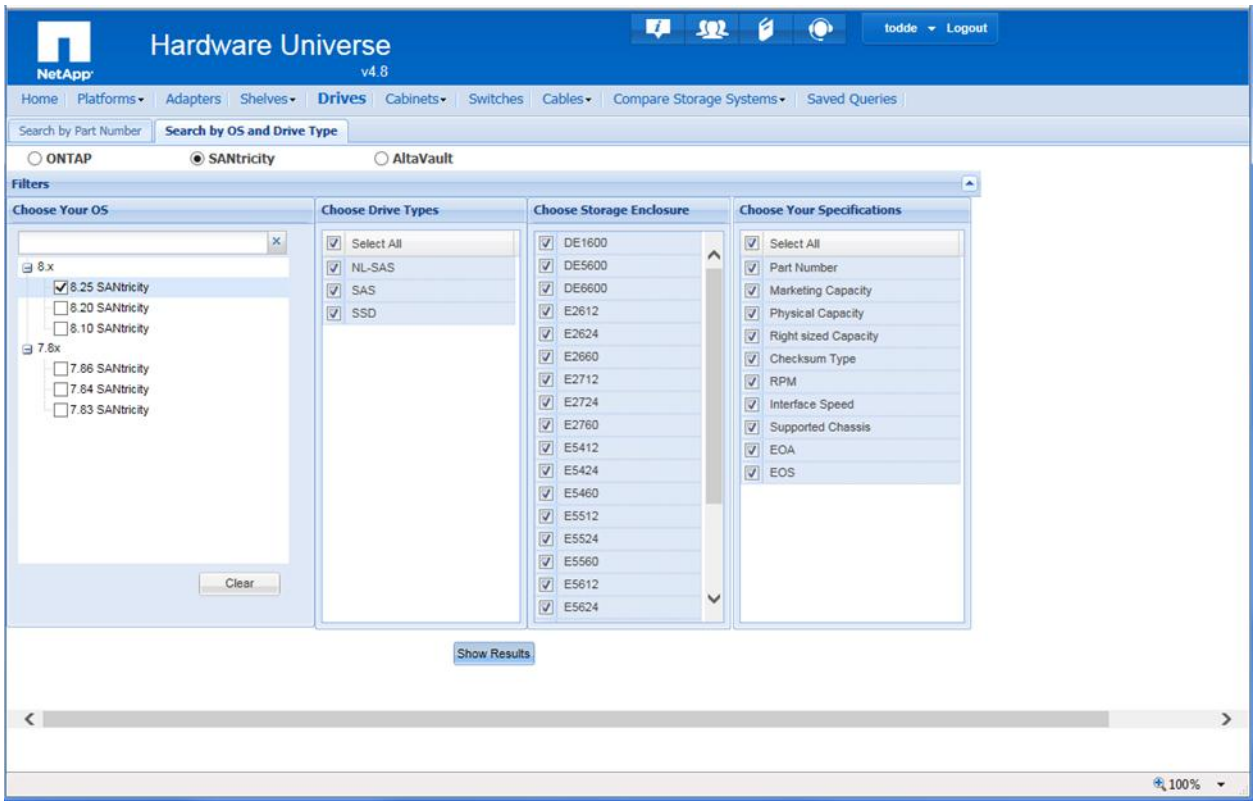
Table 12 provides a reference matrix of supported drive types and associated advanced features, including full disk encryption (FDE) and FIPS. The information is accurate as of March 2016.

Table 12) Drive feature matrix as of March 2016.

Drive Type	Data Assurance (DA): T10 PI	Full Disk Encryption (FDE)	Federal Information Processing Standards (FIPS 140-2 Level 2)
2/3/4 TB NL-SAS	x	x	
6TB NL-SAS	x	x	x
8TB NL-SAS	x	x	
900GB, 1.2TB SAS	x	x	
1.8TB SAS	x	x	x
400GB SSD	x	x	
800GB SSD	x	x	
1.6TB SSD	x		
3.2TB SSD	x		

Current drive availability information is always available in the Hardware Universe. Figure 12 shows the navigation to select drives by OS and platform compatibility.

Figure 12) Hardware Universe drives by OS and platform.



For additional information, refer to the NetApp E2700 Datasheet.

6.2 Controller Host Interface Features

By default, the E2700 controller includes two Ethernet management ports that provide out-of-band system management access, two SAS drive expansion ports that provide redundant drive expansion paths, and two 12Gbps onboard SAS ports. The E-Series E2700 controller also supports five HIC options, including:

- 4-port 12Gb SAS (SAS-3 connector)
- 2-port 12Gb SAS (SAS-3 connector)
- 2-port 10Gb iSCSI (Cat6e/Cat7 RJ45)
- 2-port optical HIC, which can be factory-configured as either 16Gb Fibre Channel or 10Gb iSCSI
- 4-port optical HIC, which can be factory-configured as either 16Gb Fibre Channel or 10Gb iSCSI

Note: A software feature pack can be applied in the field to change the host protocol of the 2-port and 4-port optical HICs:

  - From FC to iSCSI
  - From iSCSI to FC

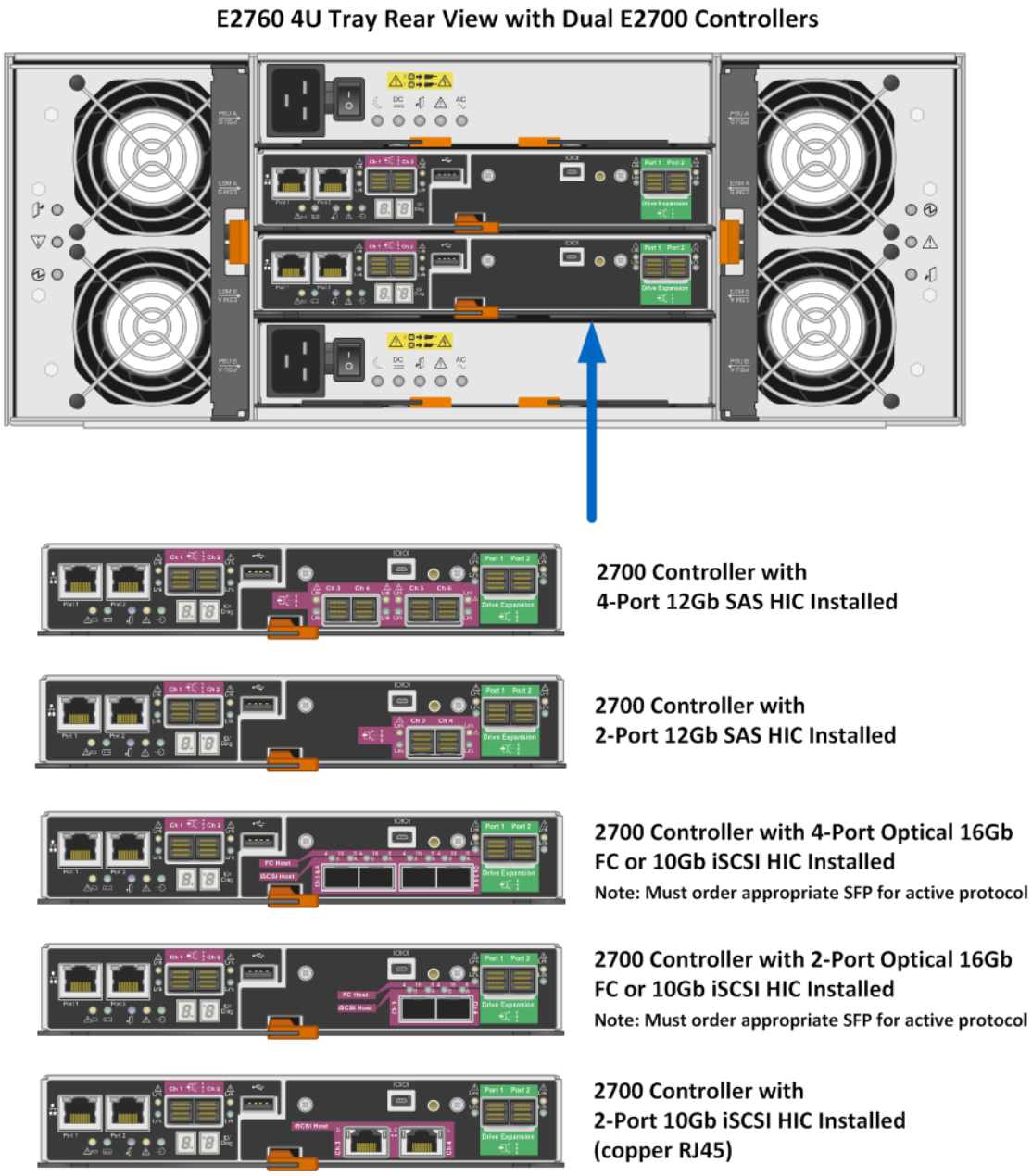
For step-by-step instructions for obtaining and applying software feature packs to change HIC protocol, go to the E-Series Systems Documentation Center (http://mysupport.netapp.com/eseries), click Upgrade/Convert the Host Interface Card, and select one of the PDFs listed for the E2700 Model Series.

For optical connections, the appropriate SFPs must be ordered for the specific implementation. Consult the Hardware Universe for a full listing of available host interface equipment.

Note: Both controllers in a duplex configuration must be configured identically.

The five HIC options are shown in Figure 13.

Figure 13) E2700 with optional HICs.



All HIC options support link speed autonegotiation.

6.3 Hardware LED Definitions

E2700 Controller-Drive Shelf LEDs

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 14 shows the LEDs on the front panel of the E2760 controller-drive shelf.

Figure 14) LEDs on front panel of E2760 controller-drive shelf.

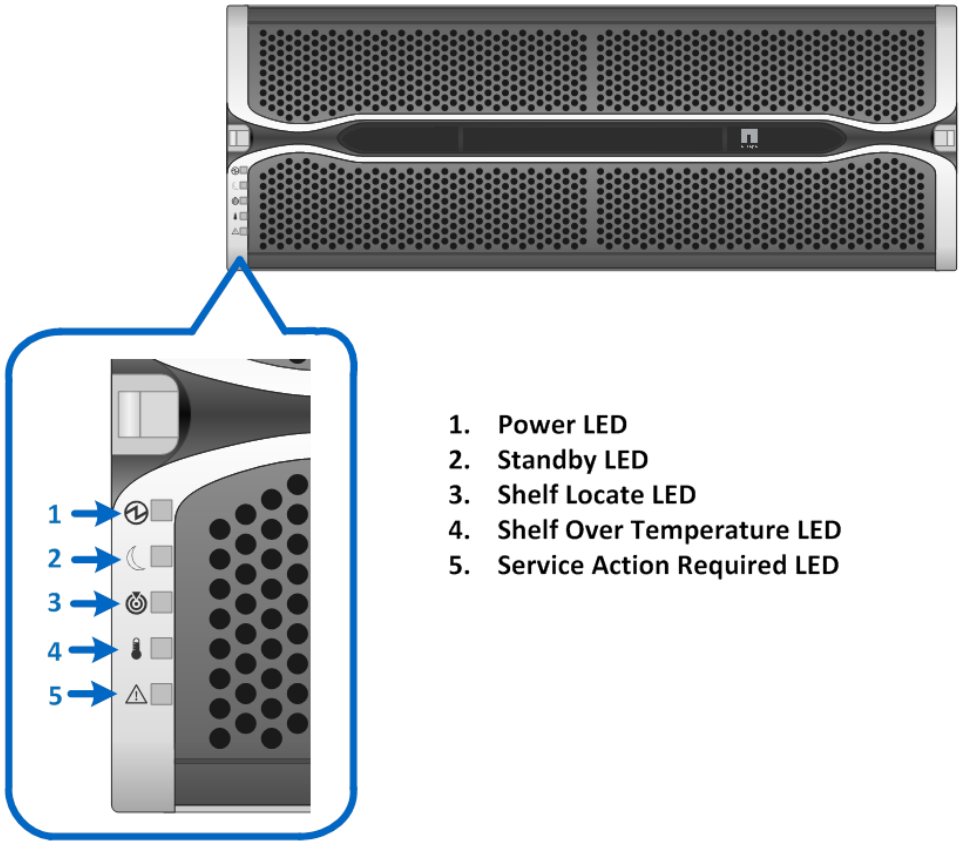
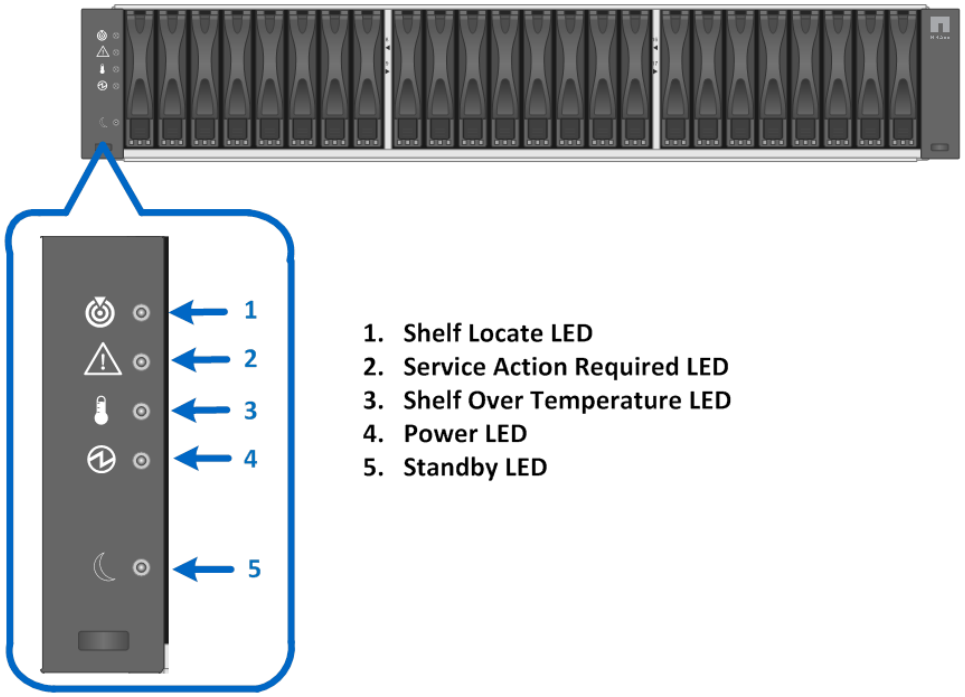


Figure 15 shows the LEDs on the front panel of the E2724 controller-drive shelf; the LEDs on the front panel of the E2712 controller-drive shelf are the same.

Figure 15) LEDs on front panel of E2724 and E2712 controller-drive shelves.



1. Shelf Locate LED
2. Service Action Required LED
3. Shelf Over Temperature LED
4. Power LED
5. Standby LED

Note: The LEDs on the front of the E2760 controller-drive shelf are in a different order from those on the front of the E2724 and E2712 shelves.

Table 13 defines the front panel LEDs on the E2760, E2724, and E2712 controller-drive shelves. The LEDs are listed in the order matching the layout on the E2760 controller-drive shelf.

Table 13) 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 15 shows the LEDs on the rear of the E2760 controller-drive shelf.

Figure 16) LEDs on E2760 power supply and fan unit (rear view).

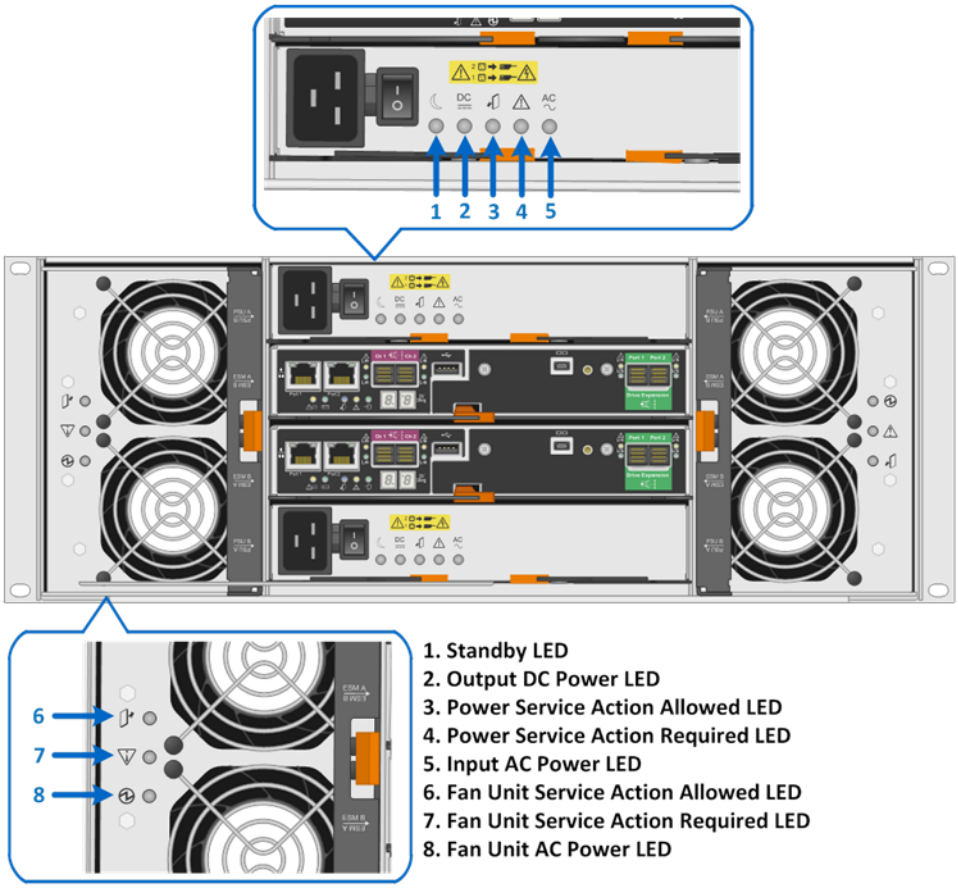


Table 14 defines the LEDs for the integrated power supply and fan unit on the rear of the E2760 controller-drive shelf.

Table 14) 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 17 and are defined in Table 15.

Figure 17) LEDs on E2724 and E2712 power supply unit (rear view).

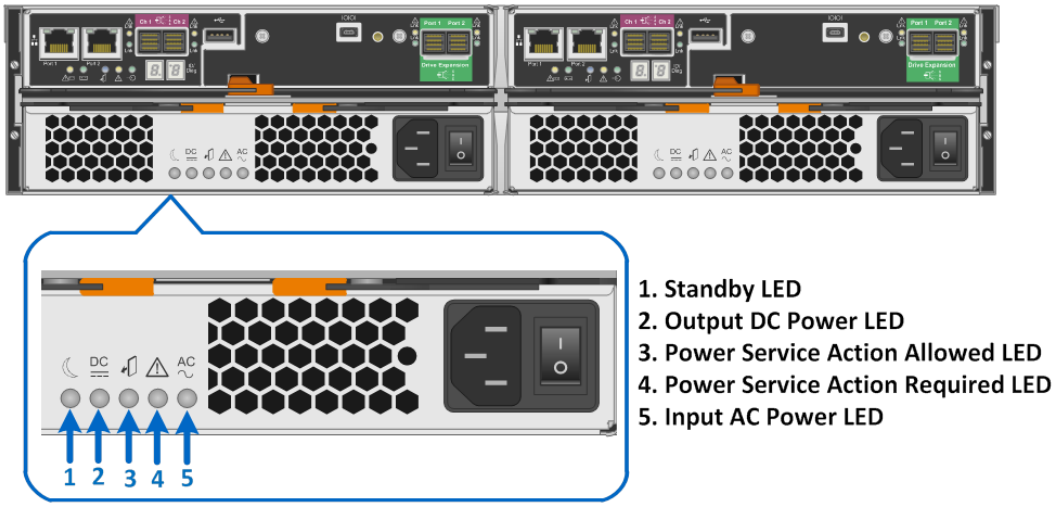


Table 15) E2724 and E2712 controller-drive shelf power supply LED definitions.

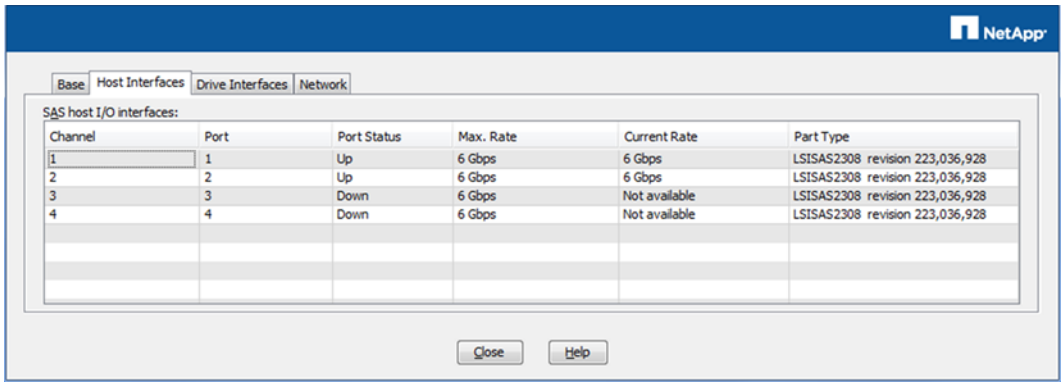
LED Name	Color	LED On	LED Off
Standby	Green	The controller-drive shelf is in standby mode.	The controller-drive shelf is not in standby mode.
Output DC power	Green	DC output power is present.	DC output power is not present.
Power service action allowed	Blue	The controller-drive shelf is in service mode.	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 canister refer to the overall controller status and to the onboard SAS host ports. The LEDs on the right side of the module refer to the drive expansion ports and to the HIC ports that are optional with the E2700 controller.

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 18, details the status of each host I/O interface that is connected to the storage system.

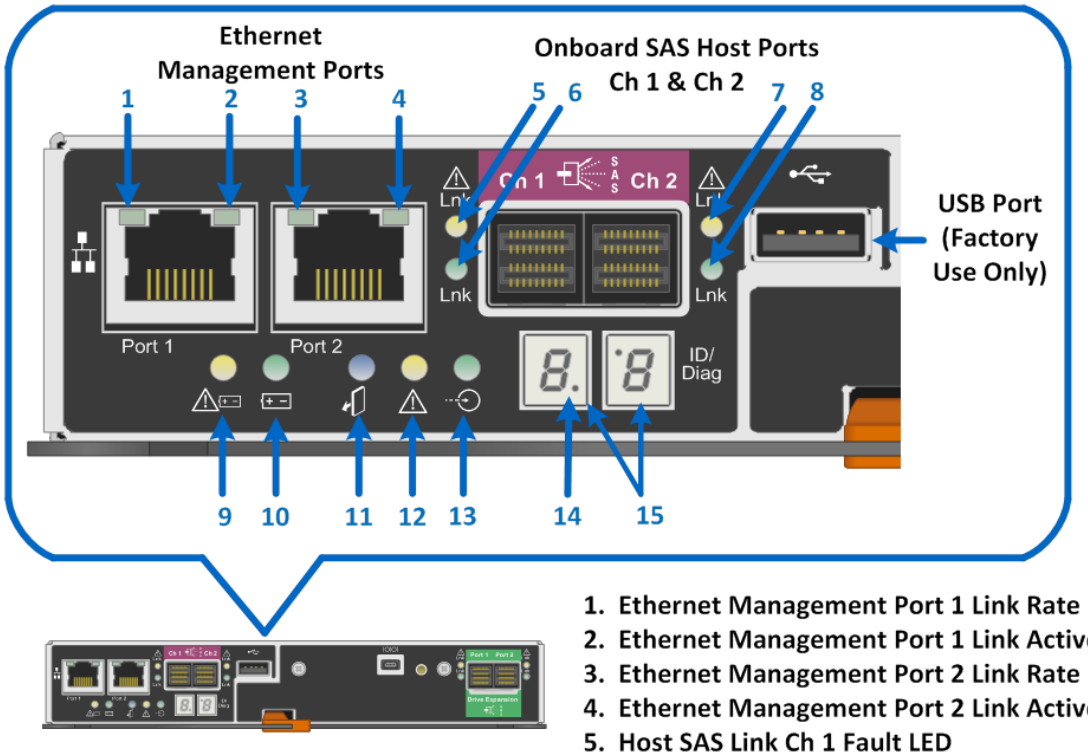
Figure 18) Controller Properties dialog box.



Controller Base Port Status LEDs

Figure 19 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 19) LEDs on left side of E2700 controller module.



1. Ethernet Management Port 1 Link Rate LED
2. Ethernet Management Port 1 Link Active LED
3. Ethernet Management Port 2 Link Rate LED
4. Ethernet Management Port 2 Link Active LED
5. Host SAS Link Ch 1 Fault LED
6. Host SAS Link Ch 1 Active LED
7. Host SAS Link Ch 2 Fault LED
8. Host SAS Link Ch 2 Active LED
9. Battery Service Action Required LED
10. Battery Charging LED
11. Controller Service Action Allowed LED
12. Controller Service Action Required LED
13. Cache Active LED
14. Heartbeat Indicator – Flashing Dot
15. Seven-Segment Display – Hardware Codes

Table 16 defines the Ethernet management port LEDs on the controller (LEDs 1 through 4 in Figure 19).

Table 16) 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	• Solid: The link is up without activity. • Blinking: The link is up with activity.	A link error has occurred.

Table 17 defines the onboard host interface port LEDs (LEDs 5 through 8 in Figure 19). These LEDs indicate the connection status for each link between the storage system and host-side hardware.

Table 17) SAS host port LED definitions.

LED Name	Color	LED On	LED Off
Host link active	Green	• 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 18 defines the controller status LEDs (LEDs 9 through 15 in Figure 19).

Table 18) 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	• 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	• 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)	• 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 20 shows the SAS expansion port LEDs.

Figure 20) LEDs for drive expansion ports (no HIC installed).

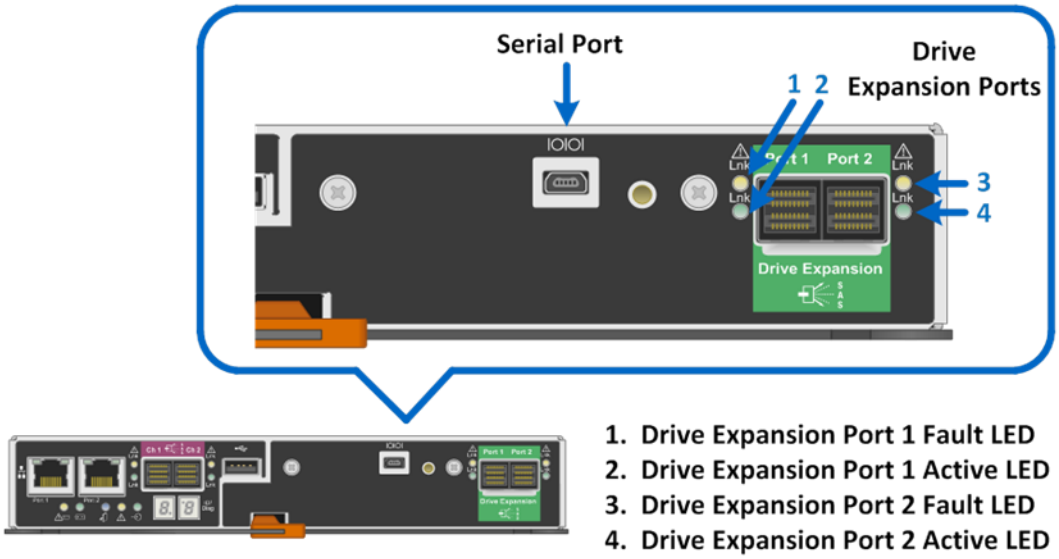


Table 19 defines each drive-side LED.

Table 19) Drive expansion port LED definitions.

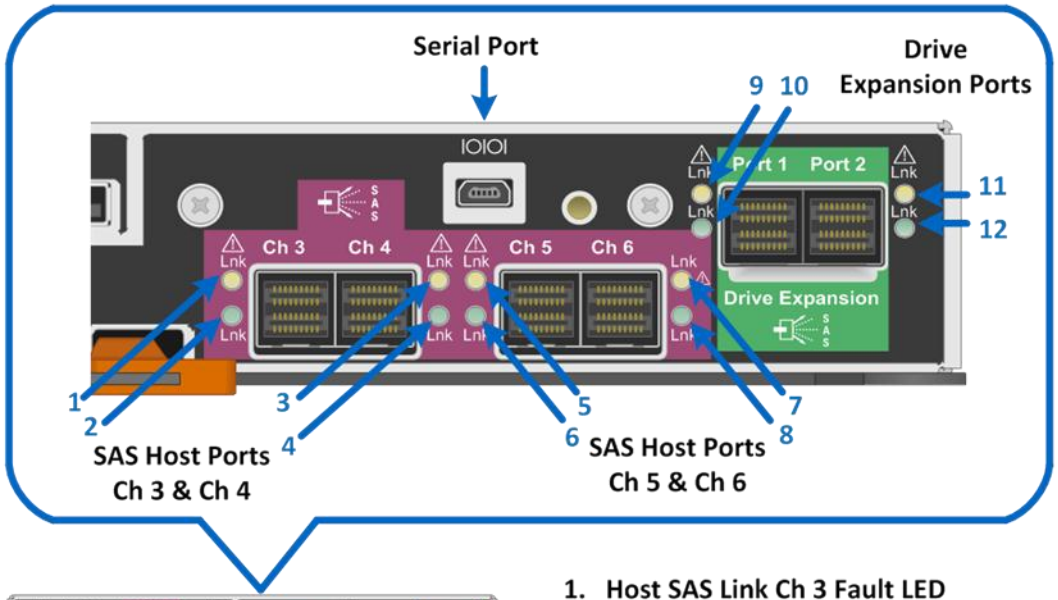
LED Name	Color	LED On	LED Off
Drive expansion link fault (port 1 and port 2)	Amber	At least one of the four PHYs in the output port is working, but another PHY cannot establish the same link to the expansion output connector.	Normal status.
Drive expansion link active (port 1 and port 2)	Green	At least 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 21 shows the LEDs for the 4-port 12Gb SAS HIC.

Figure 21) LEDs for 4-port 12Gb SAS HIC.



1. Host SAS Link Ch 3 Fault LED
2. Host SAS Link Ch 3 Active LED
3. Host SAS Link Ch 4 Fault LED
4. Host SAS Link Ch 4 Active LED
5. Host SAS Link Ch 5 Fault LED
6. Host SAS Link Ch 5 Active LED
7. Host SAS Link Ch 6 Fault LED
8. Host SAS Link Ch 6 Active LED
9. Drive Expansion Port 1 Fault LED
10. Drive Expansion Port 1 Active LED
11. Drive Expansion Port 2 Fault LED
12. Drive Expansion Port 2 Active LED

Figure 22 shows the LEDs for the 2-port 12Gb SAS HIC.

Figure 22) LEDs for 2-port 12Gb SAS HIC.

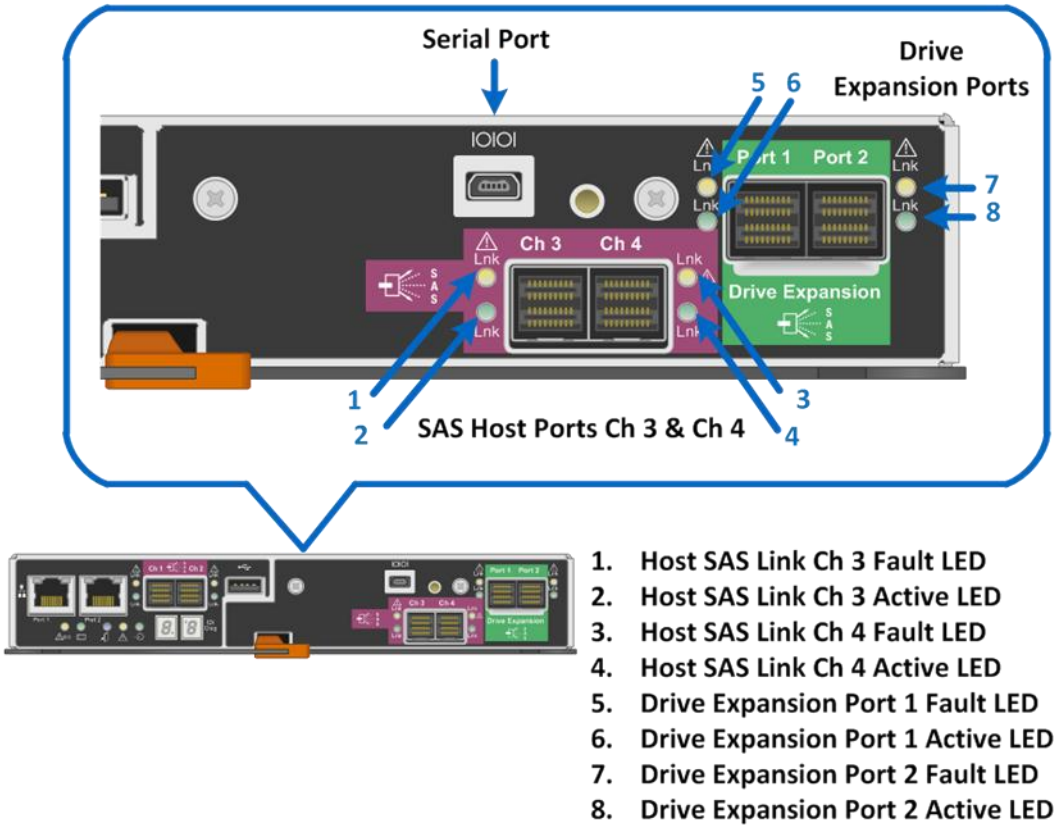


Table 20 defines the LEDs for the 4-port and 2-port 12Gb SAS HICs.

Note: The drive expansion port LEDs (LEDs 9 through 12 in Figure 21 and LEDs 5 through 8 in Figure 22) are defined in Table 19.

Table 20) 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 HICs (16Gb FC or 10Gb iSCSI) LEDs

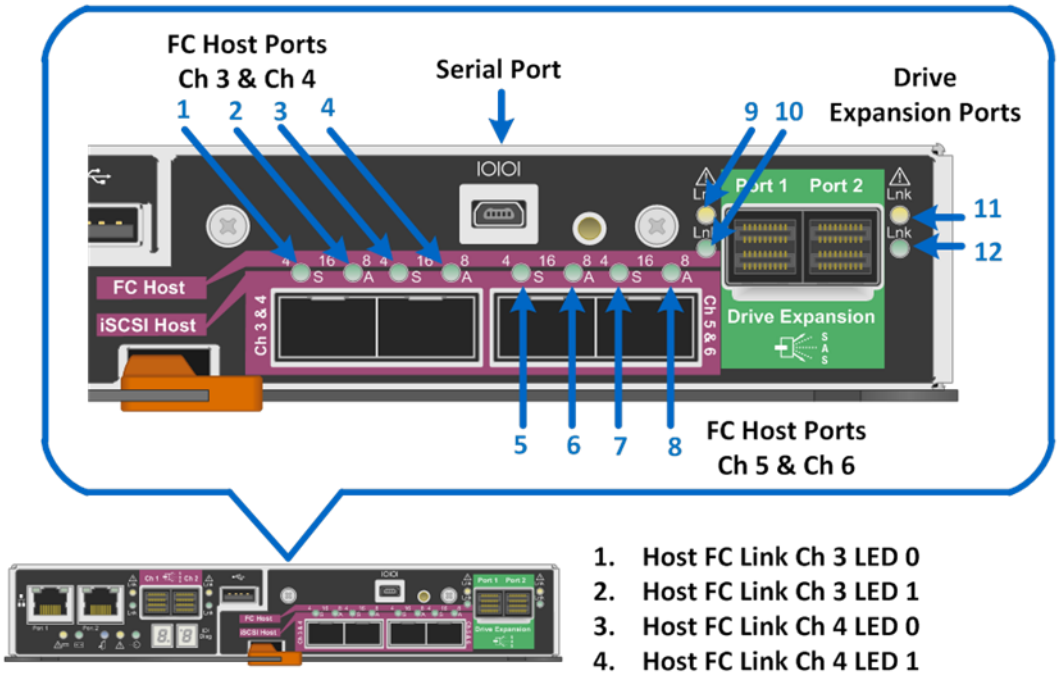
The E2700 supports a 4-port optical HIC that offers 16Gb FC protocol or 10Gb iSCSI protocol. When using this HIC and dual controllers, the E2700 storage system provides a maximum of eight 16Gb FC or eight 10Gb iSCSI ports.

Figure 23 shows the LEDs for the HIC.

The optical HIC supports several SFP options, including several 16Gb FC or 10Gb SFP+ options and a unified adapter that supports both 16Gb FC and 10Gb iSCSI. The HIC also supports 10Gb iSCSI copper by using a special cable with built-in SFP+ adapters on the HIC end and an RJ-45 connector on the switch or host end of the cable. These cables are generally available from NetApp and have a 23ft (7m) length limitation.

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

Figure 23) LEDs for 4-port optical HIC (16Gb FC or 10Gb iSCSI).



1. Host FC Link Ch 3 LED 0
2. Host FC Link Ch 3 LED 1
3. Host FC Link Ch 4 LED 0
4. Host FC Link Ch 4 LED 1
5. Host FC Link Ch 5 LED 0
6. Host FC Link Ch 5 LED 1
7. Host FC Link Ch 6 LED 0
8. Host FC Link Ch 6 LED 1
9. Drive Expansion Port 1 Fault LED
10. Drive Expansion Port 1 Active LED
11. Drive Expansion Port 2 Fault LED
12. Drive Expansion Port 2 Active LED

The E2700 controller also supports a 2-port optical HIC that offers 16Gb FC protocol or 10Gb iSCSI protocol. The 2-port HIC is functionally the same as the 4-port HIC but with two fewer ports to allow extended granularity in the configuration for scaling down FC and iSCSI host interfaces and associated cost. Figure 24 shows the LEDs for the HIC.

Figure 24) LEDs for 2-port optical HIC (16Gb FC or 10Gb iSCSI).

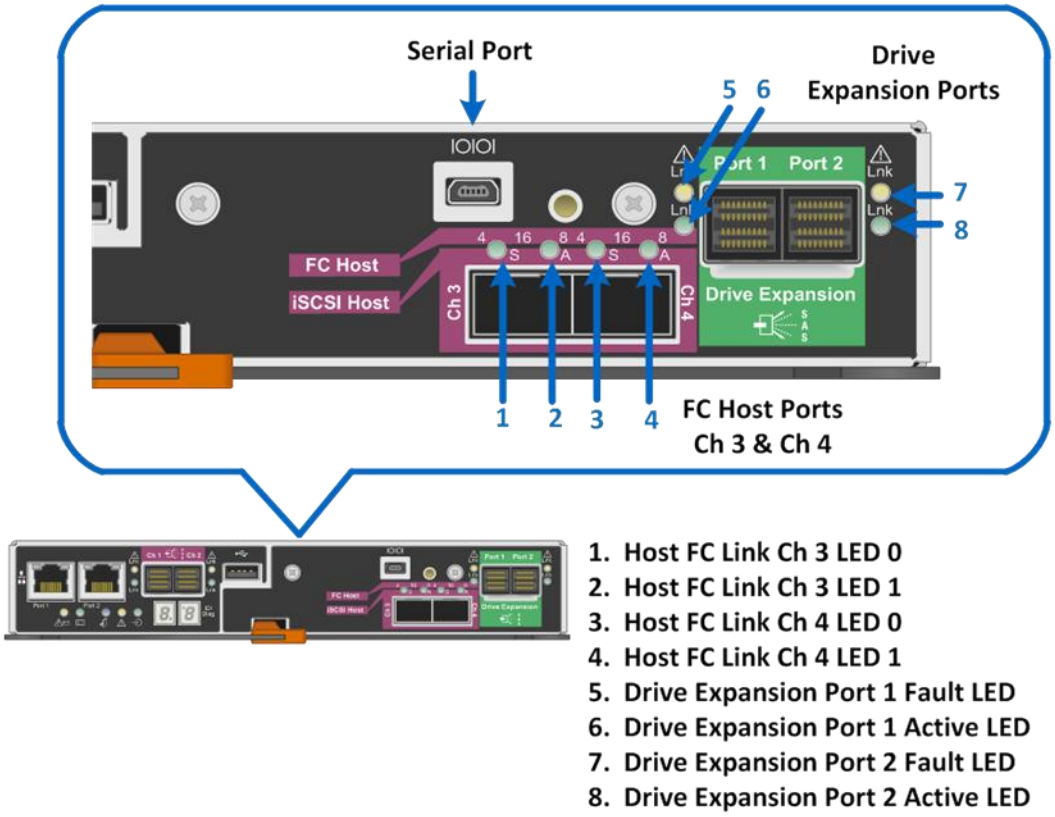


Table 21 defines the LEDs on the 4-port and 2-port optical HICs (16Gb FC or 10Gb iSCSI).

Note: The drive expansion port LEDs (LEDs 9 through 12 in Figure 23 and LEDs 5 through 8 in Figure 24) are defined in Table 19.

Table 21) 4-port and 2-port optical HIC (16Gb FC or 10Gb iSCSI) LED definitions.

LED 0	LED 1	Link Rate	Color
Off	Off	Link down	Green
Off	On	Link operating at 4Gbps	Green
On	Off	Link operating at 8Gbps or 1Gbps iSCSI link up; no activity	Green
On	On	Link operating at 16Gbps or 10Gbps 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 25, and uses standard RJ45 twinax cables to connect to switches or directly to hosts.

Figure 25) LEDs on 2-port 10Gb iSCSI HIC.

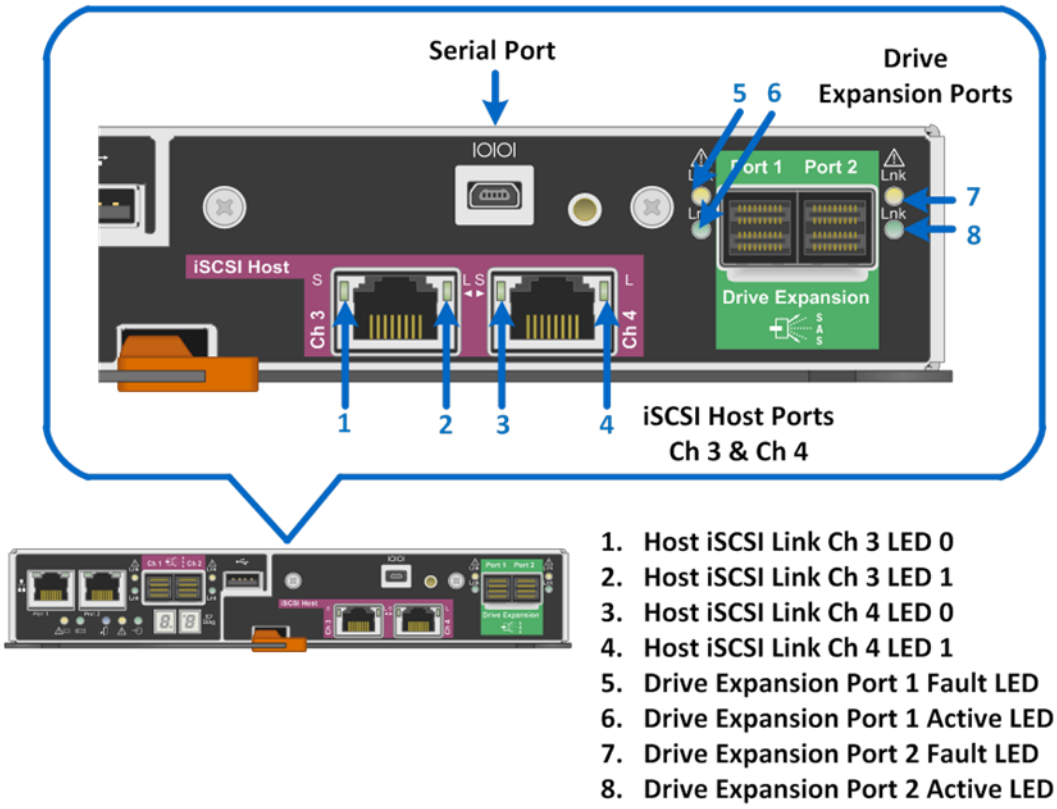


Table 22 defines the LEDs on the 2-port 10Gb iSCSI HIC.

Note: The drive expansion port LEDs (LEDs 5 through 8 in Figure 25) are defined in Table 19.

Table 22) 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 storage systems and related hardware, refer to the E2700 Series documentation at http://mysupport.netapp.com/eseries.

7 Expansion-Drive Shelves

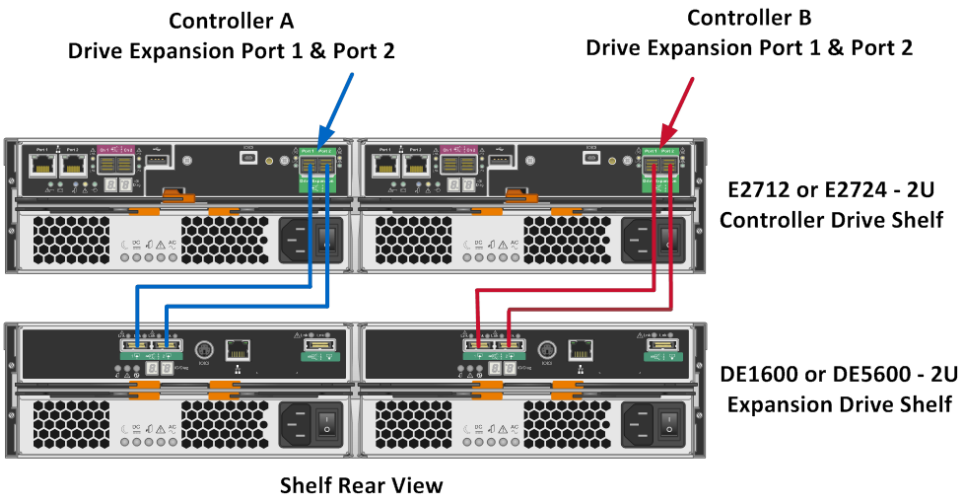
The E2700 controller-drive shelf supports 12, 24, or 60 drives based on the shelf model (DE1600, DE5600, or DE6600, respectively), but the system capacity can be further expanded by adding additional expansion-drive shelves to the controller-drive shelf, up to 16 total shelves for the DE1600 shelf option, 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.

7.1 Greenfield Installation

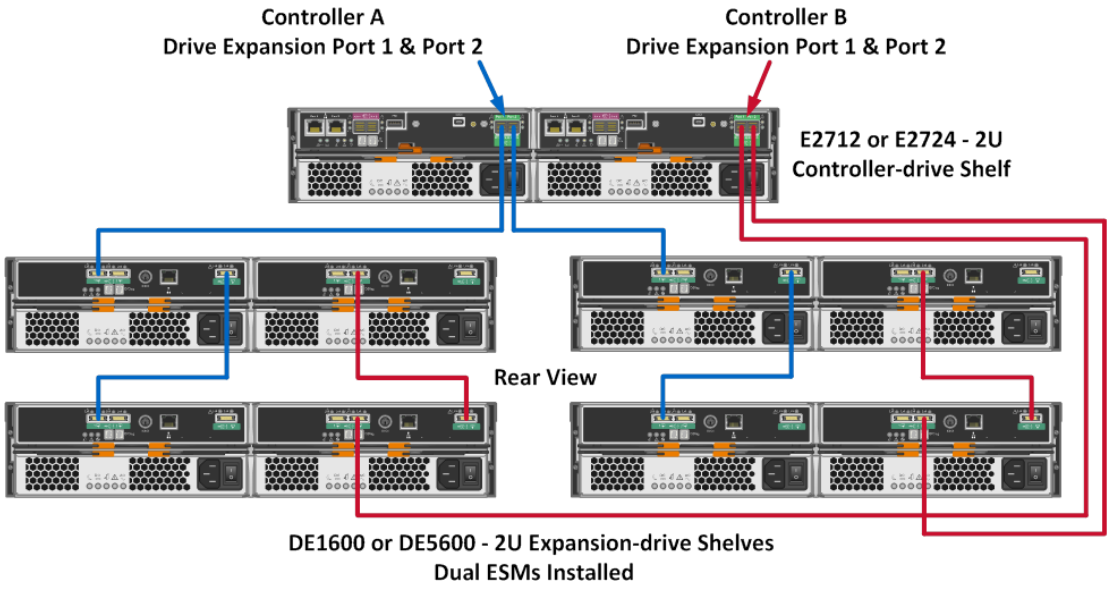
E2700 storage systems use two cabling methods: single stack and dual stack. The single-stack method is only used when the storage system has a controller-drive shelf and a single expansion-drive shelf, as shown in Figure 26.

Figure 26) 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 27.

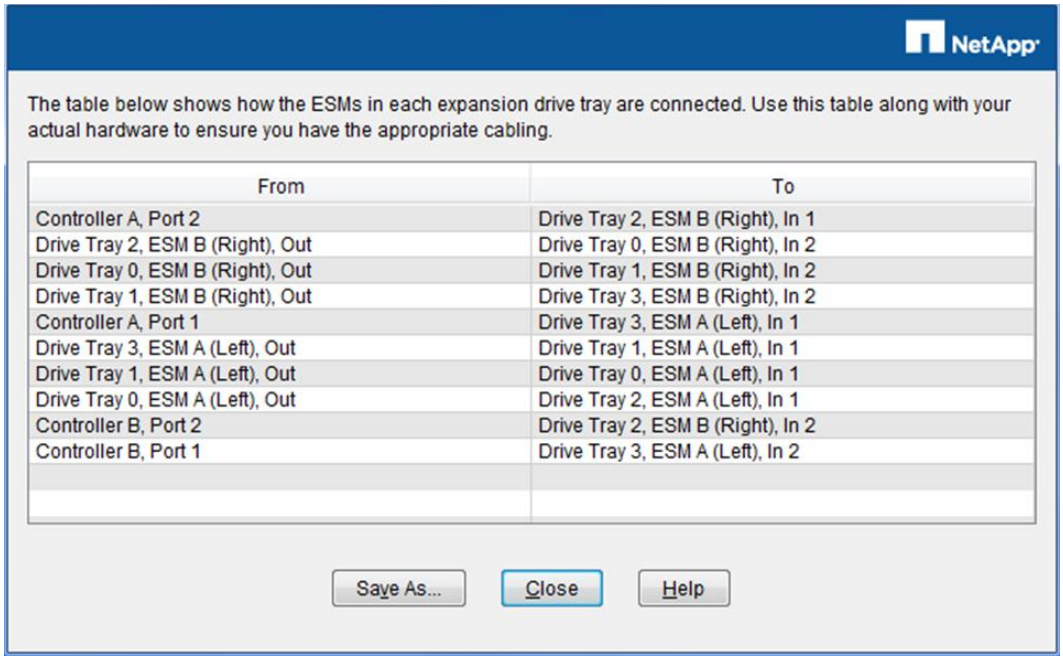
Figure 27) E2700 storage system dual-stack configuration.



For simplex controller systems, use the same cabling methods shown in Figure 26 and Figure 27 (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 make sure 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 28.

Figure 28) SANtricity Storage Manager cable connections report.



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.

Best Practice

To power off an E-Series storage system that includes expansion-drive shelves, confirm that all host I/O operations have stopped. Then, turn off both power switches on the controller-drive shelf and wait for all LEDs on the shelf to go dark. Finally, turn off both power switches on any attached expansion drive shelves and wait two minutes for the drive activity to stop.

7.2 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.

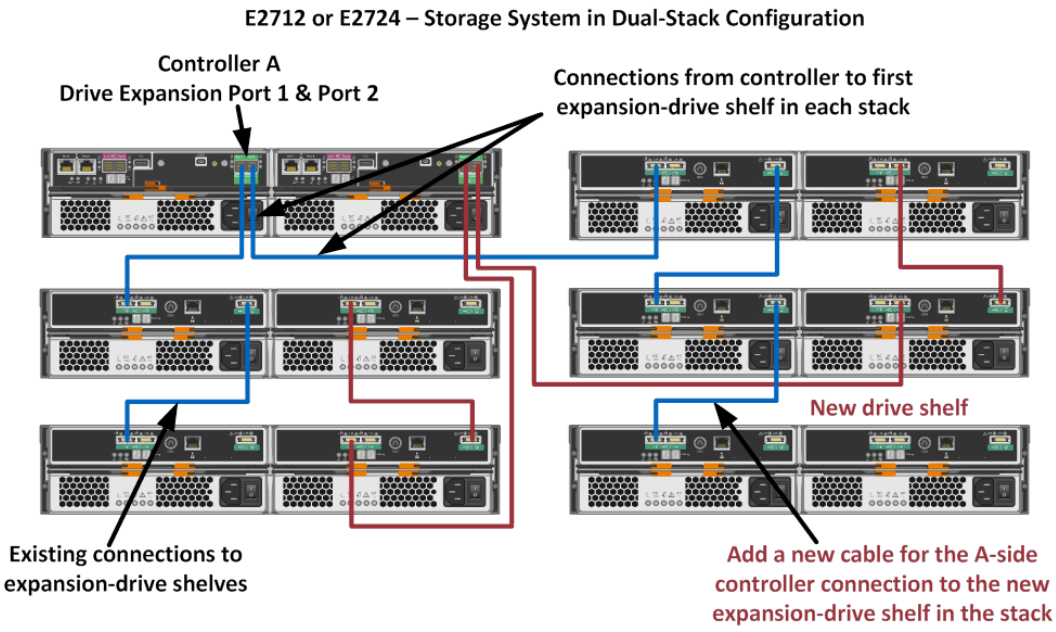
The SANtricity cable connections report can be used to verify that the cabling is configured appropriately. After additional drive shelves have been successfully added to a storage system, SANtricity can be used to add capacity to existing volume groups and disk pools or to create new volume groups and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

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 *E-Series Hardware Cabling Guide*.

Note: For more information and assistance with adding an expansion-drive shelf to an existing production E-Series system, go to http://mysupport.netapp.com/eseries and click the Cable the Hardware link, or contact NetApp Customer Support Delivery.

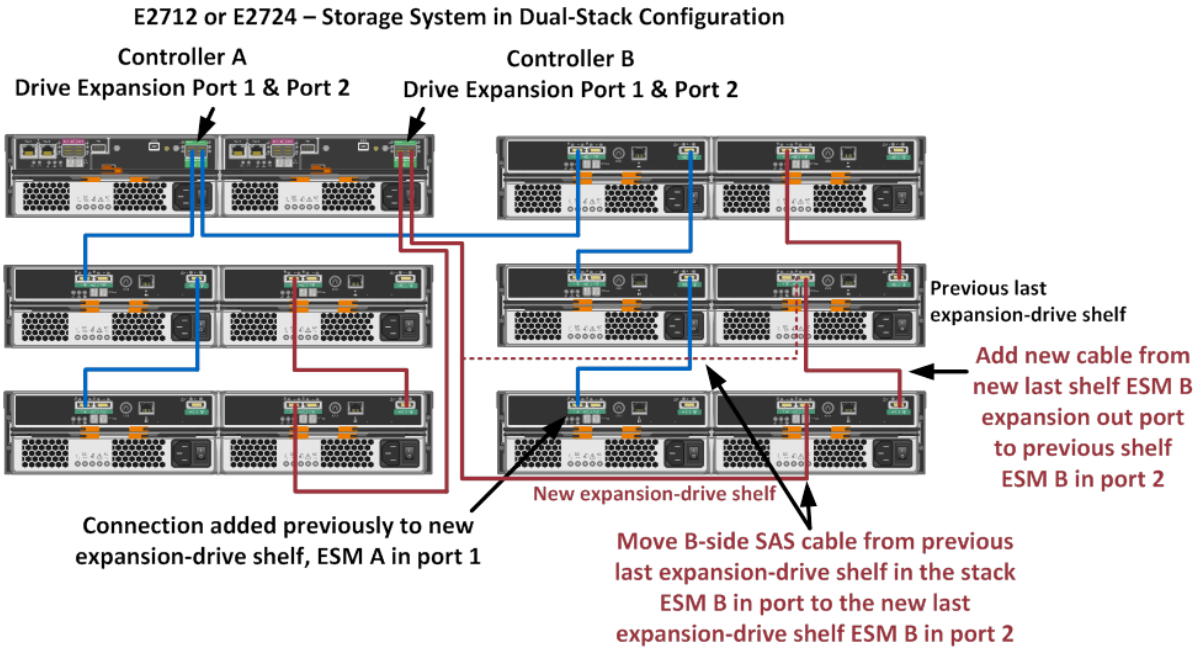
Figure 29 and Figure 30 show the hot-add connectivity when an expansion-drive shelf is added as the last shelf in the system.

Figure 29) 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 30) Drive shelf hot-add B-side cabling.



Note: The dotted red line in Figure 30 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.

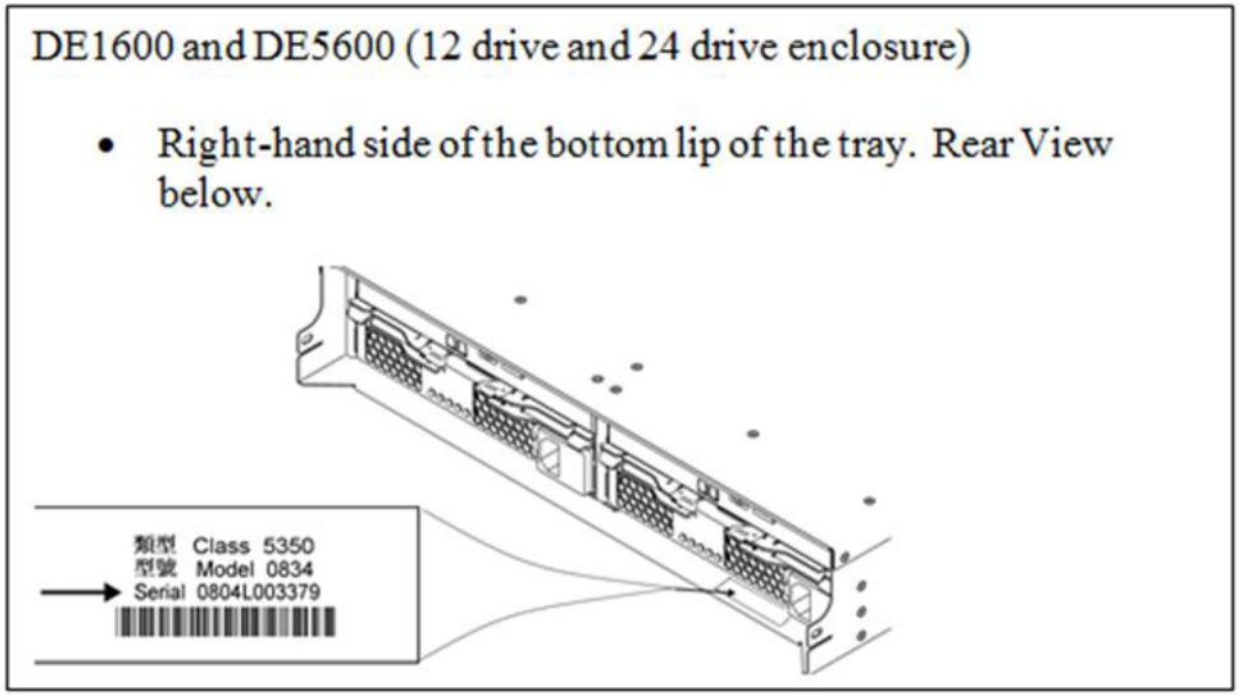
8 E-Series Product Support

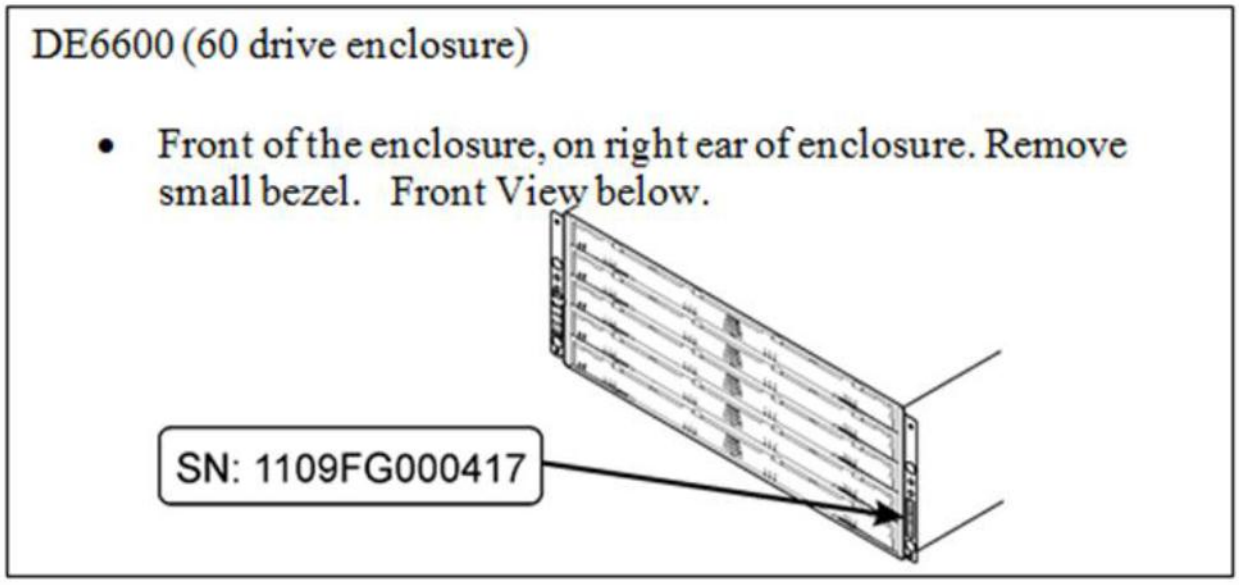
NetApp E-Series storage systems are identified by the serial number (SN) of the E-Series system shelf, not the SNs of the individual controllers within the E-Series system shelf. The correct SN must be registered for an E-Series system because only the SN of the E-Series system shelf can be used to log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

8.1 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 31 for different system types.

Figure 31) Controller-drive shelf SN.

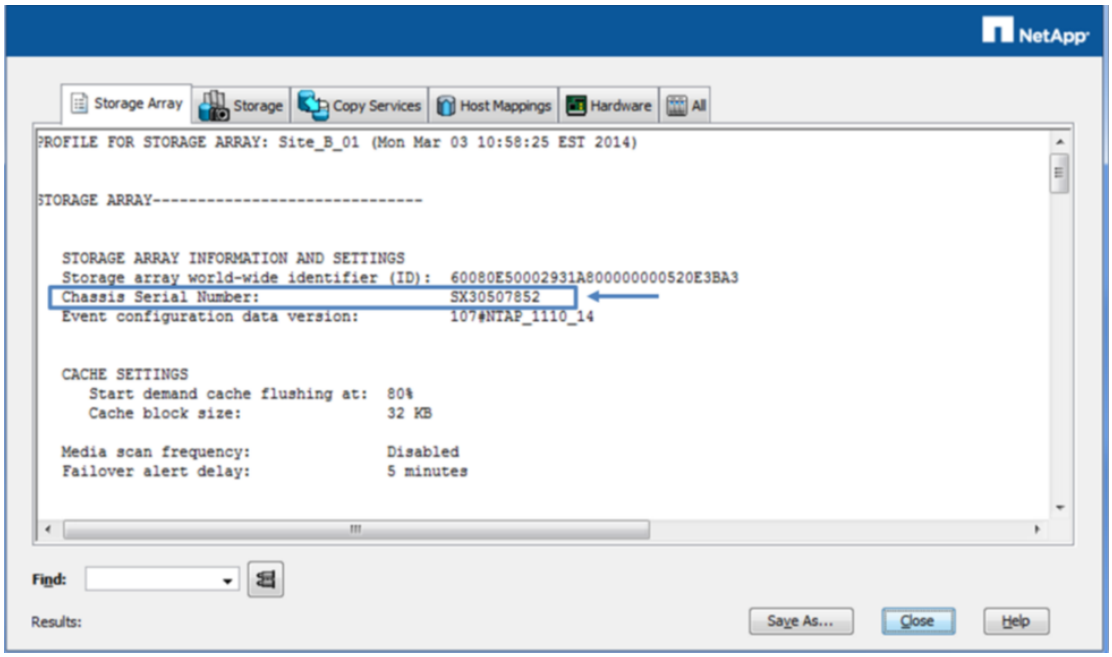




The shelf SN is also included on the shelf UL sticker; however, this sticker is often not visible after the shelves are installed in a rack.

On a running storage system, the SN is also available through SANtricity Storage Manager by viewing the storage array profile shown in Figure 32.

Figure 32) SANtricity Storage Manager AMW storage array profile.



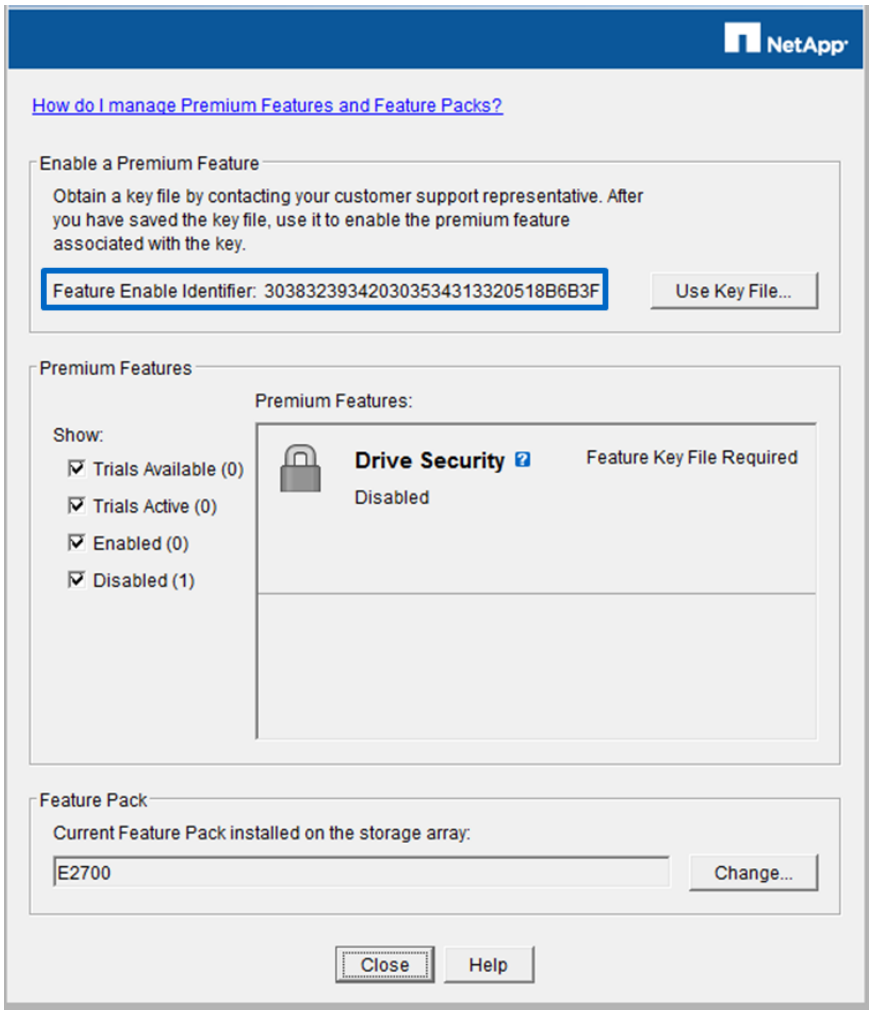
8.2 License Keys

E-Series storage arrays use two types of license keys. One type of key file is for premium features, and the other type of key file is used to change the storage system feature pack (changes the host interface protocol).

Premium Feature Keys

Drive security is the only premium feature in SANtricity 11.25 for E2700 storage systems; 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 33) and the storage system serial number: the serial number of the E-Series controller-drive shelf.

Figure 33) SANtricity 11.25 Premium Features and Feature Pack Information dialog box.



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.

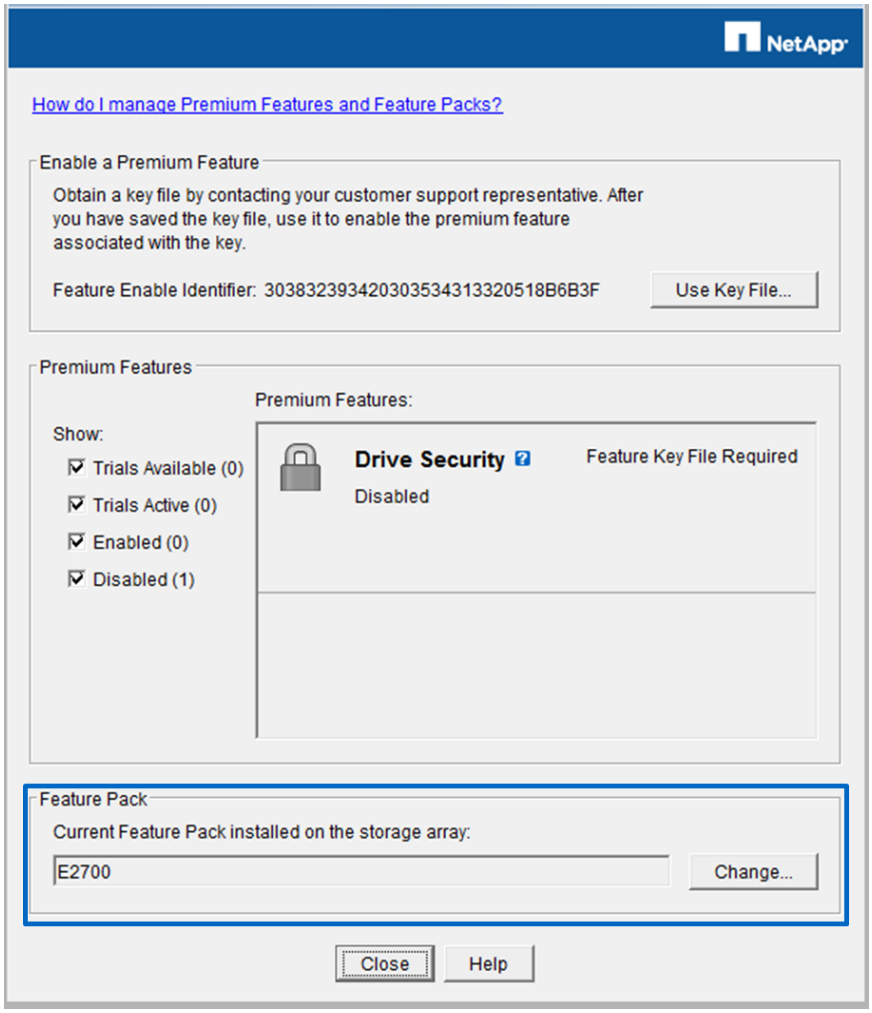
Customers must have a valid Support site account login and password to access, generate, and download the license key file.

Note: First-time users who apply for a new Support site account 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.

Feature Pack Keys

When E2700 controllers are equipped with the four-port optical HIC, feature pack keys are used to set/change the host interface protocol from FC to iSCSI or from iSCSI to FC. The process to generate a new feature pack key for your storage array is the same as the process to generate a premium feature key, except the 11-digit key activation code for each package is available at no additional cost and is listed in the hardware upgrade instructions per controller type available at https://mysupport.netapp.com/eseries. Figure 34 shows where to change the feature pack key for E-Series storage systems.

Figure 34) Premium Features dialog box: Feature pack section highlighted.



For issues with accessing license key files, open a support ticket with NetApp Customer Support Delivery using the serial number of the registered controller-drive shelf for the associated storage system.

9 Summary

The E-Series 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
- E-Series Product Documentation (both online help in SANtricity 11.25 and from the NetApp Product Documentation Library)
- E-Series SANtricity 11.25 Statement of Work (not publicly available)

Version History

Version	Date	Document Version History
Version 1.0	March 2016	Initial release concurrent with SANtricity 11.25

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.