Technical Report

Introduction to NetApp E-Series E2800 Arrays
Feature Overview with SANtricity 11.50.2

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Abstract

The NetApp® E-Series E2800 hybrid storage system is optimal for wide-ranging storage requirements such as video surveillance, enterprise backup targets, and remote office mixed workloads. This report provides detailed system information about the multiple system configuration options of NetApp SANtricity® 11.50.2. It is also a great starting point to introduce E2800 system details to sales engineers, partners, service providers, and customers.

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1 E2800 Storage Systems

NetApp E-Series E2800 storage systems address wide-ranging data storage requirements with balanced performance that is equally adept at handling large sequential I/O for video, analytical, and backup applications. It is also suited for handling small random I/O requirements for small and medium-sized enterprise mixed workloads. The E2800 brings together the following advantages:

- Support for hybrid drive configurations
- Host interface flexibility (SAS, FC, and iSCSI)
- High reliability (up to 99.9999%)
- Intuitive management. Simple administration for IT generalists, detailed drill-down for storage specialists
- The new SANtricity Unified Manager central management interface provides time-saving features not available with the legacy Storage Manager Enterprise Management Window (EMW)

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 E2800 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.

1.1 E2800 Primary Use Cases

The flexible host interface options and wide range of drive choices make E-Series E2800 storage systems an optimal storage platform for enterprises that need powerful storage systems with easy growth strategies at the lowest possible initial investment. E2800 storage systems can scale up for dedicated workloads such as:

- Business-critical backup environments for enterprises of any size
- Video applications and video surveillance environments
- Common IT applications such as Microsoft Exchange and SQL Server for small and medium enterprises
- Efficient block storage for integrated appliances

1.2 E2800 System Options

As shown in Table 1, the E2800 is available in three shelf options, which support both HDDs and solid-state drives (SSDs), to meet a wide range of performance and application requirements.

Table 1) E2800 controller shelf and drive shelf models.

Controller Shelf Model	Drive Shelf Model	Number of Drives per Shelf	Type of Drives
E2812	DE212C	12	3.5" NL-SAS drives 2.5" SAS SSDs
E2824	DE224C	24	2.5" SAS drives (HDDs and SSDs)
E2860	DE460C	60	3.5" NL-SAS drives 2.5" SAS drives (HDDs and SSDs)
Note: The E2812 supports a maximum of four shelves, which includes one controller drive shelf, and up to three expansion drive shelves. E2824 uses the same shelf count, that is, 96 total drive slots (4 x 24-drive shelves). The E2860 supports up to two expansion drive shelves for a total of			

Controller Shelf Model	Drive Shelf Model	Number of Drives per Shelf	Type of Drives
180 drive slots. All shelf models can be mixed in the same storage array, but 180 total drive slots are the maximum drive slot count supported with the E2800 array family.			

The E2812 and E2824 shelf options support one (simplex configuration) or two (dual configuration) controller canisters, while the E2860 supports only two controller canisters. All shelves support dual power supplies and dual fan units for redundancy. However, the 12- and 24-drive shelves have dual integrated power and fan canisters, whereas the 60-drive shelf (DE460C) has separate dual power supplies and fan units. The shelves are sized to hold 12 drives, 24 drives, or 60 drives, as shown in Figure 1.

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

Figure 1) E2800 shelf options (duplex configurations shown).
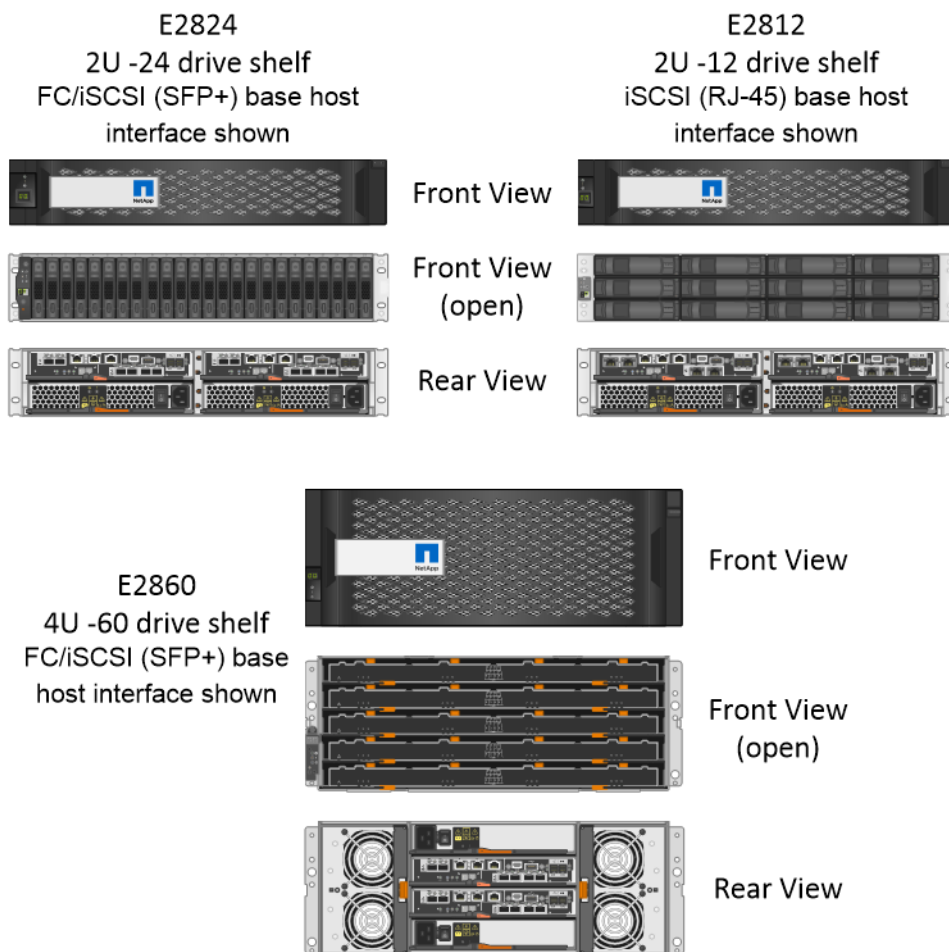
Note: The DE460C 4-rack unit (RU) 60-drive shelf requires dual ~220VAC power sources to power each shelf.

Each E2800 controller provides two Ethernet management ports for out-of-band management and has two 12Gbps (x4 lanes) wide-port SAS drive expansion ports for redundant drive expansion paths. The E2800 controllers also include two built-in host ports, either two optical 16Gb FC/10Gb iSCSI or two 10Gb

iSCSI Base-T ports. One of the host interface cards (HICs), listed in Table 2, can be installed in each controller.

Table 2) Controller options with associated HIC options.

Controller Type	2-Port / 4-Port 12Gb SAS HIC	2-Port / 4-Port 16Gb FC / 10Gb iSCSI HIC	4-Port 32Gb FC	4-Port 25Gb iSCSI	2-Port 10Gb iSCSI (Base-T)
E2800 w/ Optical Baseboard Ports	Yes	Yes	Yes	Yes	Yes
E2800 w/ Base-T Baseboard Ports	Yes	No	No	No	Yes

Note: A software feature pack can be applied in the field to change the host port protocol of the optical baseboard ports and the optical HIC ports from FC to iSCSI or from iSCSI to FC. Mixed protocol configurations are supported when the baseboard host ports are set for one protocol and the expansion HIC ports are set for a different protocol.

For optical connections, appropriate SFPs must be ordered for a specific implementation. All E2800 optical connections use OM4 fiber cable. Consult the Hardware Universe for a full listing of available host interface equipment. Figure 2 provides a close-up view of the E2800 onboard host interface options.

Figure 2) E2800 controller with onboard iSCSI Base-T ports and E2800 controller with optical base ports.

Two Base E2800 Controller Models
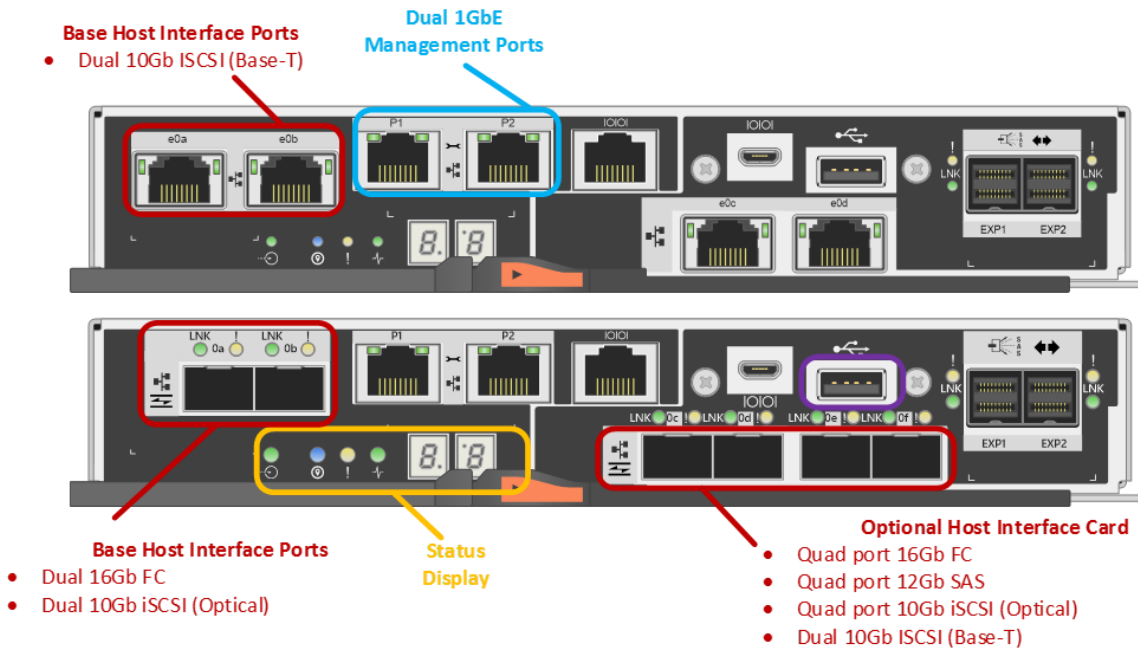
Note: For 16Gb/8Gb/4Gb FC or 10Gb iSCSI, use the unified SFP (X-48895-00-R6-C), but for 1Gb iSCSI, you must use the 1Gb iSCSI SFP (X-48896-00-C).

For detailed instructions about changing the host protocol, go to the Upgrading > Hardware Upgrade section at https://mysupport.netapp.com/eseries.

2   SANtricity Management Features

NetApp E-Series and EF-Series arrays have a rock-solid reputation for reliability, availability, simplicity, and security. The SANtricity 11.50.x release builds on that legacy by adding a new central management interface built on the existing NetApp SANtricity Web Services Proxy for new E2800/EF280 and E5700/EF570 storage systems.

The new generation E-Series and EF-Series arrays running the latest OS are now common criteria certified (NDcPP v2 certification) and are listed on the Canadian Communications Security Establishment (CSE) site.

Deployment

The decisions about which components to install if you have purchased an E2800-based storage array depend on how you answer the questions in Figure 3.

Figure 3) Decision tree to determine which SANtricity management components to install.
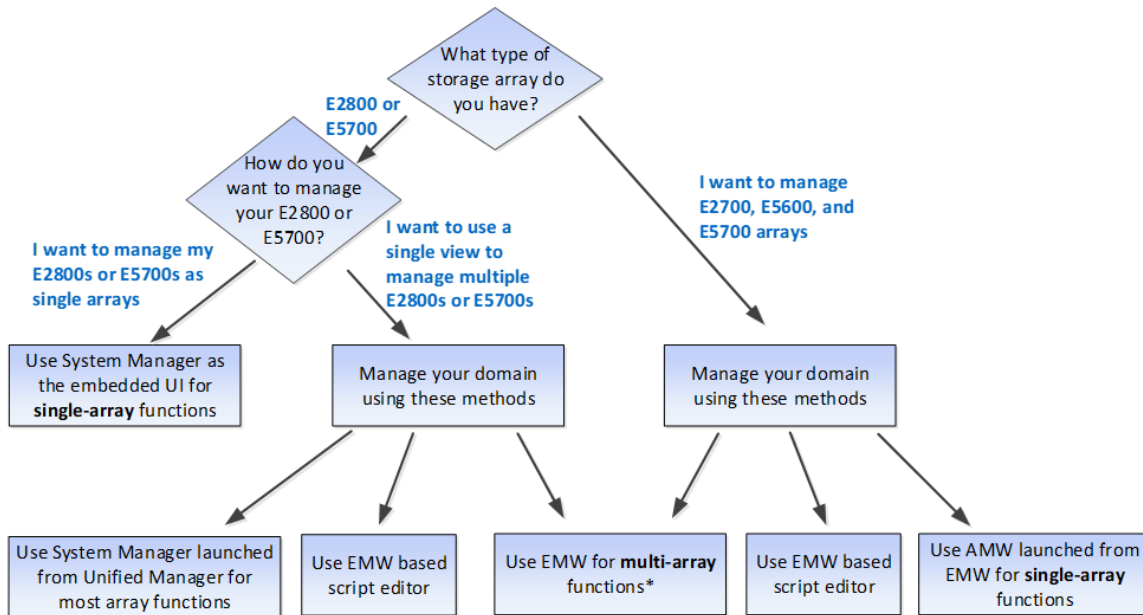
Note: If you are not using synchronous or asynchronous mirroring features, have only new-generation E2800 or other new generation E-Series or EF-Series storage arrays, and you do not want to use the SANtricity script editor or SMcli, an alternative to installing the EMW or the Unified Manager to manage multiple arrays is to simply bookmark each array in a web browser.

Single E2800 Storage Array

If you have only a single new array, are not using the synchronous or asynchronous mirroring features, and do not require the CLI, then all configuration can be handled from SANtricity System Manager. Figure 4 illustrates this configuration.

Figure 4) Managing a single E2800 with SANtricity System Manager.

E2860 preloaded with SANtricity OS, the embedded SANtricity System Manager, and on-board web services API

SANtricity System Manager in a web browser
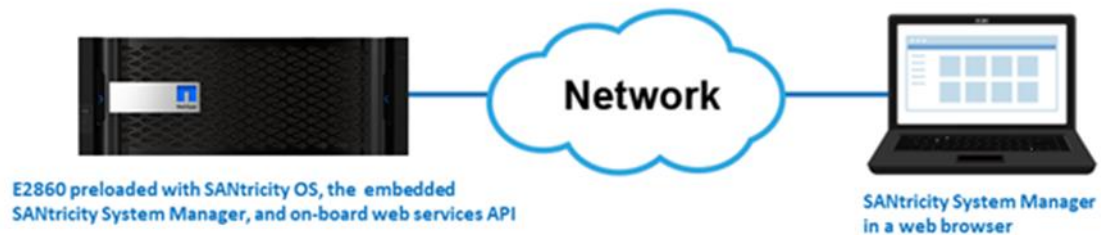
Multiple E2800 Storage Arrays

If you have one or more E2800 storage arrays, you can install the EMW or Unified Manager to manage your overall environment and handle all storage array-based configuration through SANtricity System Manager. To manage multiple arrays, you can launch SANtricity System Manager from Unified Manager or from the EMW, as shown in Figure 5.

Figure 5) Managing multiple E2800 systems with SANtricity Unified Manager or Storage Manager and SANtricity System Manager.
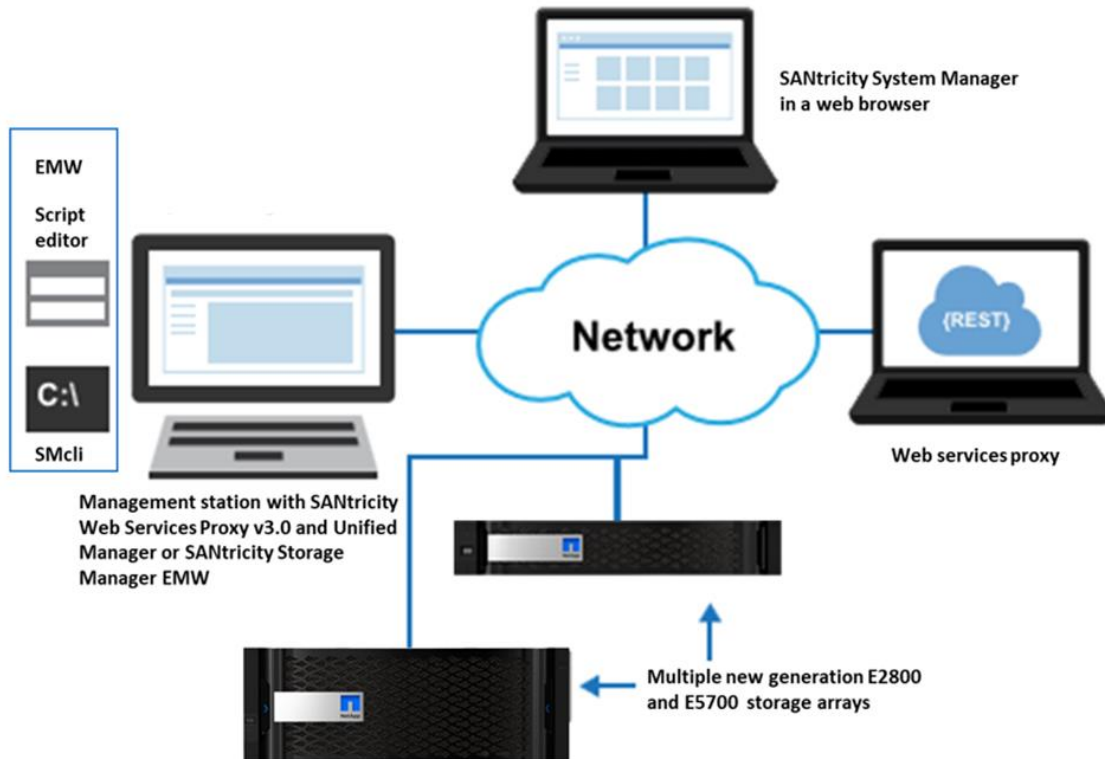
Mixed-Array Environment

For mixed-generation environments (that have older E2700 or E5600 arrays and new E5700 arrays), do the following, as shown in Figure 6.

- Use the SANtricity Storage Manager EMW to launch SANtricity System Manager for array-based tasks on the E2800 storage arrays.
- Use the AMW for array-based tasks on other E-Series storage arrays.

Figure 6) Managing a mixed-array environment with SANtricity Storage Manager and System Manager.
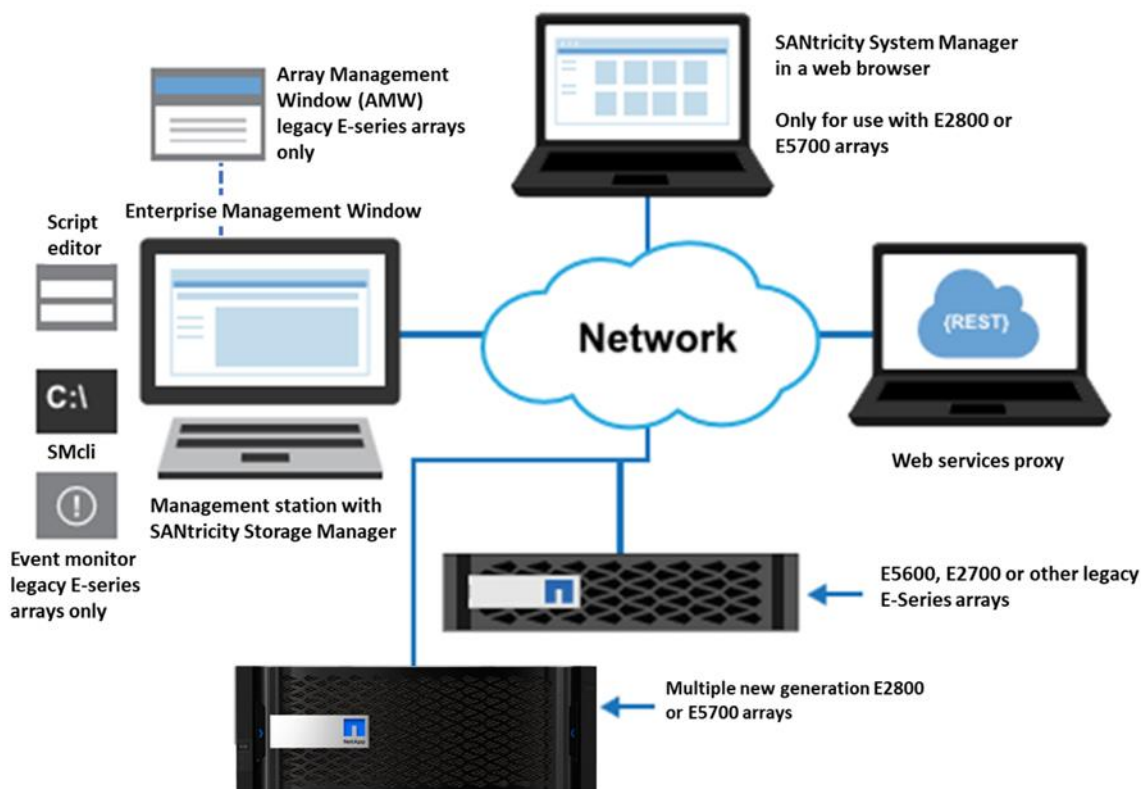
For a detailed description of installing and configuring the components you choose, see the appropriate Express Guides for deployment instructions.

2.1 SANtricity Unified Manager

SANtricity Unified Manager is a web-based central management interface that replaces the legacy SANtricity Storage Manager Enterprise Management Window (EMW) for managing the new-generation E2800/EF280 and E5700/EF570 E-Series arrays. The Unified Manager GUI is bundled with the SANtricity Web Services Proxy starting with version 3.0 and installs on a management server with IP access to the managed arrays. Unified Manager can manage up to 500 arrays.

SANtricity Unified Manager has added the following time-saving features:

- Upgrade multiple arrays with same type of controller at one time.
- Supports Lightweight Directory Access Protocol (LDAP) and role-based access control (RBAC) just like SANtricity System Manager. It includes a simplified certificate management workflow to manage the Unified Manager or Web Services Proxy server certificates (truststore and keystore certificates).
- Supports organizing arrays by groups that you can create, name, and arrange.
- Supports importing common settings from one array to another, saving time from duplicating setup steps for each array.
- Supports synchronous and asynchronous mirroring for E2800/EF280 and E5700/EF570 arrays. You need the EMW only if the initiator or target array is a legacy E2700, E5600/EF560, or earlier array model.

Note: With Unified Manager, you must use the legacy SYMbol management interface to set up or manage mirrored relationships, but once you create them, you can disable the SYMbol interface again. In an upcoming maintenance release, Unified Manager will fully support managing mirroring through the more secure SSL interface.

The E-Series SANtricity Unified Manager or E-Series SANtricity Web Services Proxy is available on the NetApp Support site's software download page. Either listing takes you to the combined Web Services Proxy with SANtricity Unified Manager download page.

After the installation wizard completes, you can open Unified Manager, or you can directly access the SANtricity Web Services Proxy as shown in Figure 7.

Figure 7) Final dialog box in the Web Services Proxy installation wizard.
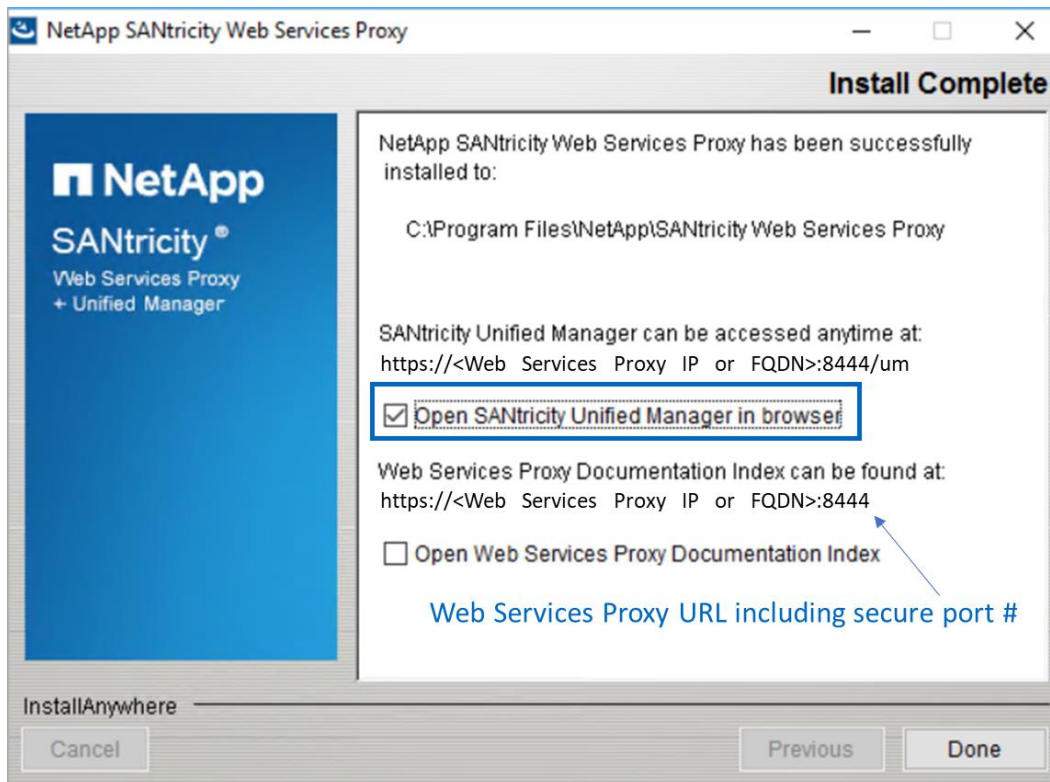
If you want to open the Unified Manager UI after the Web Services Proxy installation, simply open a browser and navigate to the server IP address and secure port number that was reserved during the Web Services Proxy software installation. For example, enter the URL in the form `https://<proxy-FQDN>:<port #>/`, and then select the link for Unified Manager. You could go directly to the Unified Manager login page (Figure 8) by adding `/um` to the URL. For example, `https://<proxy-FQDN>:<port #>/um`.

Figure 8) SANtricity Unified Manager login page.
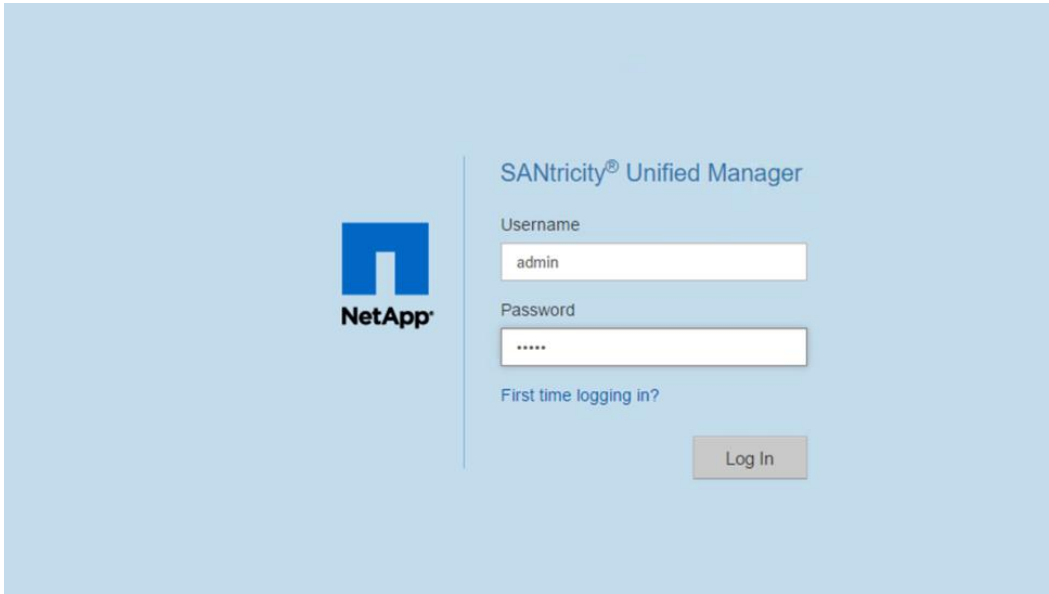
2.2 SANtricity Unified Manager Navigation

SANtricity Unified Manager has a similar appearance as SANtricity System Manager, but there is one significant difference at the initial login. SANtricity System Manager (the embedded UI for a single array) requires administrators to set the array admin password as part of the initial login. SANtricity Unified Manager has a factory default admin account and password:

- User = admin
- Password = admin

The administrator can continue the setup with the default admin settings or can change the password before completing the additional setup.

Discovering and Adding Storage Arrays

Similar to the SANtricity EMW, SANtricity Unified Manager must discover arrays to manage, and like the EMW, you can discover a single array or scan a range of IP addresses to discover multiple arrays simultaneously. Select the tab or link shown in Figure 9 to open the Add/Discover wizard. After discovering arrays, you then choose to add them to be managed by Unified Manager.

Figure 9) New SANtricity Unified Manager landing page—discover and add arrays.
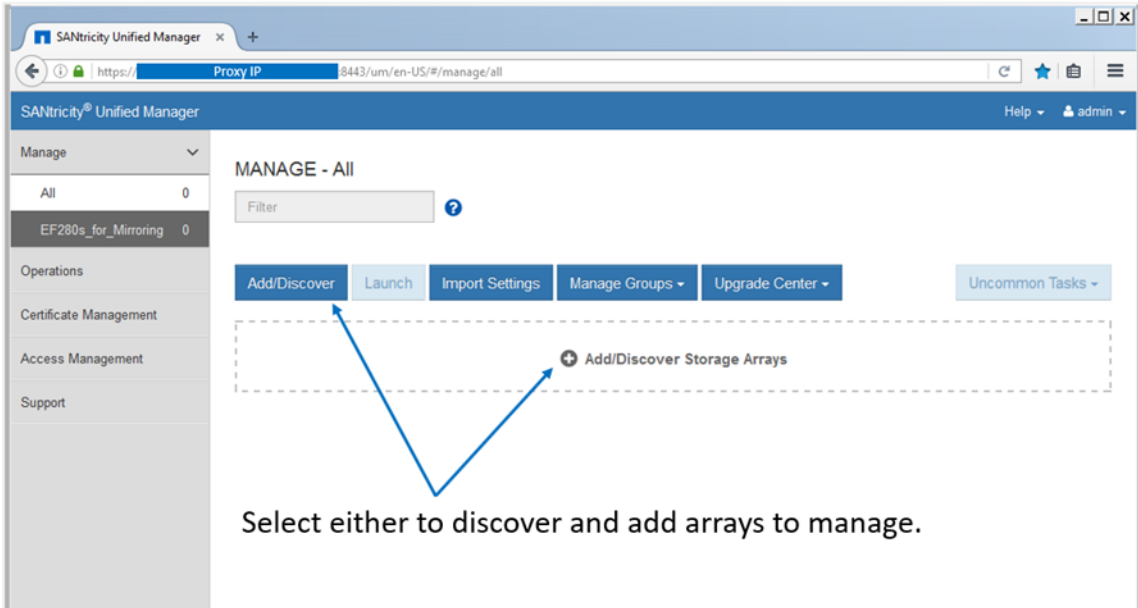
After the arrays are discovered and added, they are displayed on the landing page of Unified Manager (Figure 10).

Figure 10) SANtricity Unified Manager landing page.
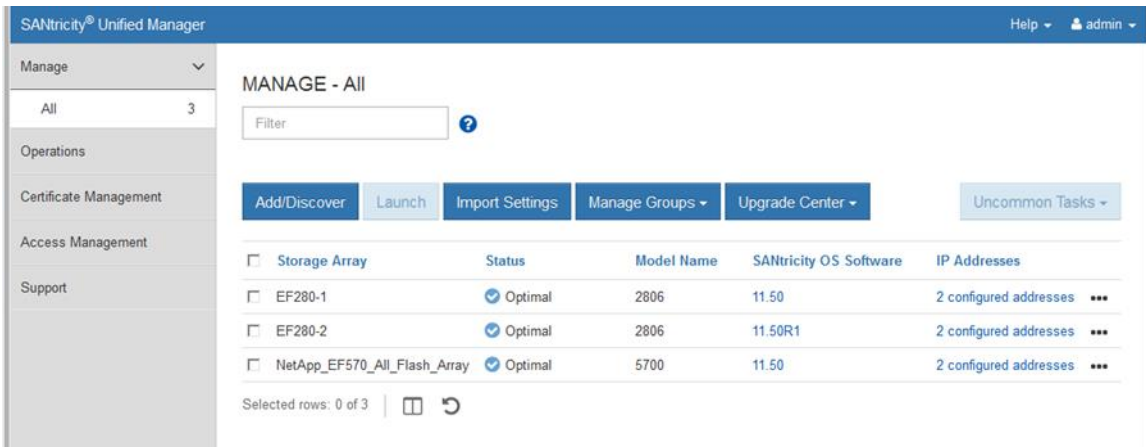
Organizing Arrays by Group

After you add arrays to Unified Manager, you can group them to organize your array management environment. Figure 10 shows EF280 arrays added to a group. This capability is available for all new generation E-Series and EF-Series arrays.

Figure 11) Creating a group to organize arrays in SANtricity Unified Manager.
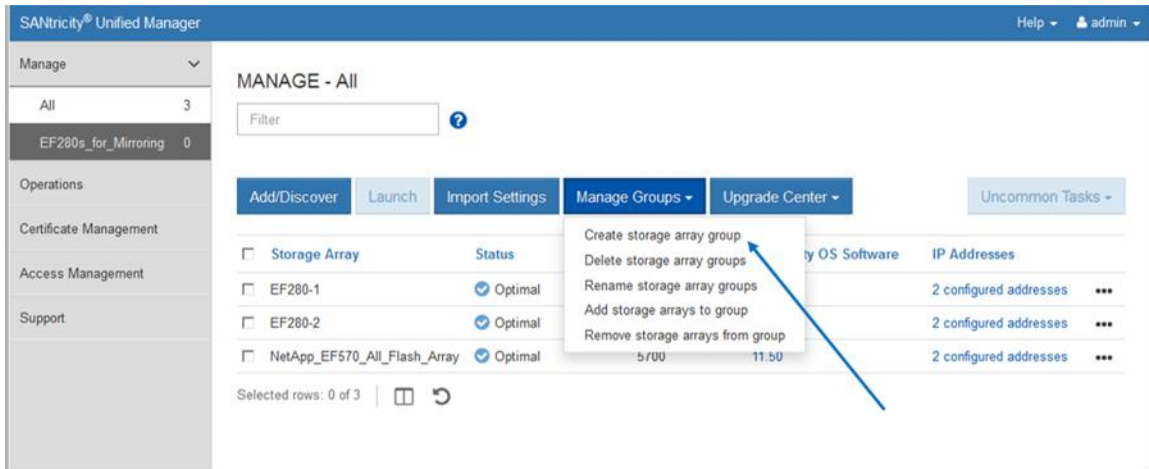
The built-in wizard makes adding arrays to groups quick and easy, as shown in Figure 12.

Figure 12) Creating a group in Unified Manager.
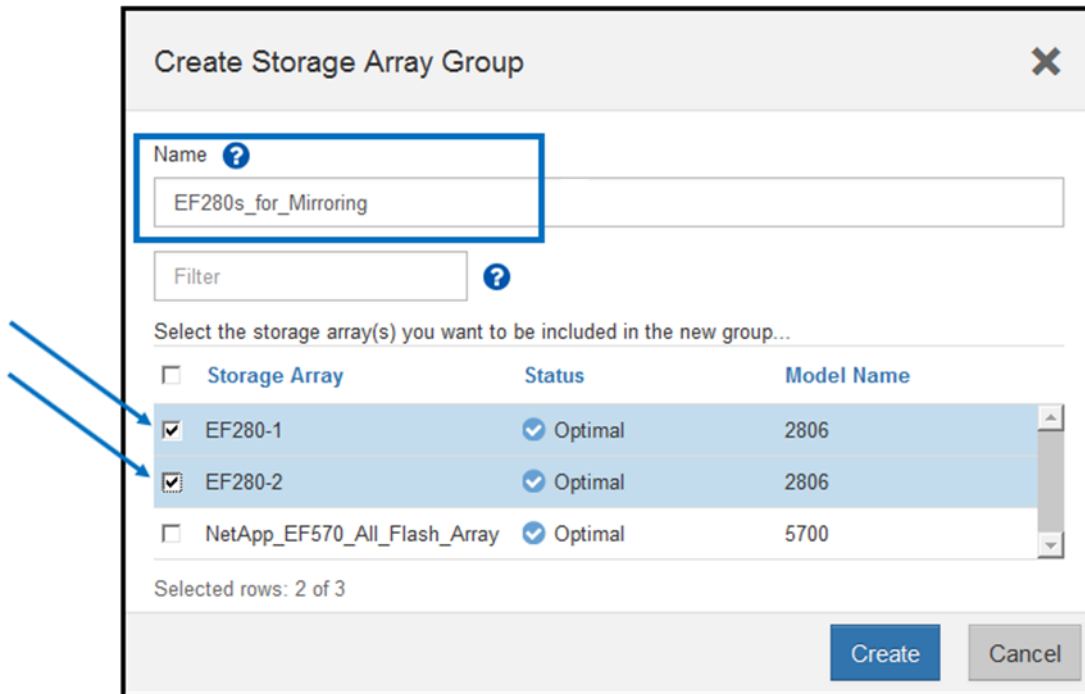
SANtricity Unified Manager allows you to see just the subset of arrays in the new group, shown in Figure 13.

Figure 13) SANtricity Unified Manager showing a newly created group.
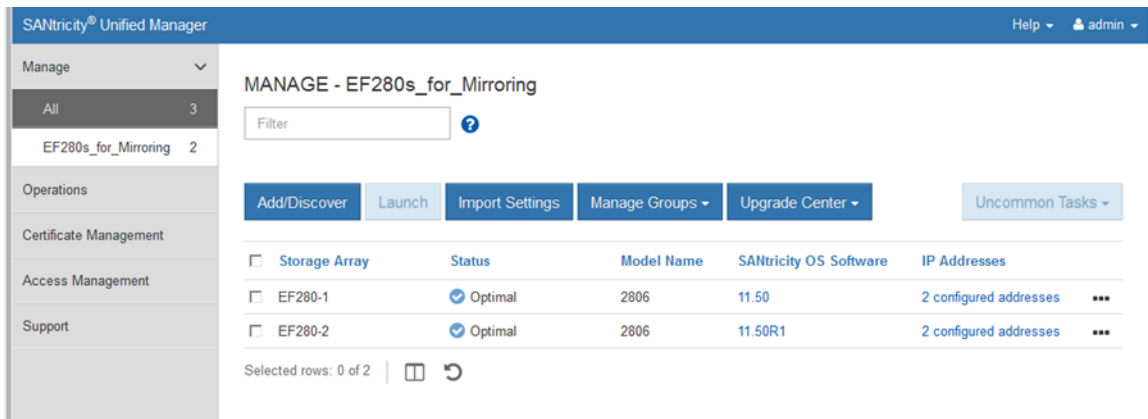
Import Settings and Viewing Operations

Other features in SANtricity Unified Manager require the ability to view operations that take some time to complete. One example is importing settings from one storage array to another. This feature is especially helpful and time saving when you install a new array in an environment that already contains E-Series or EF-Series arrays running SANtricity 11.50 or later. For example, if you want the same alerting and NetApp AutoSupport® settings on all systems, simply use the Import Settings wizard to select the setting category, the array to copy from, and the array to import to, and click Finish. The operation to copy the settings is displayed in the Operations view, as shown in Figure 14.

Note: Be careful when importing settings from another storage array, especially if you have different alerting requirements and unique storage configurations. The storage configuration option is successful only when the source and destination arrays have identical hardware configurations. The import feature does not show details about the pending import and does not prompt for confirmation. When you click Finish, you cannot stop the copy/import process.

Figure 14) SANtricity Unified Manager Operations view.
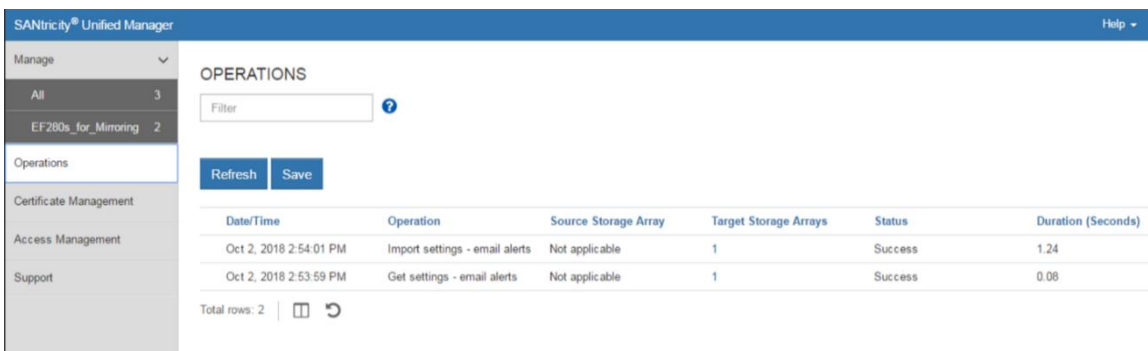
Updating SANtricity OS Through Unified Manager

To upgrade the array's firmware, import SANtricity OS software into the Unified Manager's SANtricity OS Software Repository using Manage SANtricity OS Software Repository (under Upgrade Center on the landing page). See Figure 15.

Figure 15) SANtricity Unified Manager OS Software Repository view.
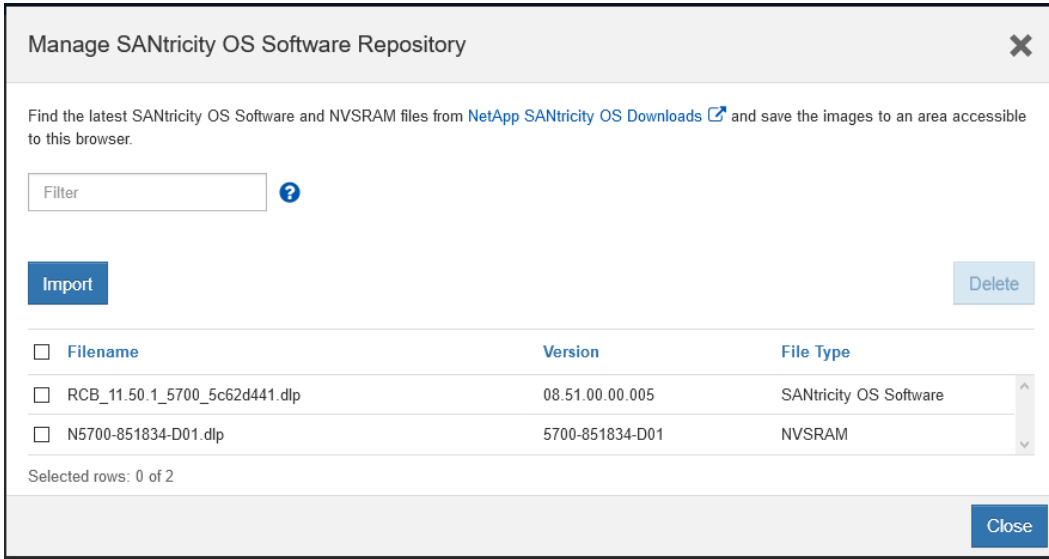
On the Unified Manager landing page, click Upgrade Center and then click Upgrade SANtricity OS Software. See Figure 16.

Figure 16) SANtricity Unified Manager upgrade OS.
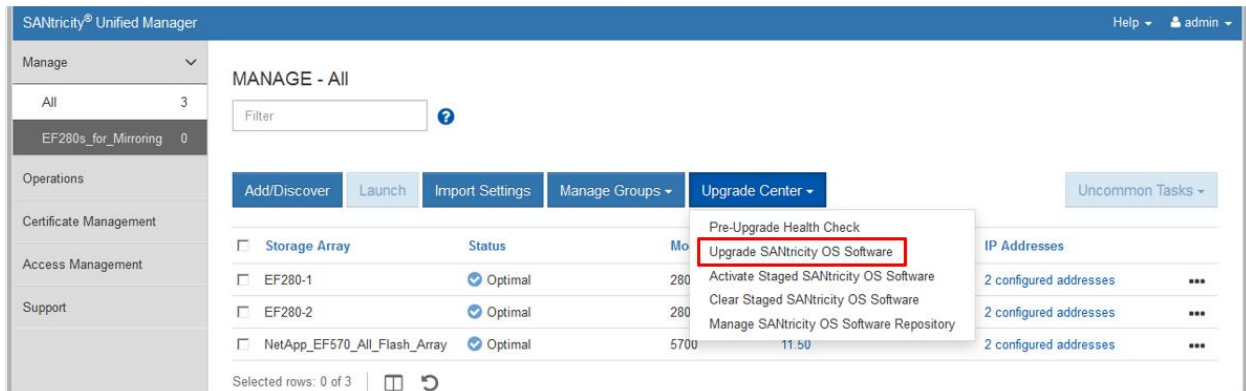
On the Upgrade SANtricity OS Software page, select the following items:

- The desired SANtricity OS and/or NVSRAM files
- The arrays to be upgraded that are appropriate to the selected SANtricity OS files
- Whether to transfer and activate the OS files immediately or at a later time

Click Start to continue. See Figure 17.

Figure 17) SANtricity Unified Manager upgrade OS options.
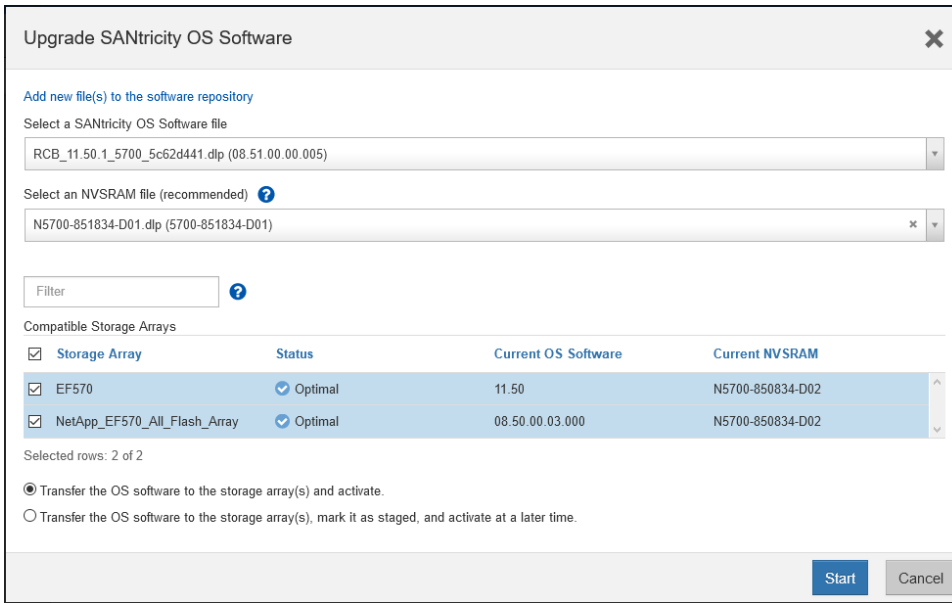
On the Confirm Transfer and Activation page, enter Upgrade and then click Upgrade to begin the SANtricity OS files transfer. See Figure 18.

Figure 18) SANtricity OS Confirm Transfer.
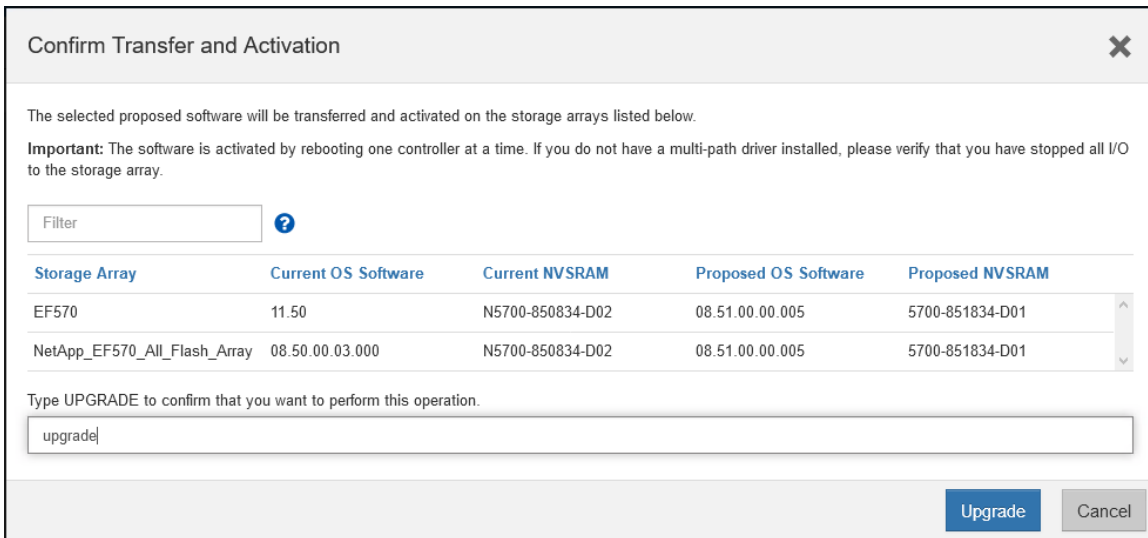
After the transfer starts, the Upgrade SANtricity OS Software window is displayed. The status of the selected arrays are updated throughout the upgrade process. The first status is Health Check in Progress, followed by File Transfer in Progress, and finally Reboot in Progress. See Figure 19.

Figure 19) Upgrade status.

Upgrade SANtricity OS Software

Storage Array	Status	Proposed OS Software	Proposed NVSRAM	
EF570	⟳ Health Check In Progress	08.51.00.00.005	5700-851834-D01	...
NetApp_EF570_All_Flash_Array	⟳ Health Check In Progress	08.51.00.00.005	5700-851834-D01	...

Total rows: 2

After the files have been transferred and the controllers have completed rebooting, the status changes to OS Software Upgrade Successful. See Figure 20.

Figure 20) OS software upgrade successful.

Upgrade SANtricity OS Software

Storage Array	Status	Proposed OS Software	Proposed NVSRAM	
EF570	✓ OS Software Upgrade Successful	08.51.00.00.005	5700-851834-D01	...
NetApp_EF570_All_Flash_Array	✓ OS Software Upgrade Successful	08.51.00.00.005	5700-851834-D01	...

Total rows: 2

Back on the Unified Manager landing page, the SANtricity OS Software version reflects the newly installed SANtricity OS version. See Figure 21.

Figure 21) New SANtricity OS version displayed.

Storage Array	Status	Model Name	SANtricity OS Software	IP Addresses	
E2860	✓ Optimal	2806	11.50R1	2 configured addresses	...
EF280-1	✓ Optimal	2806	11.50R1	2 configured addresses	...
EF570	✓ Optimal	5700	11.50.1	2 configured addresses	...
NetApp_EF570_All_Flash_Array	✓ Optimal	5700	11.50.1	2 configured addresses	...

SANtricity Unified Manager Security

SANtricity Unified Manager supports the same secure management features as SANtricity System Manager, including LDAP, RBAC, and SSL certificates. For complete details and workflow examples, see TR-4712: NetApp SANtricity Management Security.

Remote Mirroring with SANtricity Unified Manager

With Unified Manager, you can set up remote mirroring between two E2800/EF280 and/or E5700/EF570 arrays. The arrays that are used to initiate mirror relationships must run SANtricity 11.50 or later versions.

Both the initiator and target arrays must be discovered and managed by SANtricity Unified Manager, and the System Manager session for the initiator and target arrays must be launched from SANtricity Unified Manager. For this workflow, the legacy SANtricity Storage Manager and EMW are not needed. If you want to mirror between a new E-Series array and a previous generation of E-Series array, you must still use the EMW. For details about the configuration options for new E-Series and EF-Series arrays running SANtricity 11.50 or later versions, see TR-4656: SANtricity OS 11.40 Synchronous and Asynchronous Mirroring.

2.3   SANtricity System Manager

As discussed previously, the NetApp E2800 controller and SANtricity 11.50.x use the on-box browser-based management interface. However, the legacy SANtricity Storage Manager EMW can still be used with the E2800-based storage arrays. As a result, the installation flow is similar to legacy E-Series arrays. You can also elect to use the new SANtricity Unified Manager instead of the EMW if you want to manage only E2800/EF280 or E5700/EF570 storage arrays. The only UI component that is never used with the E2800 storage systems is the Array Management Window (AMW). The AMW is still used with E5\2700 and other legacy E-Series systems. The AMW has been replaced on the E2800 by the embedded, browser-based SANtricity System Manager UI.

Overview

SANtricity System Manager provides embedded management software, web services, event monitoring, and AutoSupport for E2800 arrays. Previous arrays that use the E2700, E5600, and EF560 controllers do not have this embedded functionality or the security features introduced in SANtricity System Manager 11.40 and later versions. Because you might have a mixed environment, with both the new E2800 storage array and older E-Series storage arrays, there are various management options. Table 3 provides an overview of management use cases.

Table 3) Management use cases.

Task	E2700 and E5600	E2800 and E5700
Manage and Discover		
Discover an array in your management domain	EMW	• SANtricity Unified Manager • EMW
Add an array to or remove an array from your management domain	• EMW • SANtricity storage management CLI (SMcli)	• SANtricity Unified Manager • EMW • SMcli (requires that SANtricity Storage Manager be installed)
Launch SANtricity System Manager	N/A	• SANtricity Unified Manager • EMW • Directly from browser

Task	E2700 and E5600	E2800 and E5700
Launch the AMW	EMW	N/A
AutoSupport and Legacy Support Bundle Collection		
Enable or disable AutoSupport, AutoSupport OnDemand, and AutoSupport remote diagnostics features	• EMW • SMcli	• System Manager • SANtricity Unified Manager • SANtricity Web Services (REST)
Show AutoSupport logs for all arrays or a select storage array	• EMW • SMcli	• System Manager • REST
Enable or disable legacy support bundle collection for a select storage array	• EMW • SMcli	N/A
Specify the support bundle collection schedule	• EMW • SMcli	N/A
Configuration and Status		
Display information (other than alert settings) about configured arrays	• AMW • SMcli • REST (requires SANtricity Web Services Proxy)	• System Manager • SMcli (both legacy and secure) • REST
Show the IP address of each array	• AMW • SMcli • REST (requires Web Services Proxy)	• SANtricity Unified Manager • System Manager • SMcli (both legacy and secure) •
Show the WWN of each array	• AMW • SMcli • REST (requires Web Services Proxy)	• System Manager • SMcli (both legacy and secure) • REST
Show the status of each array	• EMW/AMW • SMcli • REST (requires Web Services Proxy)	• SANtricity Unified Manager • System Manager • SMcli (both legacy and secure) • Secure CLI • EMW
Set up remote volume mirroring groups and pairs	• EMW/AMW • SMcli • EMW script editor CLI • REST (requires Web Services Proxy)	• System Manager • Unified Manager and System Manager • EMW • SMcli (both legacy and secure)

Task	E2700 and E5600	E2800 and E5700
Show array-level configuration, provisioning, and tuning	- AMW - SMcli - EMW script editor CLI - REST (requires Web Services Proxy)	- System Manager - REST
Alert and SNMP Configuration		
Show or configure global alert settings	- EMW - SMcli - REST (requires Web Services Proxy)	- N/A - REST
Configure email server or SNMP settings for an array	- EMW - SMcli - REST (requires Web Services Proxy)	- System Manager - REST
Send a test email based on global alert settings	- EMW - SMcli - REST (requires Web Services Proxy)	- N/A - REST
Certificate handling: view SSL information, get a certificate signing request (CSR), import a new certificate	N/A	- System Manager - REST
More convenient syslog configuration	N/A	- System Manager - REST
Save up to 30 days of historical statistical I/O data	N/A	- System Manager - REST
Apply application tags to volumes	N/A	- System Manager - REST

E2800 storage systems are shipped preloaded with SANtricity 11.50.x, which includes SANtricity System Manager 11.50. To discover E2800 storage systems running SANtricity 11.50.x from a central view, download SANtricity Storage Manager 11.5x or Web Services Proxy 3.0 or later from the NetApp Support site and load it on a management server that has IP access to the storage systems.

Note: The x in the SANtricity Storage Manager version number must be greater than or equal to the x in the SANtricity 11.50.x version number.

Previous versions of SANtricity Storage Manager (the EMW) cannot discover E2800 arrays running SANtricity 11.50.x. However, SANtricity Storage Manager 11.5x can discover the new E2800 arrays and all the previous E-Series array software versions from the last five years. If you use SANtricity Unified Manager instead of the SANtricity EMW, you must use SANtricity Web Services Proxy 3.0 or later.

Following are reasons to download and install at least some portions of the SANtricity Storage Manager software package:

- You have multiple older-generation and new-generation E-Series or EF-Series arrays and want the enterprise view from the EMW.
- You plan to use synchronous or asynchronous remote mirroring from older-generation arrays and new-generation arrays.
- You need to use SMcli, in either legacy or secure mode.
- You need the Host Utilities package (SMutils) for legacy arrays. The host package is loaded on I/O generating hosts.
- You need to install the Microsoft Windows device-specific module (DSM) on a Windows host for multipath failover (delivered as part of the Windows host package).

Following are reasons to download and install the latest version of the SANtricity Web Services Proxy and Unified Manager:

- You have multiple new-generation E-Series or EF-Series arrays and want the enterprise view from SANtricity Unified Manager.
- You plan to use synchronous or asynchronous remote mirroring with only new-generation arrays.
- You want to use the new management features to set up and organize arrays in a more user-friendly UI.
- You want a more secure enterprise view that supports the same user and session security as SANtricity System Manager.

If you do not want to use the SANtricity EMW or SANtricity Unified Manager to discover and manage your E-Series arrays, you do not need to download and install the legacy SANtricity Storage Manager or Web Services Proxy software. To use any of the listed functionalities, download and install Storage Manager or the Web Services Proxy as described. You should install the various SANtricity host packages according to your operating system, if recommended by the NetApp Interoperability Matrix Tool (IMT). See the appropriate OS Express Guide for host setup requirements, instructions, and references. The guides are available from the NetApp Support site at https://mysupport.netapp.com/eseries.

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 before the initial product installation date.

System Manager Navigation

After you log in to SANtricity System Manager, the home page is displayed, as shown in Figure 22.

- The icons on the left of the home page are used to navigate through the System Manager pages and are available on all pages. The text can be toggled on and off.

- The items on the top right of the page (Preferences, Help, Log Out) are also available from any location in System Manager.

- Highlighted on the bottom-right corner is the drop-down menu used extensively in System Manager.

Figure 22) SANtricity System Manager home page.
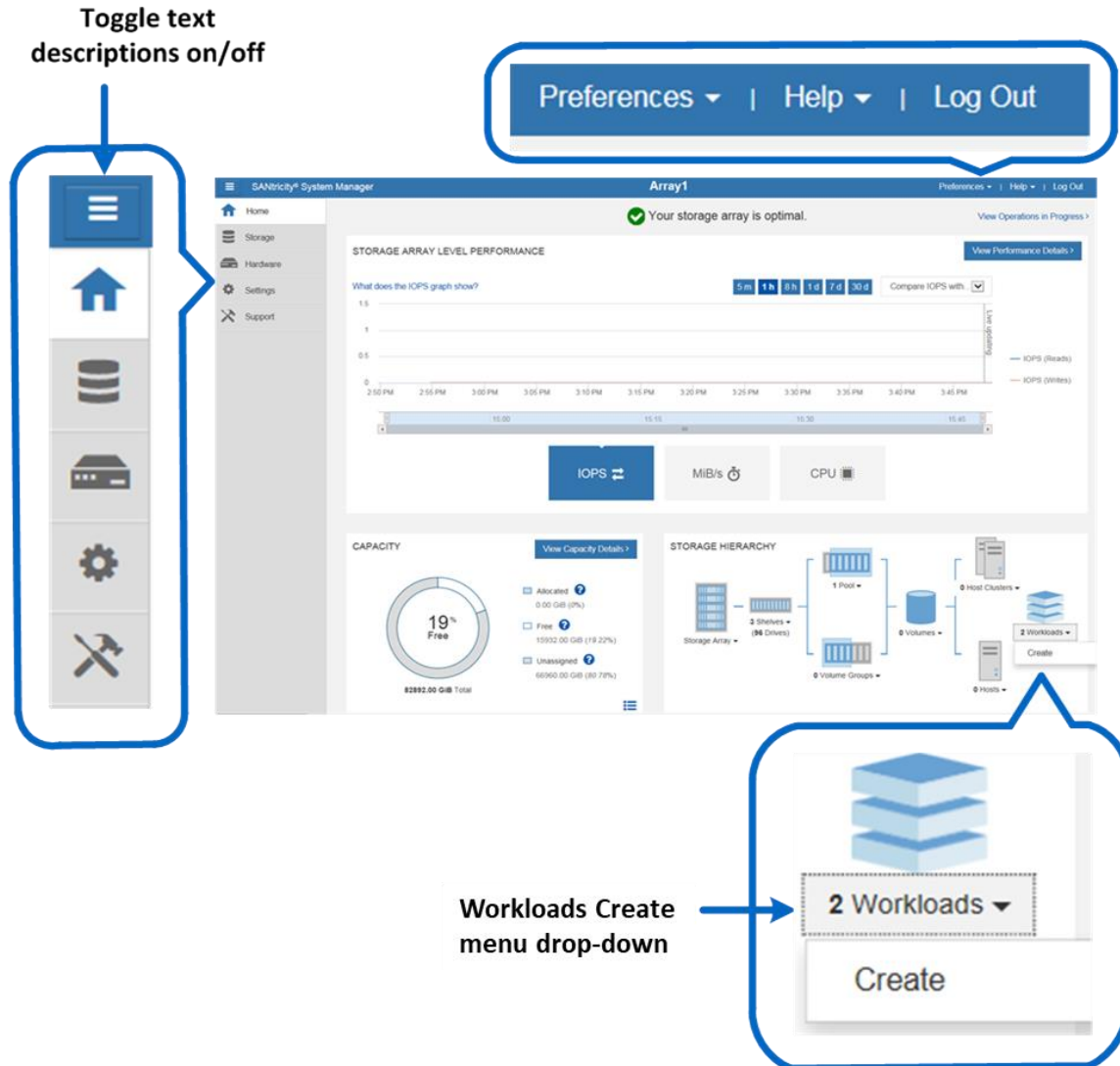
Figure 23, Figure 24, Figure 25, and Figure 26 show the other four main pages that are used in SANtricity System Manager and that are accessible from anywhere in the application.

Figure 23) System Manager Storage page.
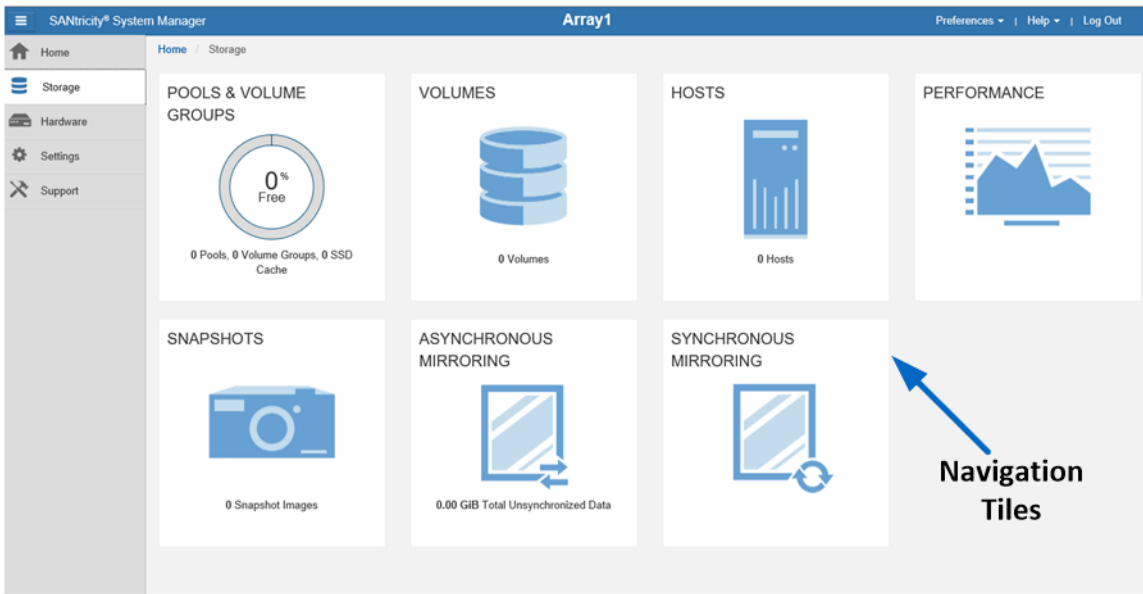
Figure 24) System Manager Hardware page.
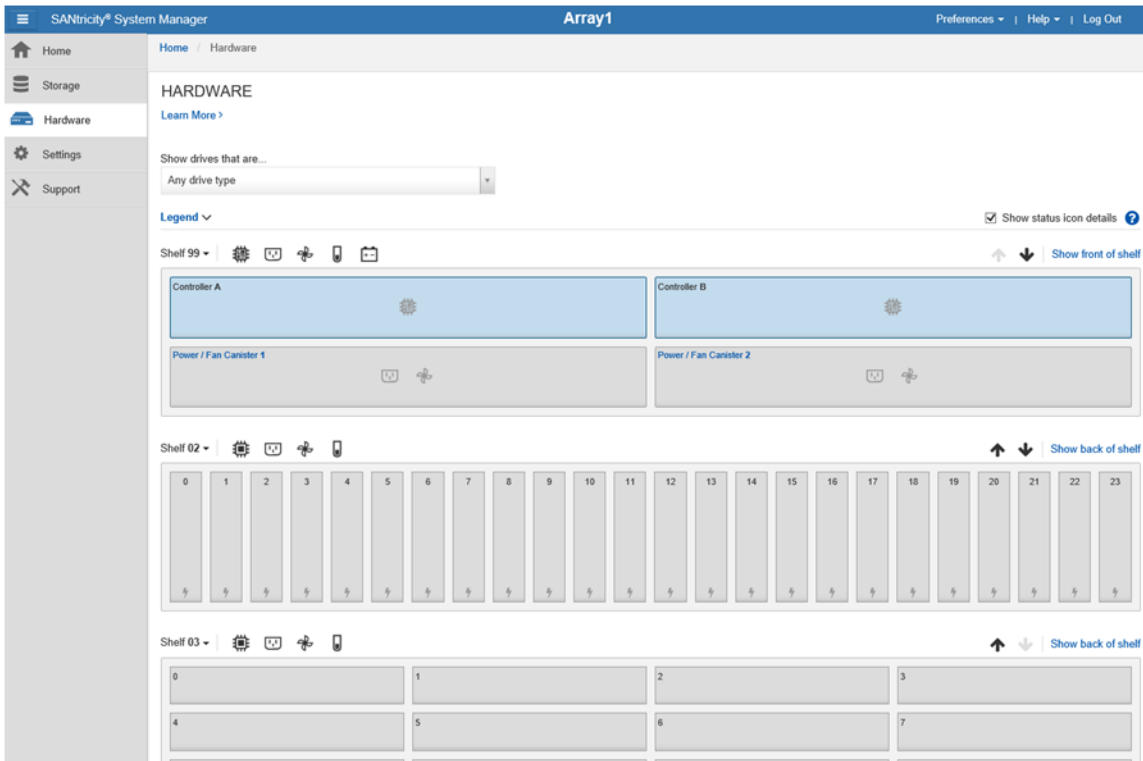
Figure 25) System Manager Settings page with new security tiles.
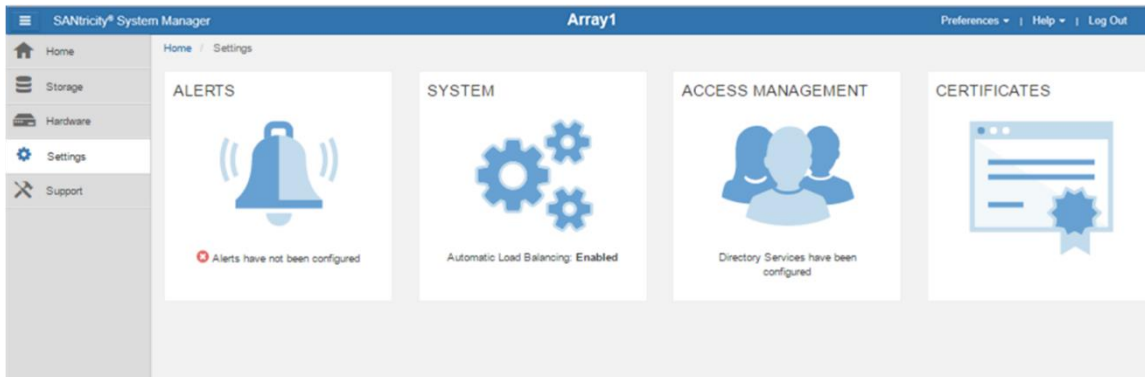
Note: Figure 25 shows the view for an administrator or security administrator. Others with a lower access permission level will see only the Alerts and System tiles.

Figure 26) System Manager Support page.
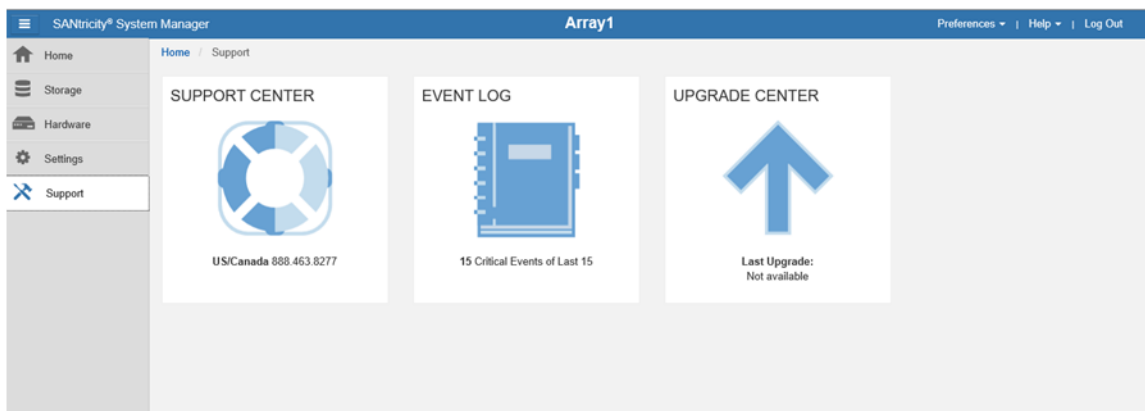
Figure 27 displays the Support Center, which you can reach by selecting the Support Center tile on the Support page. From the Support Center, use navigation tabs to reach support topics.

Figure 27) System Manager Support Center.
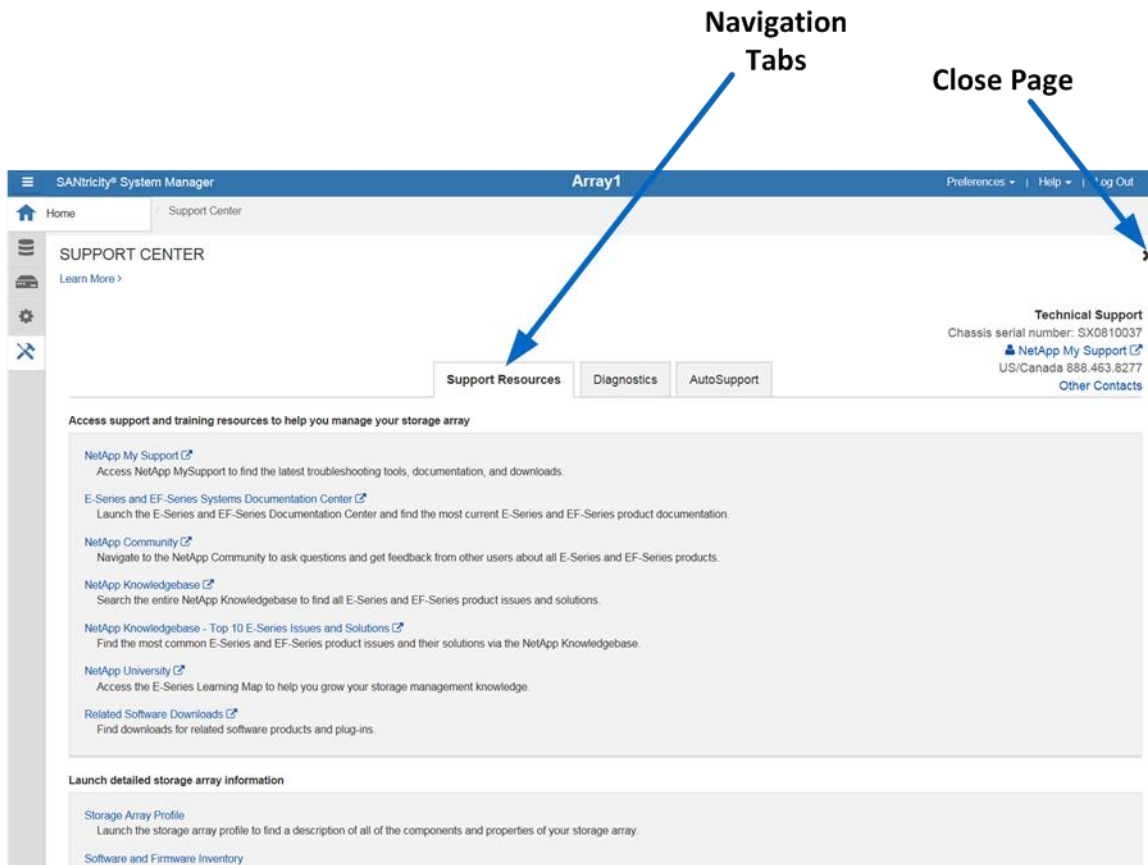
See the System Manager Tables in the appendix for a list of legacy SANtricity Storage Manager AMW functions and their corresponding locations in SANtricity System Manager. The SANtricity System Manager online help also provides an excellent reference guide.

SANtricity System Manager Security

SANtricity System Manager supports multiple levels of management interface security including:

- Support for directory services using LDAP.
- Support for RBAC: five standard roles with varying permission levels.
- Support for certification authority (CA) and SSL certificates.
- Implementation of a secure CLI. The CLI is secure when the certificates are installed. Syntax and invocation are the same as in the legacy CLI, but additional security parameters are supplied.
- Security enhancements that extend to the onboard web services API, where user account passwords are now required.

    Note: If you want to run in the previous security mode with a single administrative password and still use symbols to communicate through the legacy API, the new security features can be disabled by the admin or security users.

LDAP and RBAC

LDAP is a commonly used communication protocol that enables directory servers such as Microsoft Active Directory to provide centralized identity control over user and group definitions.

RBAC is software on the E-Series array that defines standard user levels, each with a well-defined set of access permissions. By authenticating a user as a member of a group and setting group permissions on the array side, SANtricity 11.40 and later versions provide the granularity of access that customers require.

Table 4 defines the permission level with each role.

Table 4) Built-in roles and associated permissions.

Note: See the SMcli command reference from the NetApp Support site for a detailed listing of SMcli commands available with each user role.

Role Name (login as)	Access Permissions
Root Admin (admin)	This role allows you to change the passwords of any local users and execute any command supported by the array. The admin password is set at initial login or any time after.
Security Admin (security)	This role allows you to modify security configuration settings on the array. It allows you to view audit logs, configure secure syslog server, LDAP or LDAPS server connections, and manage certificates. This role provides read access but does not provide write access to storage array properties such as pool or volume creation or deletion. This role also has privileges to enable or disable SYMbol access to the array.
Storage Admin (storage)	This role allows full read and write access to the storage array properties and maintenance/diagnostics functions. However, it does not include access to perform any security configuration functions.
Support Admin (support)	This role provides access to all hardware resources on the array, failure data, MEL/Audit log and CFW upgrades. You can view the storage configuration but cannot change it.
Monitor (monitor)	This role provides read-only access to all storage array properties. However, you will not be able view the security configuration.

Setting Up the Directory Server and Roles

Directory servers, like most data center devices, are complex and designed to fulfill many use cases. However, the E-Series LDAP/RBAC implementation focuses on authentication and two main elements: users and groups. As with most applications, you must understand a few acronyms and follow a few conventions to set up communication between the E-Series array and the directory server. The most critical acronyms to understand are:

- **CN.** Stands for `commonName`, used to identify group names as defined by the directory server tree structure.
- **DC.** Stands for `domainComponent`, the network in which user and groups exist (for example, netapp.com).
- **DN.** Stands for `distinguishedName`, the fully qualified domain name made up of one or more comma-separate common names, followed by one or more comma-separated DCs (for example, `CN=functional_group_name,CN=Users,DC=netapp,DC=com`).

E-Series systems follow a standard web server implementation on the controllers, and information about the general directory services setup is available on the web. As a result, setting up the service on E-Series systems only requires some fields, which are listed in Table 5.

Table 5) LDAP/RBAC required fields and definitions.

Field Name	Definitions
Domain (for example, netapp.com)	Network domains defined in the directory server of which users accessing the storage array are members.
Server URL	Can be a fully qualified domain name or IP and port number in the format `ldap://<IP:port_number>` (port 389 or port 636 for LDAPS).
Bind account	Format is `CN=binduser,CN=Users,DC=<some_name>,DC=com`.
Bind account password	Password for bind account user.
Search base DN	Format is `CN=Users,DC=<some_name>,DC=com`.
User name attribute	The LDAP attribute that defines the user name. Example: `sAMAccountName` is a standard entry for legacy Windows-based browsers, including Windows 95, Windows 98, and Windows XP. Linux can have other designations.
Group attributes	The LDAP attribute that defines the groups to which a user belongs. Example: `memberOf` is a standard attribute.

Figure 28 shows a sample Active Directory server integration with SANtricity System Manager. The entries are all examples except for user name attributes and group attributes in the privileges section. Those items are standard entries for Windows and are not likely to change for most implementations.

Figure 28) SANtricity System Manager directory server setup wizard.

The array roles for the specified user groups are set in the Role Mapping tab. In Figure 29, users who are members of the StorageAdmin, StorageTechs, and ITSupport groups are authenticated as branches of the Users group @cre.com. When users in one of those groups log in to the array, they are allowed access to certain views and functions in the management interface according to the permissions granted.

Figure 29) Role Mapping tab in the directory server settings wizard.
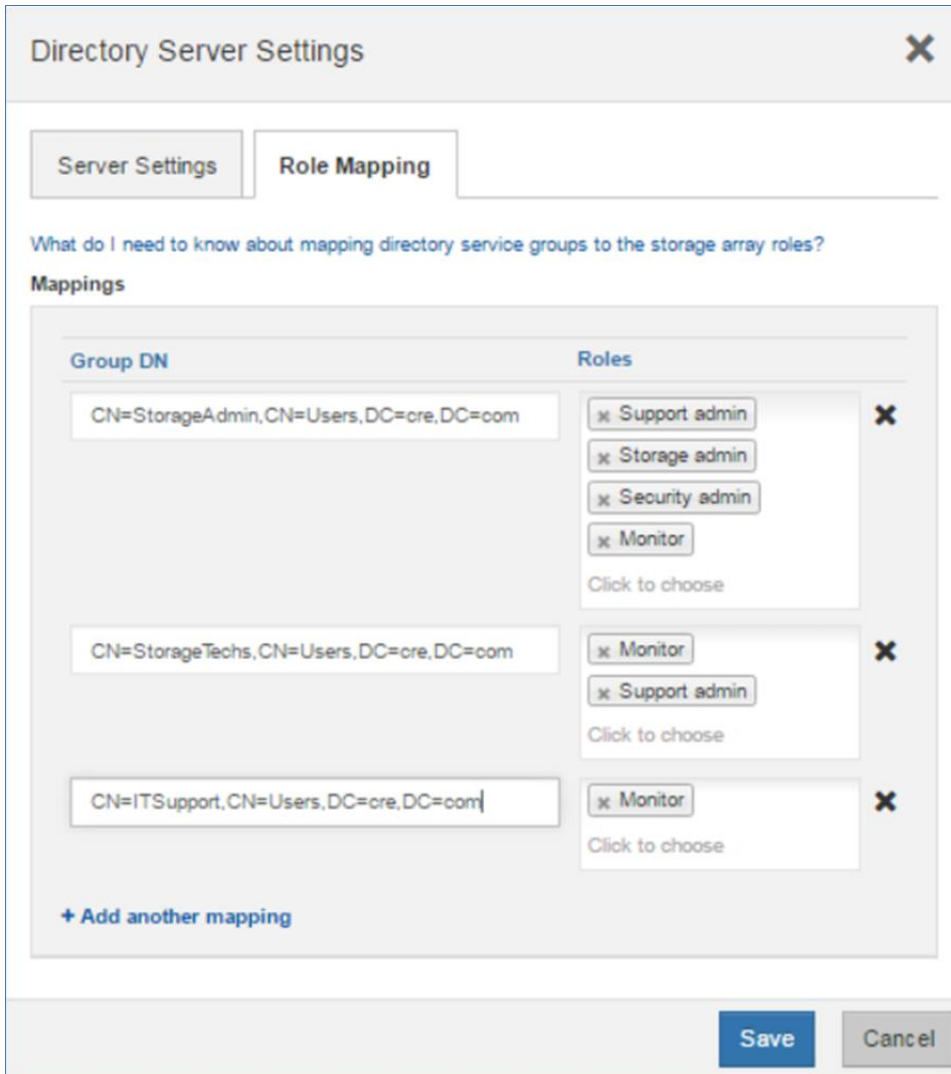
Note: The monitor role is automatically added to all group DNs. Without monitor permission, users in the associated mapped group are not able to log in to the array.

Multiple groups can be defined and mapped to specific roles that meet individual business requirements. Figure 30 shows the difference in user views and access to features according to access permission level.

The top half of the figure shows the view after you log in without security access or permission. With this login you can monitor and access support, but it does not provide the security access of the second group mapping in Figure 30.

Figure 30) SANtricity System Manager views change based on user permission level.

Logged-in as a user who does not have security access/permission

| Help ▾ | todde | Log Out

| Help ▾ | admin | Log Out
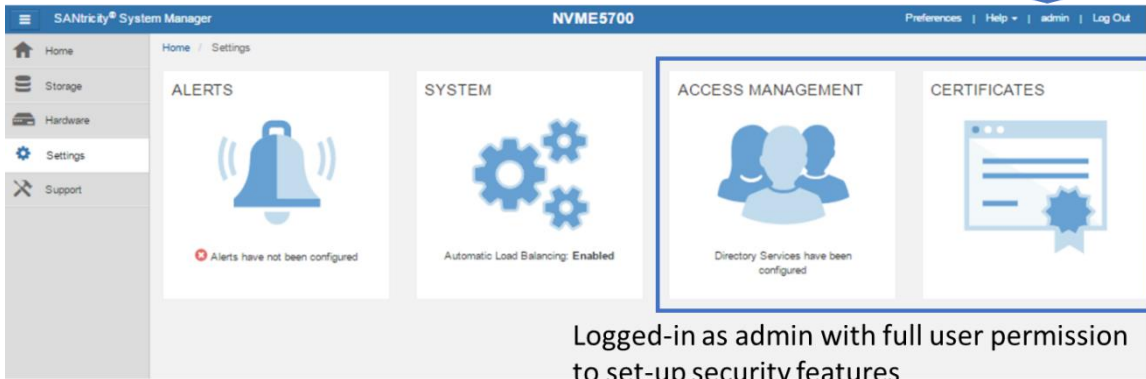
Logged-in as admin with full user permission to set-up security features

SANtricity Web Server Security Certificates

In addition to authentication and access control, SANtricity System Manager supports standard CA certificates. This support enables secure communications (SSL/TLS) between browser clients and the E-Series built-in web servers on the controllers. On E2800 arrays, the SANtricity System Manager UI is accessed through one of the two controllers. (In the legacy SANtricity Storage Manager application, access was through both controllers simultaneously.) As a result, all communication to the other controller in the E2800 array is done through the midplane in the shelf. Because you can log in to either of the controllers through the web browser, both controllers must run a web server instance. For proper communication, both controllers must present a self-signed certificate to each other. This process happens automatically when the admin or security user logs in to each controller and opens the Certificates tile. Figure 31 shows the dialog box that is displayed the first time the tile is opened.

Figure 31) Initial step required to set up web server certificates.
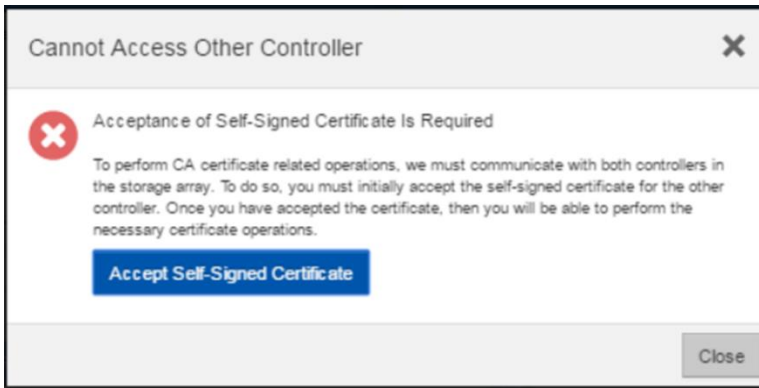
You must accept the self-signed certificate to continue setting up certificates. The process takes you to another webpage, where the certificate is created in the background. Follow the prompts to complete the process. When the process is complete, the array requires the admin user or a user with security permissions to log in again. Both controllers are then displayed with valid local host certificates, as shown in Figure 32.

Figure 32) SANtricity System Manager Certificates tile expanded.
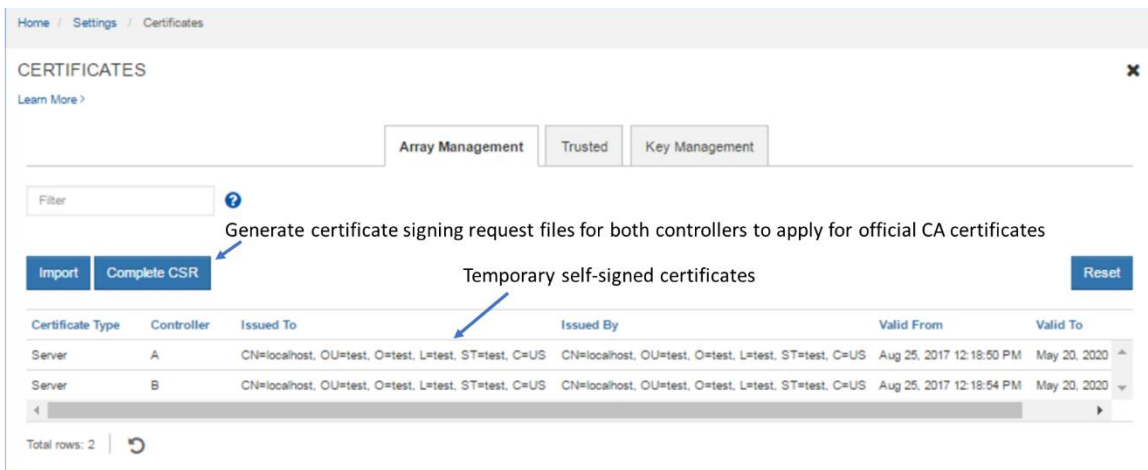
To enable the E-Series onboard web servers to validate certificates from external client browsers, the controllers are preloaded with industry-standard CA root certificates. To view a list of factory-installed CA root and intermediate certificates, select the Trusted tab in the Certificates tile window shown in Figure 32 and then select Show Preinstalled Certificates from the drop-down menu.

For complete details and procedures to manage certificates for SANtricity System Manager and SANtricity Unified Manager, see TR-4712: NetApp SANtricity Management Security.

Multifactor Authentication

Feature Overview

Multifactor authentication (MFA) includes several new functional areas on E2800 arrays:

- **Authentication with Security Assertion Markup Language (SAML) 2.0 to support MFA.** You can manage authentication through an identity provider (IdP) by using SAML 2.0. An administrator establishes communication between the IdP system and the storage array and then maps IdP users to the local user roles embedded in the storage array. Using IdP allows the administrator to configure MFA.

- **Digitally signed firmware.** The controller firmware verifies the authenticity of any downloadable SANtricity firmware. Digitally signed firmware is required in controller firmware version 8.42 (SANtricity 11.40.2) and later. If you attempt to download unsigned firmware during the controller upgrade process, an error is displayed, and the download is aborted.

- **Certificate revocation checking using Online Certificate Status Protocol (OCSP).** Certificate management includes certificate revocation checking through an OCSP server. The OCSP server determines whether the certificate authority (CA) has revoked any certificates before the scheduled expiration date. The OCSP server then blocks the user from accessing a server if the certificate is revoked. Revocation checking is performed whenever the storage array connects to an AutoSupport server, external key management server, LDAP over SSL (LDAPS) server, or syslog server. Configuration tasks are available from Settings > Certificates and require security admin permissions.

- **Syslog server configuration for audit log archiving.** In access management, you can configure a syslog server to archive audit logs. After configuration, all new audit logs are sent to the syslog server; however, previous logs are not transferred. Configuration tasks are available from Settings > Access Management and require security admin permissions.

How MFA Works

MFA is provided through the industry-standard SAML protocol. SAML does not directly provide the MFA functionality; instead, it allows the web service to send a request to an external system. The external system requests credentials from the user and verifies those credentials. Information about the authenticated user is then returned to the web service to allow the user to be assigned appropriate roles. With the previous E-Series authentication methods, the web service was responsible for requesting the user credentials and authenticating the user. With SAML, an external system provides all authentication activity. The external system can be configured to require any amount and types of user authentication factors.

SAML identifies two types of systems that cooperate to provide authentication of users:

- **Identity provider.** The identity provider (IdP) is the external system that does the actual authentication of users by requesting the user credentials and verifying their validity. Maintenance and configuration of the IdP is your responsibility.

- **Service provider.** The service provider (SP) is the system that sends a request to the IdP to have a user authenticated. For E-Series storage arrays, the controllers are the service providers; each controller is a separate SP.

Using SAML to provide MFA also enables single sign-on (SSO) capabilities. If multiple applications are configured to use the same IdP, SSO enables them to accept the same user credentials without requiring users to reenter them. The SSO feature is available only if the user is accessing these applications with the same browser.

Note that when SAML is enabled, SANtricity System Manager is the only management access point. There is therefore no access through the SANtricity CLI, the SANtricity Web Services REST API, in-band management (I/O path that uses a host agent), or native SYMbol interface. The lack of SYMbol access

means that you cannot use the Storage Manager EMW or other SYMbol-based tools such as the NetApp Storage Management Initiative Specification (SMI-S) provider.

For more information about MFA, see the E-Series online help center and the E-Series Documentation Center. For detailed explanations about the full set of SANtricity management security features and settings, see TR-4712: NetApp SANtricity Management Security.

2.4 SANtricity Storage Features

SANtricity offers several layers of storage features ranging from security for data at rest, features that manage host paths, features to manage large-capacity drives that ensure data integrity and efficiently manage drive faults, and features that provide data protection. The following sections describe many of the features and provide links to additional information resources.

Drive Encryption

When external key management is enabled from the Settings tile, use the Key Management tab to generate a CSR file. Use the CSR file on the key management server to generate a client certificate. Import the client certificate from the Key Management tab to enable secure communication between the E-Series controllers and the external key management server. For more information about the SANtricity drive security feature, see the E-Series online help center and TR-4474: NetApp SANtricity Drive Security: Feature Details Using SANtricity 11.40.

Host and Path Management Features

When considering the elements of E-Series multipath functionality, you must understand two concepts. The first is controller-to-volume ownership and how path failover between controllers is managed through asymmetrical logical unit access (ALUA). This scenario occurs when the primary paths to an E-Series volume (I/O paths through the owning controller) are lost. The second concept concerns how the multipath driver on the host interacts with multiple ports on each E-Series controller (target port group support, or TPGS) to spread I/O across the interfaces and maximize performance. This section provides a brief explanation of each concept. For a deep explanation of E-Series multipath behavior, see TR-4604: Clustered File Systems with E-Series Products: BPG for Media.

The design of the E-Series multipath behavior has evolved from a host multipath driver-managed scenario (explicit failover) to the new E-Series-led path management model (implicit failover). However, the E-Series fundamentals have not changed. For example, E-Series systems have asymmetric dual active controllers for which:

- Volume ownership alternates as volumes are provisioned.
- Write I/O is mirrored to the peer controller.
- Both controllers have access to every volume on the array.
- Both controllers have multiple host ports.
- If one E-Series controller fails, the other controller takes control of all the LUNs and continues to process I/O.

These attributes allow host multipath drivers to spread I/O across ports on each controller that are associated to the volumes owned by that controller (TPGS). The drivers use path policies such as least queue depth and round robin. Depending on the host operating system, the default path policy is one of these two methods.

When all the paths from a host to one E-Series controller are lost, I/O from that host to the volumes owned by that controller is routed to ports on the other E-Series controller, which performs "I/O shipping" across the shelf midplane to the controller that owns the volumes. In parallel, an ALUA timer is set, and changes in controller-to-volume ownership are delayed until the timer expires. This delay time is long enough for links to reset and return to service (the default is 5 minutes). After the timer expires, the array

decides whether to initiate a change of volume ownership to the peer controller. The decision is based on whether the nonowning controller is still receiving more than 75% of the I/O.

Table 6 provides a list of SANtricity host types and the associated support for implicit failover/failback.

Table 6) SANtricity host types and associated failover behavior in SANtricity 11.50.x.

Host Type	ALUA/AVT Status	Implicit Failover	Implicit Failback	Automatic Load Balance
Linux DM-Multipath (kernel 3.10 or later)	Enabled	Supported	Supported	Supported
VMware	Enabled	Supported	Supported	Supported
Windows	Enabled	Supported	Supported	Supported
Windows cluster	Enabled	Supported	Supported	Supported
ATTO cluster (all operating systems)	Enabled	Supported	Not supported	Not supported

Reliability Features

Table 7 provides a list of SANtricity reliability features and a brief explanation of each with references to additional information.

Table 7) SANtricity 11.50.x features for long-term reliability.

E2800 Reliability Features with SANtricity 11.50.x
Dynamic Disk Pools. NetApp patented technology that allows administrators to group a set of drives on the array to form a specialized RAID configuration. The configuration uses an 8+2 RAID 6–like algorithm to stripe I/O across all drives in the pool. The technology provides consistent performance, but it excels when a drive fails; rebuilds often take hours instead of days when the system uses large-capacity NL-SAS drives. For feature details, see TR-4652: SANtricity OS 11.40.1 Dynamic Disk Pools.
DDP capacity limits. As of SANtricity 11.40.1, the total allowable capacity associated to the DDP feature on an E2800/EF280 array is 6PiB. The maximum single volume size is 2PiB.   The current maximum volume capacity for a thin-provisioned volume is 256TiB.
Media scan with redundancy check. A background scan of media that is run on a set schedule and detects data integrity issues. This feature is a critically important to turn on by default when you provision new volumes.   **Note:** If you have been running I/O to an array with media scan off, consult with NetApp Technical Support before you turn it on.
Data assurance (T10 PI). Confirms data integrity from the HIC to the drive (end-to-end in the storage array). This data integrity is especially important with large-capacity drives.
Cache mirroring. Each E-Series controller owns a set of LUNs and is responsible for processing I/O to and from those LUNs. Both controllers have access to all LUNs, and by default, all incoming writes are cached in memory on the peer controller. This mechanism enables a second level of data integrity checking and enables E-Series and EF-Series arrays to handle controller failover scenarios gracefully.
Nondisruptive controller firmware upgrade. Using the ALUA host type with multiple paths to hosts and an upgrade wizard that activates one controller at a time, this feature prevents upgrades from affecting host-to-LUN access.

E2800 Reliability Features with SANtricity 11.50.x
Note: Most host OSs support the ALUA host type; however, you must verify that you are using ALUA-capable host types before executing an in-service upgrade.
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 to move the data before the drive fails. If the drive fails, rebuild resumes where the evacuator was disrupted, reducing the rebuild time.
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.
SSD wear-life tracking and reporting. This metric is found in the Hardware tab's Drive Settings dialog box. It indicates the wear life of SSDs and replaces two SSD wear-life metrics (average erase count and spare blocks remaining) that were in previous versions of SANtricity. The metric is Percent Endurance Used; to access it, select a drive from the hardware view and then select Settings.
Online drive firmware upgrade. This feature upgrades one drive at a time and tracks writes to the affected drives during the upgrade window; it should be used only during low write I/O periods. **Note:** Parallel drive firmware upgrades are supported offline to upgrade multiple drives more quickly during a maintenance window.
Automatic load balancing. This feature provides automated I/O workload balancing and confirms that incoming I/O traffic from hosts is dynamically managed and balanced across both controllers. The workload of each controller is continually monitored and analyzed in the background. When I/O on one controller significantly exceeds the I/O on the other controller for a prolonged and predictable period, SANtricity can change LUN ownership from the busy controller to the less busy controller. The feature does not react to short-term changes in I/O patterns. However, when a change of ownership is needed, SANtricity interacts with the affected host multipath driver to initiate an implicit path failover. Most current server operating systems and associated multipath drivers support implicit failover. For more information, search for "What is automatic load balancing?" in the System Manager online help.
Embedded SNMP agent. For the E2800 controller, SNMP is supported natively. The embedded SNMP agent complies with the SNMP V2C standard and RFC 1213 (MIB-II). For more information, search for "manage SNMP alerts" in the System Manager online help.
Automatic alerts. This feature sends email alerts to notify data center support staff about events on the storage array.
Event monitor and system log. The SANtricity event monitor automatically records events that occur on the storage array. Syslog enables a second level of activity tracking that allows you to connect events with associated changes recorded in the system log.
AutoSupport. E-Series products have supported AutoSupport for several releases.
Ability to enable or disable AutoSupport maintenance window. AutoSupport includes an option for enabling or suppressing automatic ticket creation on error events. Under normal operation mode, the storage array uses AutoSupport to open a support case if there is an issue. To enable or disable the AutoSupport maintenance window, select Support > Access Management > AutoSupport.

SANtricity Data Management Features

E-Series E2800 systems ship with significant storage management features that can be activated from SANtricity System Manager. Table 8 lists the E2800 features that are standard with SANtricity 11.50.x.

Table 8) E2800 standard features that are included with SANtricity 11.50.x.

E2800 Data Management Features with SANtricity 11.50.x
SANtricity System Manager (embedded single-array management). The browser-based, on-box SANtricity System Manager is used to manage individual E5700/EF570 and E2800/EF280 storage arrays. • Access all array setup, storage provisioning, and array monitoring features from one UI. • You need the EMW only if you are managing legacy arrays or a mix of legacy E-Series or EF-Series arrays and new E5700/EF570 or E2800/EF280 arrays. Otherwise, use SANtricity Unified Manager when you only have new-generation E-Series or EF-Series arrays. • Includes an embedded RESTful API that can be used for management.
Volume workload tags. SANtricity System Manager provides a built-in volume tagging feature that allows administrators to organize the volumes in their array by workload type. Usually, the tag is only for organization purposes. In some cases—for example, Microsoft and VMware tags—the volume creation wizard provides suggested configuration or volume segment size settings associated with the workload type. You do not have to accept the recommendations. The configurations are suggestions for saving time when you provision volumes for common applications.
Storage partitions. Partitions can consist of an individual host without shared LUNs, host groups with shared LUNs, or a combination of both. This concept has been abstracted in the new System Manager, but you can view the partitions by using a CLI.
Thin provisioning. This feature enables you to overcommit storage and add capacity when you need it. This approach is a DDP feature. Starting with 11.40.2, it is available through the CLI and the SANtricity Web Services REST API. **Note:** DDP thin provisioning is intended for use cases that do not have a specific performance requirement, such as slow-growing, age-out archives where data is written once and seldom read. This feature is not appropriate for transactional workloads requiring low latencies and high IOPS or throughput, such as backup application use cases in which you want to maintain or reduce a backup window.
SSD read cache. This feature enables you to accelerate 85% or higher random read workloads by using a few SSDs. **Note:** The SSD read cache is not recommended for environments with sequential write workloads and should never be used with DDP thin provisioning. Both cases can result in reduced performance.
Secure SSD read cache. The SSD read cache can be secured with a nonsecure base volume or a secure base volume (FIPS drive). However, when there is an FIPS secure base volume, the storage management software alerts you if 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 when you create it.
Changing host protocol. Supported through new feature pack keys. To obtain free activation codes and detailed instructions for each starting and ending protocol, go to the E-Series and SANtricity 11 Resources page (Upgrading > Hardware Upgrade).

SANtricity Copy Services Features

Table 9 lists standard copy services features with E2800 storage arrays.

Table 9) SANtricity 11.50.x copy services features.

Standard SANtricity Copy Services Features
SANtricity Snapshot copies. Point-in-time NetApp Snapshot™ copies.
Synchronous mirroring. Real-time mirroring to a remote site (usually within 10km).
Asynchronous mirroring. Mirroring to a remote site where RPO = 0 is not a requirement.
Volume copy. Used to clone volumes for testing/development or analytics purposes.

For additional details and use case information about SANtricity copy services features, see TR-4458: Deploying NetApp E-Series Copy Services with Oracle and SQL Server Databases. For mirroring details and setup procedures, see TR-4656: SANtricity 11.40 Synchronous and Asynchronous Mirroring guide.

2.5   SANtricity Management Integration

Starting with SANtricity 11.40 and continuing with SANtricity 11.50.x, the E-Series SANtricity integration model changed focus. To support today's modernized data center operations and partner appliances, NetApp is de-emphasizing legacy plug-ins and emphasizing API integration.

Table 10 shows the SANtricity APIs and toolkits that can be used for scripting and custom integration into other management tools and appliance architectures. For the web services software and documentation, go to the NetApp Support software downloads page and select E-Series/EF-Series SANtricity Management Plug-Ins. For the Windows PowerShell toolkit, go to the NetApp PowerShell Toolkit page of the NetApp Support site.

Table 10) SANtricity APIs and toolkits.

APIs and Toolkits	Description
SANtricity Web Services Proxy **Note:** You can use either the proxy or the embedded REST API for E2800 systems.	These web APIs provide a collection of REST interfaces to configure, manage, and monitor E-Series systems.
NetApp PowerShell Toolkit	The unified toolkit provides end-to-end automation and storage management across NetApp storage systems.

Table 11 provides a list of third platform plug-ins that use E-Series storage systems as building blocks in cloud storage environments. The SANtricity Web Services Proxy is available at http://mysupport.netapp.com/NOW/download/software/eseries_webservices/1.3/. Usually, the plug-ins listed are available on the various provider websites. For more information about third platform integration with E2800 storage systems, contact your NetApp sales representative.

Table 11) Third platform plug-ins that use the SANtricity Web Services Proxy.

Software Package	Use
SANtricity performance application for Splunk Enterprise	A display and monitor tool to report configuration and performance details of multiple E-Series systems in one interface.

2.6 SANtricity Web Services Native REST API

The SANtricity Web Services REST API is an embedded API for experienced developers. Actions performed through the REST API are applied on execution and without user prompts or confirmation dialog boxes. The REST API is URL based, and the accompanying API documentation is completely interactive. Each URL contains a description of the corresponding operation and lets you perform the action directly through the API documentation. To access the documentation, select API Documentation in the Help drop-down menu from any page in System Manager, as shown in Figure 33.

Figure 33) Opening the API documentation.
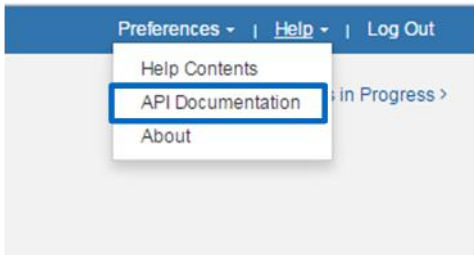
Each URL endpoint presented in the API documentation has a corresponding POST, DELETE, or GET option. These URL endpoint options, known as HTTP verbs, are the actions available through the API documentation. A sample from the REST API documentation is shown in Figure 34. You can expand or hide operations by selecting the drop-down beside the topic name or clicking the individual endpoints. Click Try it out to execute the endpoint. You must click Execute to run an endpoint (Figure 35).

Note: To execute successfully, some endpoints require additional input parameters in the Try it out dialog box. No additional input is required for this example.

Figure 34) Example expanding the device-ASUP endpoint.
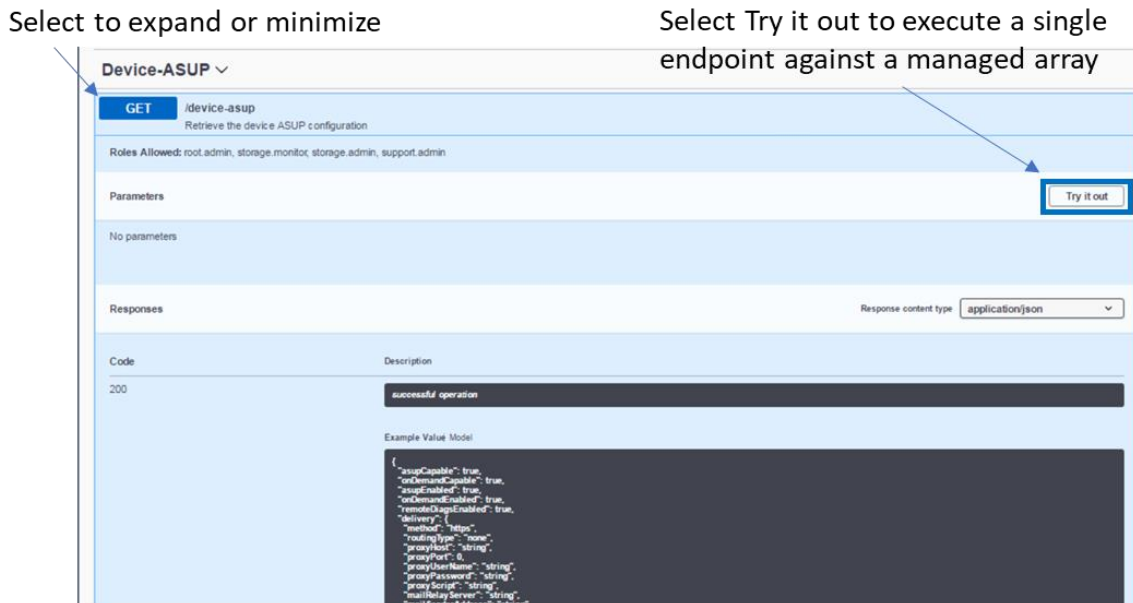
Figure 35) REST API documentation sample.

The corresponding output for the GET device-asup endpoint is shown in Figure 36 and Figure 37.

Figure 36) Sample output from the Try It Out! button.

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Figure 37) Device-asup endpoint possible response codes and definitions.

Data in the REST API is encoded through JSON. The structured JSON data from the REST API can be easily parsed by programming languages (C, C++, cURL, Java, Python, Perl, and so on). JSON is simple encoding based on key-value pairs with support for list and subject objects. Objects start and end with curly braces (that is, { }), whereas lists start and end with brackets (that is, [ ]). JSON understands values that are strings, numbers, and Booleans. Numbers are floating-point values. The API documentation provides a JSON template for each applicable URL operation, allowing the developer to simply enter parameters under a properly formatted JSON command.

For more information, see the E-Series Documentation Center.

3   Sales 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, including the launch of Fusion, the NetApp one-stop tool for all product sizing. This tool is not available to end customers, but it is a key tool for sales engineers and partner sales to propose the most cost-effective configurations that meet customers' requirements.

3.1   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.

Tool Description

Config Advisor creates PDF, Word, and Excel reports about 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 and associated installation documentation use the Config Advisor link above, acknowledge the EULA, and select Continue. For general installation instructions, use the Config Advisor Installation and Administration Guide.

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.
- **Presentation layer.** The presentation medium is flexible. Users can view the output using Config Advisor's UI, or they can generate PDF, Excel, or Microsoft Word reports for these contents.

3.2   Fusion

The E-Series Performance Sizing tool launched from Fusion allows sales engineers and partners to confirm that specific customer architectures are properly sized and can meet customer performance requirements.

The E-Series Performance Sizing 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 38 shows the new performance sizer landing page. On this page, you can select a new forward sizing (enter criteria and see possible configurations). You can perform reverse sizing (enter criteria and get one report back with details for that configuration). You can also base new sizing calculations on previous sizing configurations.

Figure 38) E-Series and EF-Series performance sizing tool launched from the Fusion tool.

Figure 39 shows the expanded details from the configuration option containing 10TB drives that meet the criteria in Figure 38. You can easily compare configuration options associated to various drive choices using this method.

Figure 39) Performance sizing report.
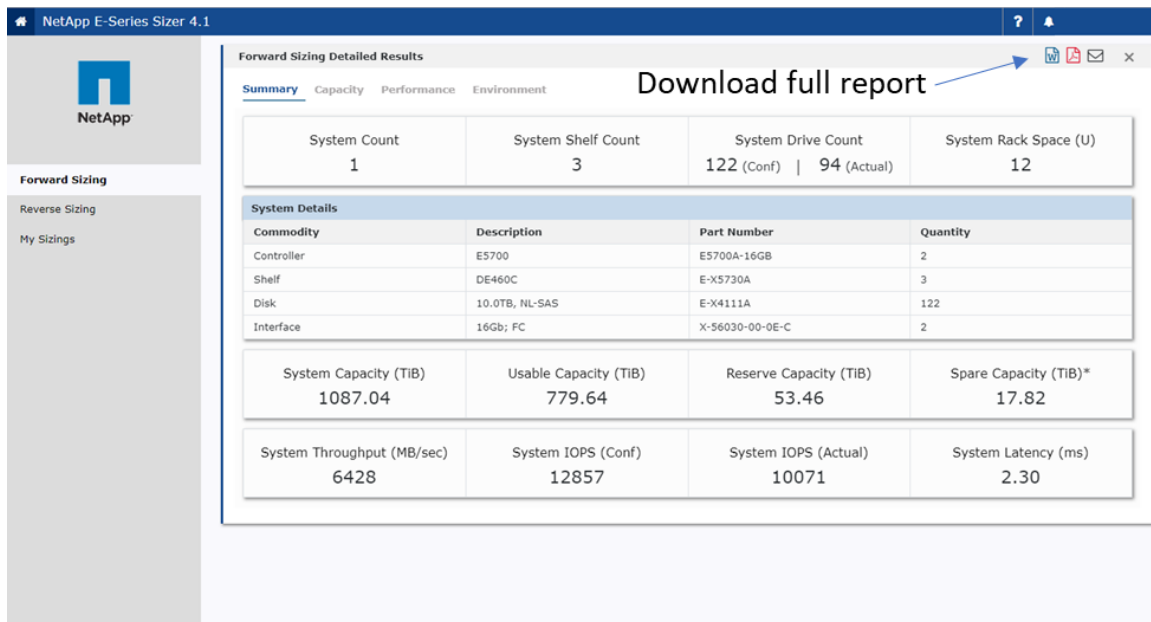
3.3 Synergy

NetApp Synergy is a web-based 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.

3.4 Hardware Universe

The Hardware Universe 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 systems 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.

The Hardware Universe 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.

3.5 Host Utilities

When customers implement E-Series with Windows and Linux operating systems, they can use the settings in the Host Utilities 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.

4 Software Specifications for E2800 Hardware

Table 12 lists the software specifications for the E2800-based storage systems.

Table 12) SANtricity software boundaries for E2800-based storage systems.

Components	Maximum
Storage Hardware Components	
Shelves (controller and expansion)	4 (1x controller + 3x expansion)
Max Drives - Drive Slot Count	180 (120 SSDs)
SSD cache capacity	5TB
Logical Components	
Host Partitions	128
Volumes per partition	256
Volumes	512
Disk pools per system	20

Total DDP capacity in an array (maximum capacity includes RAID overhead, DDP reserve capacity, and a small DDP-specific overhead based on the number of drives in the pool and other factors)	• SANtricity 11.40:
	  2PiB maximum DDP capacity per E2800 array
	• SANtricity 11.40.1 and later:
	  6PiB maximum DDP capacity per E2800 array

Maximum standard RAID capacity limits	Limits for standard RAID based on maximum supported drives per RAID type: • 30 drives any supported capacity for RAID 5 and RAID 6 • All drives any supported capacity for RAID 10
Maximum single-volume capacity (SANtricity 11.40/11.40.1 and later)	2PiB
Maximum single-DDP thin volume capacity (SANtricity 11.30 and later)	256TB
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

Components	Maximum
Per system	256
Snapshot Groups	
Per volume	4
Per system	256
Mirrors	
Mirrors per system	32
Mirrors per volume	1
Mirrors per asynchronous mirror group	32
Asynchronous mirror groups per system	4

For additional software limits and specifications, see the Hardware Universe.

5 Hardware Configurations

E2800 storage systems use a modular approach to hardware configuration. 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. E-Series has a proven track record of reliability and scalability to satisfy requirements in remote dedicated environments or primary data centers.

5.1 Controller Shelf Configurations

E2800 controllers can be paired with DE212C, DE224C, or DE460C E-Series shelves. The following sections provide detailed information about each shelf configuration.

E2812 Controller Shelf

The E2812 is a 2RU shelf that holds up to 12 3.5" drives or 2.5" drives with adapter. It features one or two RAID controllers and one or two ENERGY STAR Platinum certified high-efficiency power supplies (913W) with integrated fans. An E2812-based storage system supports a maximum of 180 HDDs (120 SSDs) and a mix of drive shelf models.

Figure 40, Figure 41, and Figure 42 show the front and rear views of the E2812 controller shelf. In the example, the E2800 controllers have two optical base ports and no HIC.

Figure 40) E2812 front view with bezel.
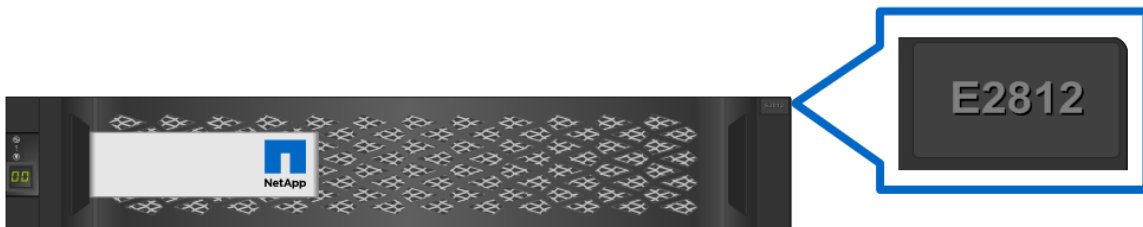
Figure 41) E2812 front view (open).

Figure 42) E2812 rear view.
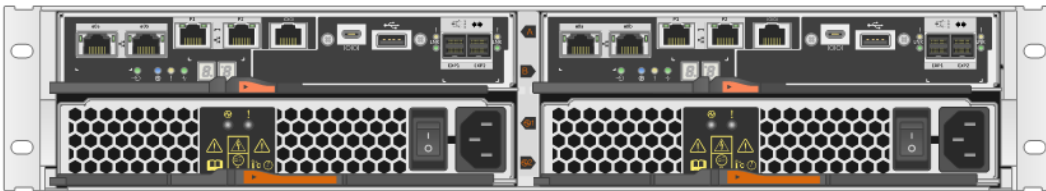
E2824 Controller Shelf

The E2824 is a 2RU shelf that holds up to 24 2.5" drives. It features one or two RAID controllers and one or two ENERGY STAR Platinum certified high-efficiency power supplies (913W) with integrated fans. An E2824-based storage system supports a maximum of 180 HDDs (120 SSDs) and a mix of drive shelf models in a single system.

Figure 43, Figure 44, and Figure 45 show the front and rear views of the E2824 controller shelf. In the example, the E2800 controllers have two optical base ports and no HIC.

Figure 43) E2824 front view with bezel.
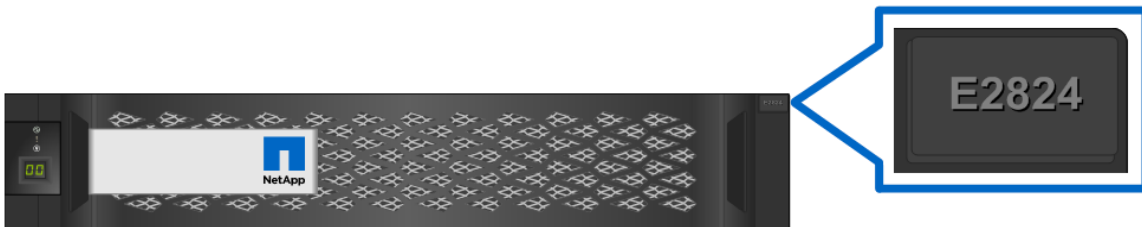
Figure 44) E2824 front view (open).
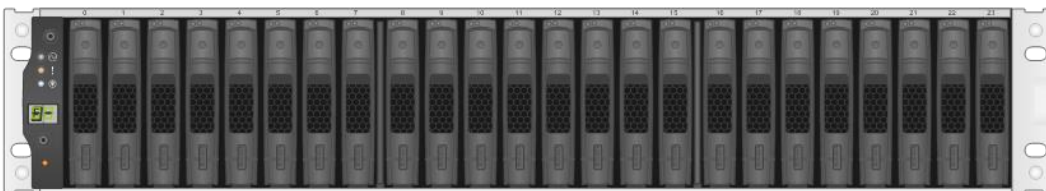
Figure 45) E2824 rear view.
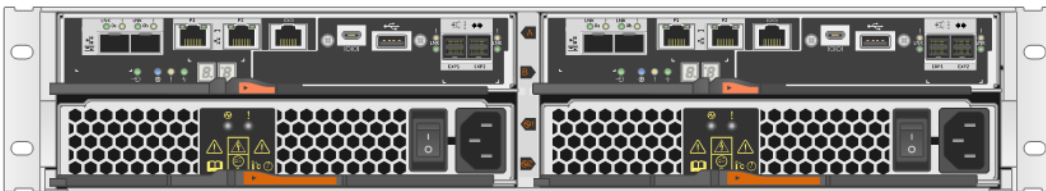
E2860 Controller Shelf

The E2860 is a 4RU shelf that holds up to 60 3.5" drives or 2.5" drives with adapter. It features two RAID controllers and two ENERGY STAR Platinum certified high-efficiency power supplies (2325W) with separate dual fan modules. An E2860-based storage system supports a maximum of 180 HDDs (120 SSDs). When mixing shelf models, the maximum drive counts vary and are governed by a maximum shelf count of 3 total shelves (a controller drive shelf and up to 2 expansion drive shelves), and the system must not exceed 180 total drive slots.

Figure 46, Figure 47, Figure 48 and show the front and rear views of the E2860 controller shelf. In the example, the E2800 controllers have two optical base ports and no HIC.

Figure 46) E2860 front view with bezel.
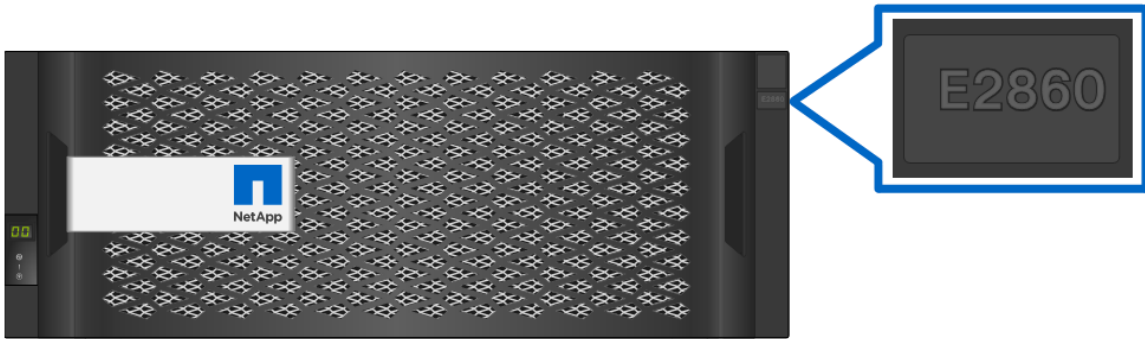
Figure 47) E2860 front view (open).
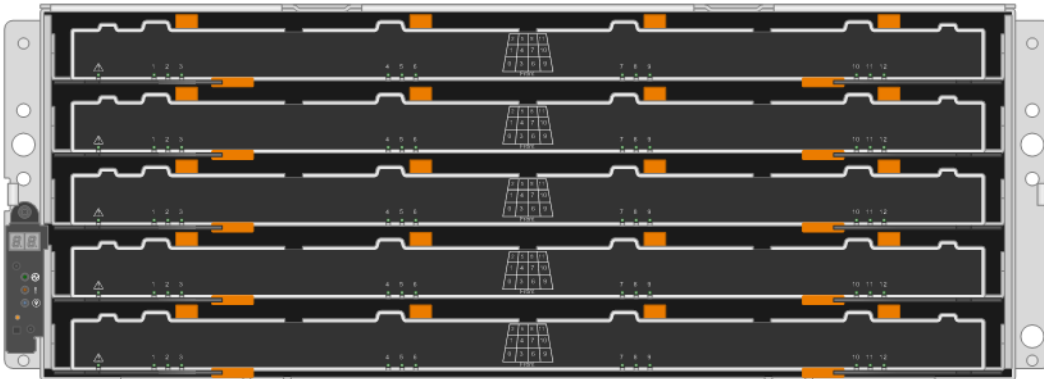
Figure 48) E2860 rear view.

E2800 Hardware Specifications

The E2800 controller has the following base hardware features:

- Dual Ethernet ports for management-related activities
- Either two optical FC/iSCSI or two RJ-45 iSCSI baseboard ports for host connection
- Dual 12Gb SAS drive expansion ports to attach expansion drive shelves

    Note: The additional of an optional HIC is needed only if you want to use the SAS protocol, if you need more than two host ports per controller, or want to use both FC and iSCSI protocols.

Table 13 lists the technical specifications for the E2800-based storage systems.

Table 13) E2800 technical specifications.

Specification	E2812	E2824	E2860
Maximum raw system capacity	480TB	1.4PB (15.3TB SSDs)	1800TB
Maximum number of drives per system	48 HDDs (48 SSDs)	96 HDDs (96 SSDs)	180 HDDs (120 SSDs)
Shelf form factor	2RU, 12 drives	2RU, 24 drives	4RU, 60 drives
Memory	4GB or 16GB per controller: simplex system.		
	8 GB or 32GB per duplex system.		
Onboard host I/O	2-port 10Gb iSCSI (Base-T) per controller or 2-port 10Gb iSCSI (optical)/16Gb FC per controller.		
	Note: Only one interface can be configured per system on the onboard host ports.		
Optional host I/O (HIC) • Controllers must match • The Base-T iSCSI onboard controller can use only the 2-port Base-T HIC • A software feature pack can be applied to convert the FC HIC ports to iSCSI or to convert iSCSI HIC ports to FC	2-port 10Gb iSCSI (Base-T) per controller.		
	2-port 12Gb SAS (wide-port) per controller.		
	4-port 12Gb SAS (wide-port) per controller.		
	2-port 10GB iSCSI (optical) or 16Gb FC per controller.		
	4-port 10Gb iSCSI (optical) or 16Gb FC per controller.		
Drive shelves supported for expansion drive offerings	DE212C (2RU, 12 drives): 3 expansion shelves maximum; supports the same drive types as E2812 controller shelf.		
	DE224C (2RU, 24 drives): 3 expansion shelves maximum; supports the same drive types as E2824 controller shelf.		
	DE460C (4RU, 60 drives): 2 expansion shelves maximum; supports the same drive types as E2860 controller shelf.		
	DE6600 (4RU, 60 drives): 2 expansion shelves maximum; supports the same drive types as E2824 and/or E2812 controller drive shelves. **Note:** Supports only SAS 2 (6Gbps) transfer speeds.		

Specification	E2812	E2824	E2860
	DE5600 (2RU, 24 drives): 3 expansion shelves maximum; supports the same drive types as E2824 controller shelf. **Note:** Supports only SAS 2 (6Gbps) transfer speeds.		
	DE1600 (2RU, 12 drives): 3 expansion shelves maximum; supports only NL-SAS drive types. **Note:** Supports only SAS 2 (6Gbps) transfer speeds.		
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 and DDP. **Note:** It is only possible to create RAID 3 volumes through the CLI. For more information, search for "using the create volume group wizard" in the System Manager online help.		
	Redundant, hot-swappable storage controllers, disks, and power fan canisters.		
	Mirrored data cache with battery-backed destage to flash.		

See the Hardware Universe for current supported drive availability information and encryption capability by drive capacity (FDE, FIPS).

Figure 49 shows the navigation to select drives by OS and platform compatibility.

Figure 49) Hardware Universe drives by OS and platform.
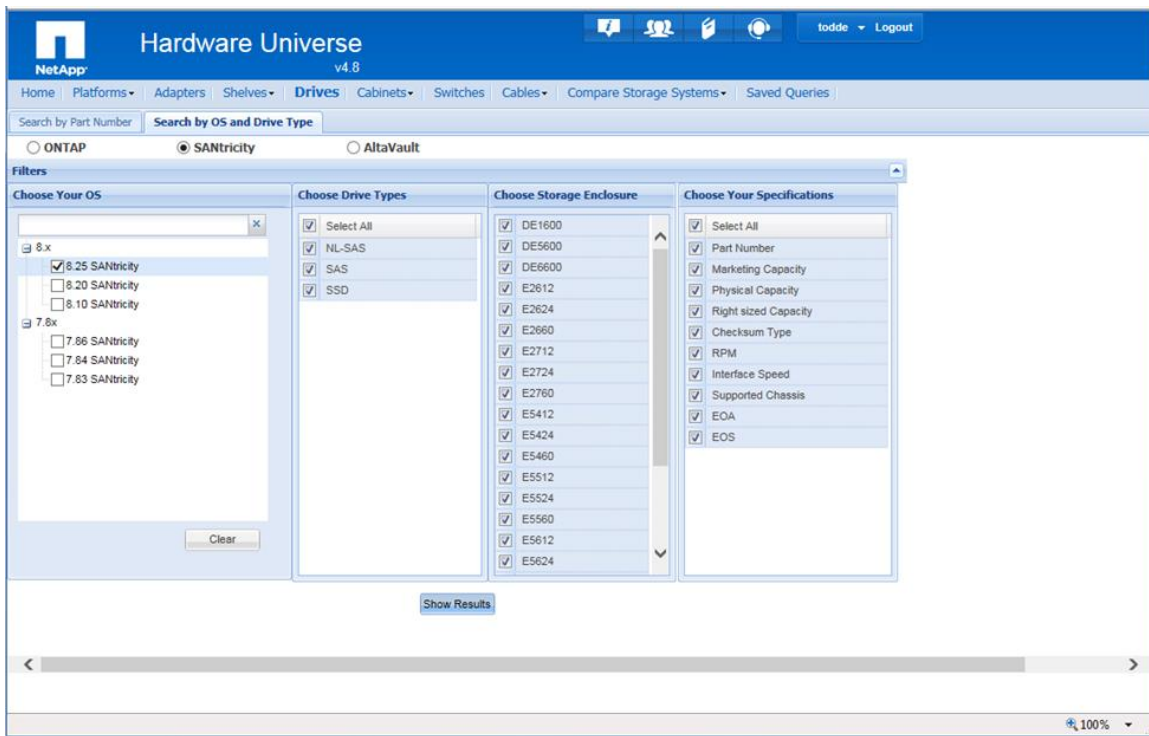
For additional information, see the NetApp E2800 datasheet in the NetApp Library.

5.2 Controller Host Interface Features

By default, the E2800 controller includes two Ethernet management ports that provide out-of-band system management access and either two optical FC/iSCSI or two RJ-45 iSCSI baseboard ports for host connection. The E-Series E2800 controller also supports seven HIC options, including:

- 2-port 10Gb iSCSI BASE-T (restricted to controller with BASE-T onboard host ports)
- 2-port 12Gb SAS (SAS 3 connector)
- 4-port 12Gb SAS (SAS 3 connector)
- 2-port optical HIC, which can be configured as either 16Gb FC or 10Gb iSCSI
- 4-port optical HIC, which can be configured as either 16Gb FC or 10Gb iSCSI
- 4-port 32Gb FC optical HIC **(new with SANtricity 11.50 and later versions)**
- 4-port 25Gb iSCSI optical HIC **(new with SANtricity 11.50 and later versions)**

   Note: A software feature pack can be applied in the field to change the host protocol of the optical baseboard ports and for the 2-port or 4-port 16Gb FC, or 10Gb iSCSI optical HICs. However, the 32Gb FC and 25Gb iSCSI HICs are not programmable. Also, the 25Gb iSCSI port speed must be manually set by using the SANtricity System Manager GUI or SMcli interface, one port per controller. Changing one port will automatically change all four ports on a HIC.

For instructions to obtain and apply software feature packs to change baseboard and HIC protocol, go to the E-Series and EF-Series Systems Documentation Center. Locate the Upgrading > Hardware Upgrade section of the page, select Changing the Host Protocol, and download the Converting E2800 Host Protocol document.

The optical 32Gbps FC and 25Gbps iSCSI HICs support several SFP options, including two FC and one iSCSI option. There are two options for the 16Gb FC or 10Gb iSCSI base ports. Table 14 provides details about the FC options.

Table 14) FC host interface port speed and associated SFPs.

HIC Protocol	32Gbps SFP	16Gbps SFP	8Gbps SFP
32Gbps FC	32Gbps/16Gbps	16Gbps/8Gbps	N/A
16Gbps FC base ports	N/A	16Gbps/8Gbps/4Gbps	8Gbps/4Gbps

Table 15 provides details about the iSCSI port speed based on the installed SFP. For the 16Gbps FC/10Gbps iSCSI base ports, use the unified SFP part number X-48895-00-R6-C. For 1Gbps iSCSI base ports, use SFP part number X-48896-00-C.

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

Table 15) iSCSI host interface port speed and associated SFPs.

HIC Protocol	25Gbps SFP	10Gbps SFP (Unified SFP)	1Gbps SFP
25Gbps iSCSI	25Gbps/10Gbps*	N/A	N/A
10Gbps iSCSI base ports	N/A	10Gbps	1Gbps

* You must change port speed from 25Gbps to 10Gbps or 10Gbps to 25Gbps by using SANtricity System Manager in the iSCSI setup section. Change one HIC port per controller as required to match the SFP and the switch port setting. The remaining HIC ports on each controller change automatically to match the one port per controller that you manually changed.

For optical connections, 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.

Figure 50 shows the seven HIC options.

Figure 50) E2800 with optical base ports HIC options.

E2824 2U - 24 drive shelf with Dual E2800 Controllers FC/iSCSI shown

E2800 controller with
2-port 10Gb iSCSI RJ-45 HIC installed

E2800 controller with
4-port 12Gb SAS HIC installed

E2800 controller with
2-port 12Gb SAS HIC installed

E2800 controller with 4-port optical
16Gb FC or 10Gb iSCSI HIC installed

E2800 controller with 2-port optical
16Gb FC or 10 Gb iSCSI HIC installed

E2800 controller with 4-port
optical 32Gb FC HIC installed

E2800 controller with 4-port
optical 25Gb iSCSI HIC installed

Figure 51 shows the HIC options available when the baseboard host ports are 10Gb iSCSI Base-T.

Figure 51) E2800 with Base-T iSCSI onboard host ports: HIC options.

E2824 Array - E2800 Controllers with iSCSI Base-T Host Ports
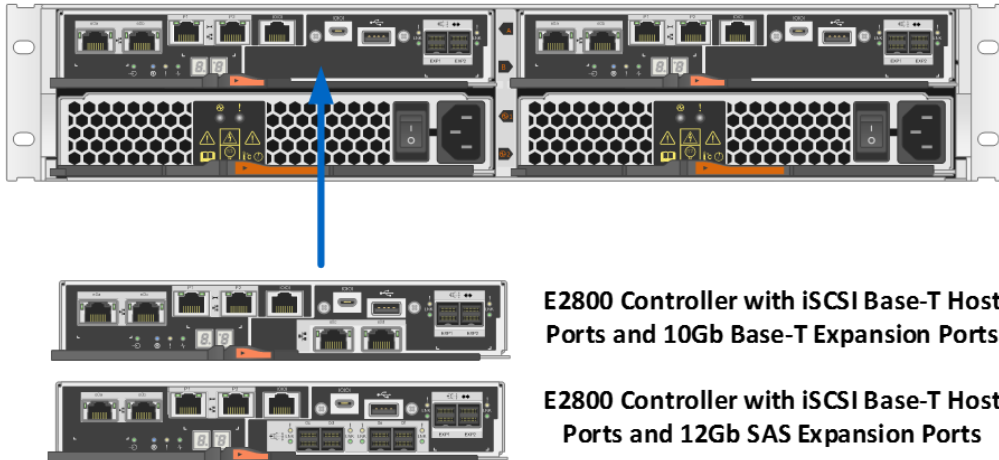
E2800 Controller with iSCSI Base-T Host Ports and 10Gb Base-T Expansion Ports

E2800 Controller with iSCSI Base-T Host Ports and 12Gb SAS Expansion Ports

Note: All HIC options support link speed auto-negotiation except for 25Gb iSCSI. In that case, the port speed must be manually set by using SANtricity System Manager or SMcli.

5.3   Hardware LED Definitions

E2800 Controller Shelf LEDs

The E2800 controller shelf has LED status indicators on the front of the shelf, the operator display panel (ODP), the rear of the shelf, the power fan canisters, and the controller canisters. The new E2800 shelf ODP also includes a dual seven-segment display to indicate the shelf identity. The LEDs on the ODP indicate systemwide conditions, and the LEDs on the power fan canisters indicate the status of the individual units.

Figure 52 shows the ODP of the E2812 and E2824 controller shelves. Figure 53 shows the ODP of the E2860 controller shelf.

Figure 52) ODP on the front panel of E2824 and E2812 controller shelves.

1. Shelf Power LED
2. Shelf Attention LED
3. Shelf Locate LED
4. Shelf Identity
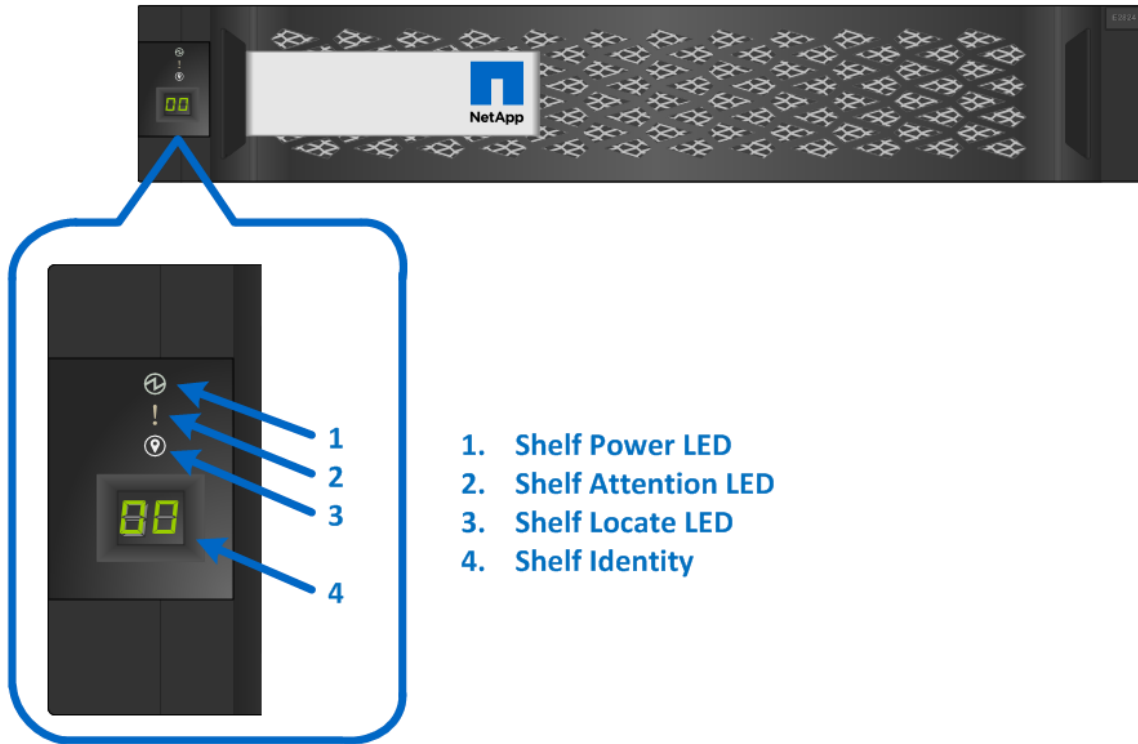
Figure 53) ODP on the front panel of E2860 controller shelves.

1. Shelf Identity
2. Shelf Power LED
3. Shelf Attention LED
4. Shelf Locate LED
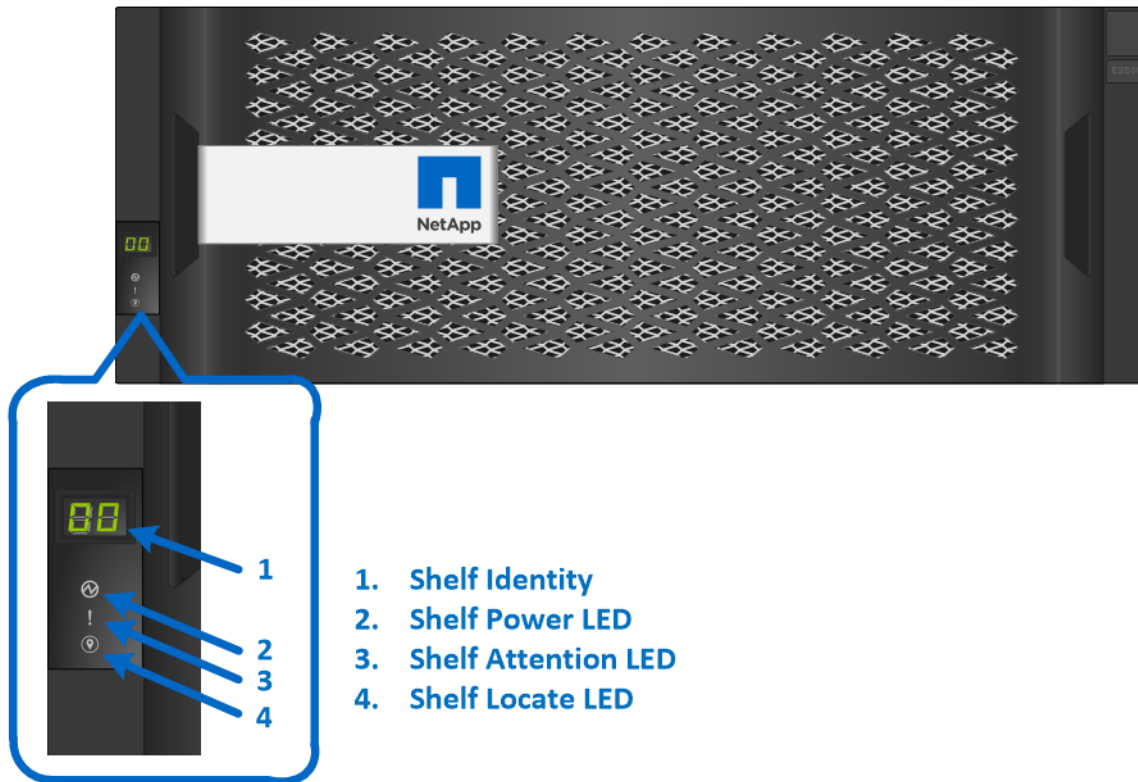
Table 16 defines the ODP LEDs on the E2800 controller shelf.

Table 16) E2800 controller shelf LED definitions (front panel).

LED Name	Color	LED On	LED Off
Power	Green	Power is present.	Power is not present.
Attention	Amber	A component in the controller shelf requires attention.	Normal status.
Locate	Blue	There is an active request to physically locate the shelf.	Normal status.

Note: The shelf-identity feature displays a numerical value to identify the shelf. The dual seven-segment display indicates values from 00 to 99.

Power Fan Canister Status LEDs

The power fan canisters for the E2824 and E2812 controller shelves are identical. The LEDs on the rear panel are shown in Figure 54 and are defined in Table 17.

Figure 54) LEDs on the E2824 and E2812 power fan canister (rear view).

1. **Power LED**
2. **Attention LED**
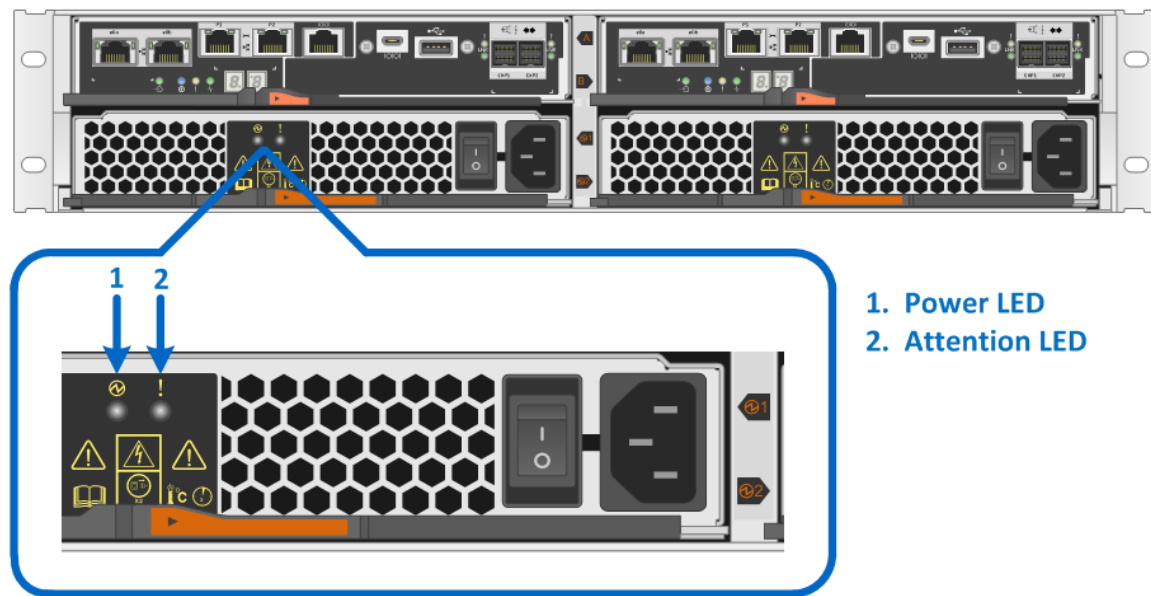
The power and fan canisters are separate for the E2860 controller shelf. The LEDs on the rear panel of each are shown in Figure 55 and defined in Table 17.

Figure 55) LEDs on the E2860 power canister (rear view).

1. **Power LED**
2. **Attention LED**
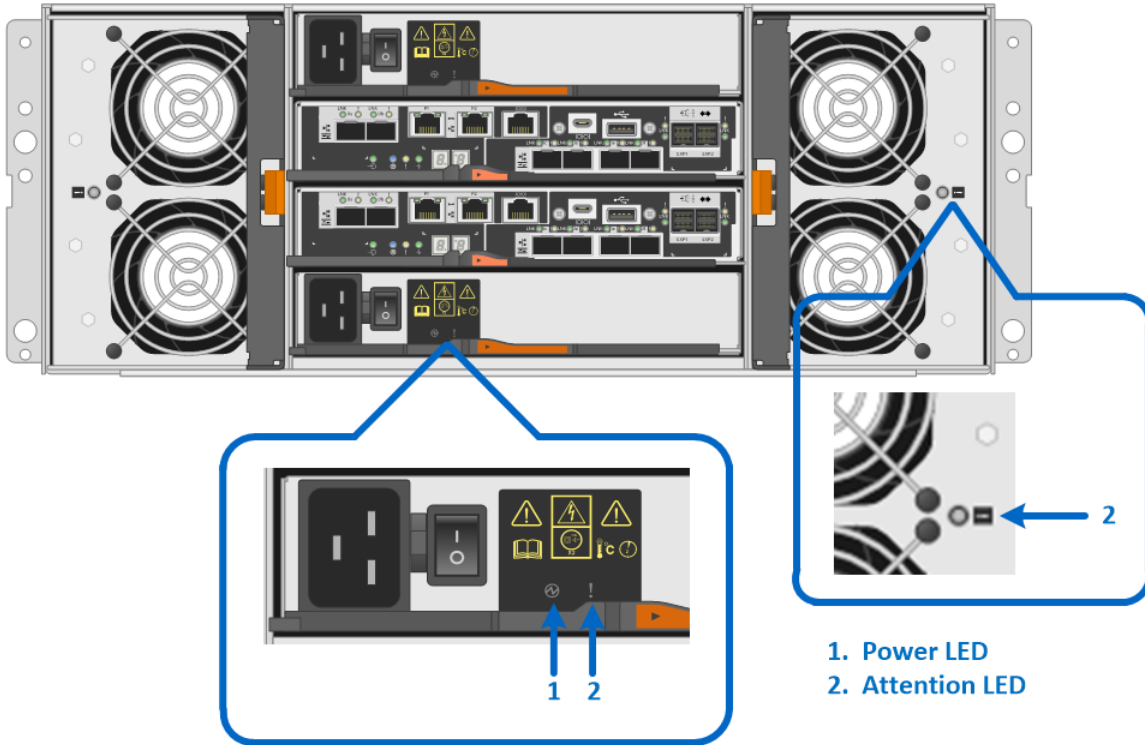
Table 17) E2812, E2824, and E2860 controller shelf power and fan canister LED definitions.

LED Name	Color	LED On	LED Off
Power	Green	AC power is present.	AC power is not present.
Attention	Amber	The power supply or the integrated fan has a fault.	Normal status.

E2800 Controller Canister LEDs

The E2800 controller canister has several LED status indicators. The LEDs on the left side of the module refer to the overall controller status and to the onboard host ports. The LEDs on the right side of the module refer to the drive expansion ports and to the optional HIC ports.

Host port status can be verified by directly checking the port LEDs or by using the SANtricity System Manager GUI. The Host Interfaces tab of the Controller Settings dialog box (Figure 56) details the status of each host I/O interface that is connected to the storage system.

Figure 56) Controller settings dialog box.
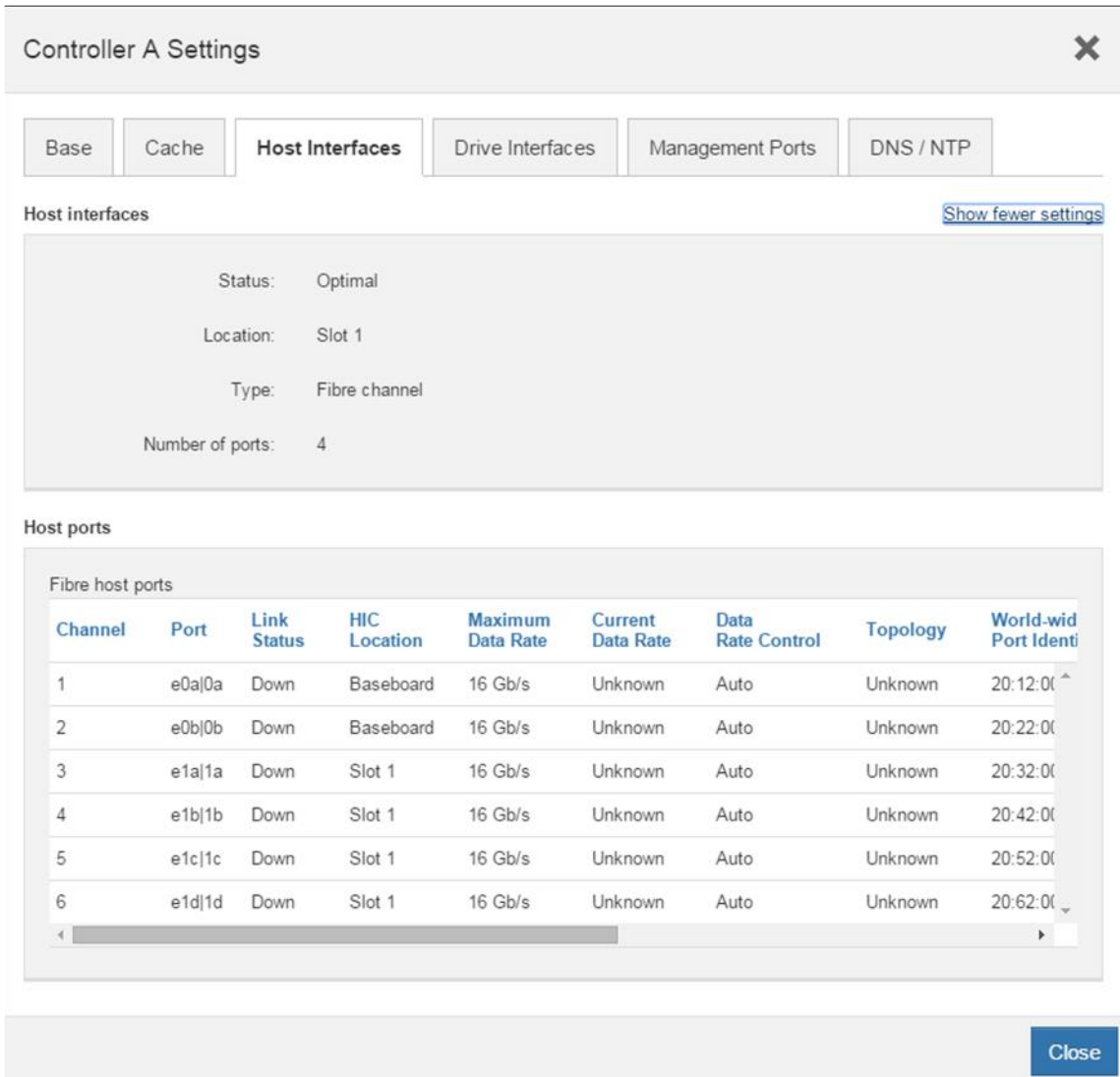
Controller Base Port Status LEDs

Figure 57 shows the onboard LED status indicators on the left side of the E2800 controller canister with the RJ-45 iSCSI baseboard host ports. Most of the LEDs are lit when a fault condition exists. However, the cache active LED is lit when the cache is active. 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. The dot in the second seven-segment LED is on to indicate a diagnostic code. Otherwise, the display indicates the shelf ID.

Figure 57) LEDs on the left side of E2800 controller canister with RJ-45 iSCSI host ports.
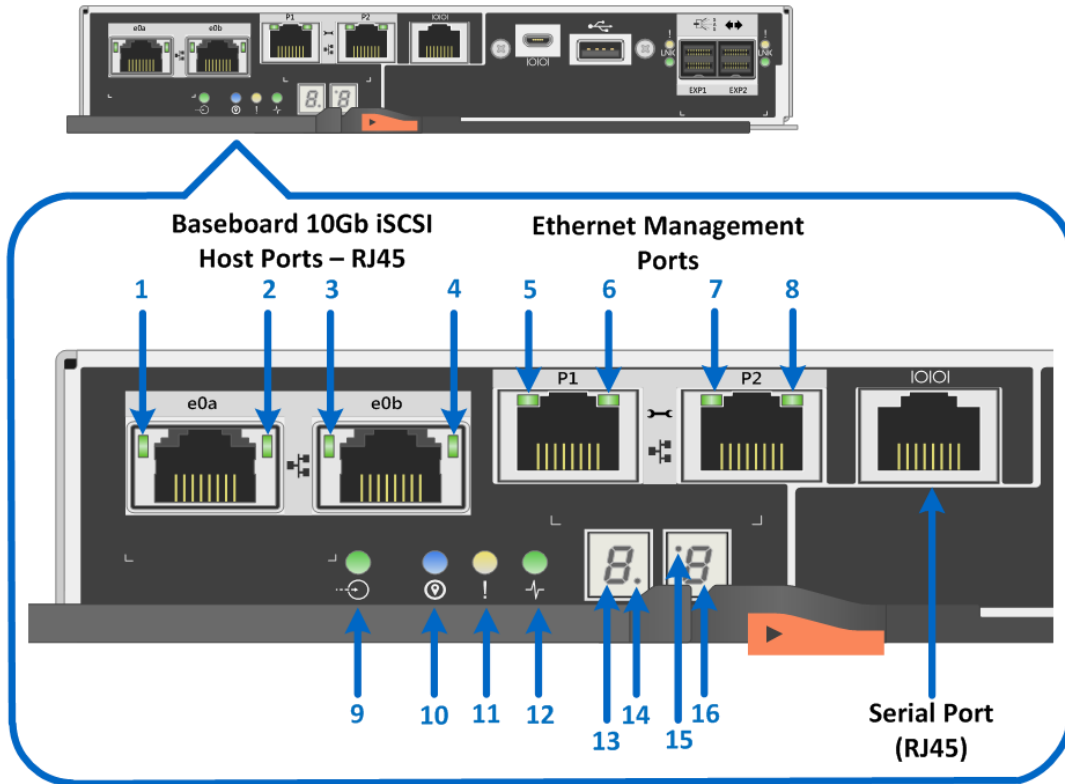
1. Baseboard Host Port e0a iSCSI Link State LED
2. Baseboard Host Port e0a iSCSI Link Activity LED
3. Baseboard Host Port e0b iSCSI Link State LED
4. Baseboard Host Port e0b iSCSI Link Activity LED
5. Ethernet Management Port P1 Link State LED
6. Ethernet Management Port P1 Link Activity LED
7. Ethernet Management Port P2 Link State LED
8. Ethernet Management Port P2 Link Activity LED
9. Cache Active LED
10. Locate LED
11. Attention LED
12. Activity LED
13. Seven-segment Display – Upper Digit
14. Flashing dot heartbeat indicator
15. On to indicate diagnostic code LED
16. Seven-segment Display – Lower Digit

Table 18 defines the baseboard host interface port LEDs (LEDs 1 through 4 in Figure 57). These LEDs indicate the connection status for each link between the storage system and host-side hardware.

Table 18) iSCSI RJ-45 baseboard host port LED definitions.

LED Name	Color	LED On	LED Off
Host port link state (top left)	Green	Link is up.	Link is down.

LED Name	Color	LED On	LED Off
Host port link activity (top right)	Green	Link activity.	No link activity.

Table 19 defines the Ethernet management port LEDs on the controller (LEDs 5 through 8 in Figure 57).

Table 19) Ethernet management port LED definitions.

LED Name	Color	LED On	LED Off
Ethernet management port link state (top left)	Green	Link is up.	Link is down.
Ethernet management port link activity (top right)	Green	Blinking: The link is up with activity.	No link activity.

Table 20 defines the controller status LEDs (LEDs 9 through 15 in Figure 57).

Table 20) Controller base features LED definitions.

LED Name	Color	LED On	LED Off
Cache active	Green	Write data in cache.	Normal status.
Locate	Blue	Request to locate the enclosure is active.	Normal status.
Attention	Amber	Some fault exists in the controller canister.	Normal status.
Activity	Green	Blinking: controller active.	Controller is not in service.
Heartbeat (upper digit of seven-segment LED, lower right)	Yellow	Blinking: heartbeat.	Controller is not in service.
Diagnostic (lower digit of seven-segment LED, upper left)	Yellow	Seven-segment display indicates diagnostic code.	Seven-segment display indicates shelf ID.
Two seven-segment LEDs	Yellow	• Shelf ID if diagnostic LED off. • Diagnostic code if diagnostic LED on.	The controller is not powered on.

Figure 58 shows the onboard LED status indicators on the left side of the E2800 controller canister with the 16Gb FC or 10Gb iSCSI baseboard host port LEDs.

Figure 58) LEDs on left side of E2800 controller canister with 16Gb FC/10Gb iSCSI host ports.
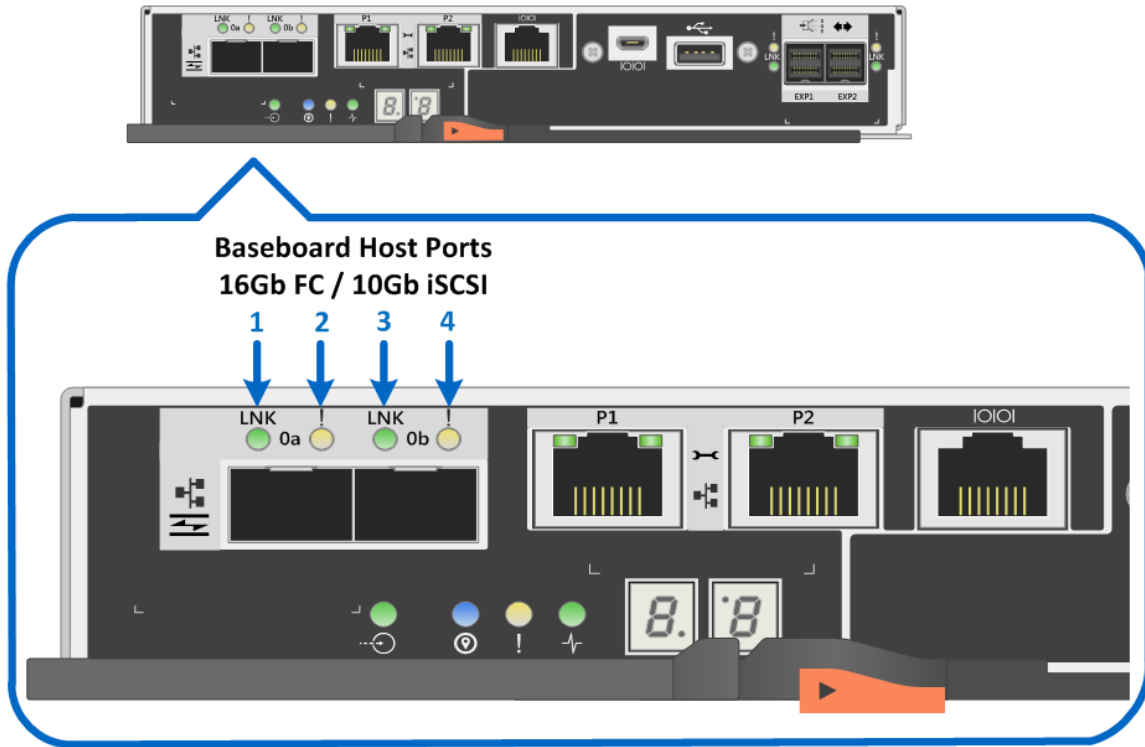
1. **Baseboard Host Port 0a 16GB FC/10Gb iSCSI Link LED**
2. **Baseboard Host Port 0a 16GB FC/10Gb iSCSI Fault LED**
3. **Baseboard Host Port 0b 16GB FC/10Gb iSCSI Link LED**
4. **Baseboard Host Port 0b 16GB FC/10Gb iSCSI Fault LED**

Table 21 defines the baseboard host interface port LEDs (LEDs 1 through 4 in Figure 58). These LEDs indicate the connection status for each link between the storage system and host-side hardware.

Table 21) 16Gb FC/10Gb iSCSI baseboard host port LED definitions.

LED Name	Color	LED On	LED Off
Host port link/activity	Green	• Solid: link up with no activity. • Blinking: link up with activity.	Link is down.
Host port attention	Amber	Port requires operator attention.	Normal status.

Drive-Side SAS Expansion Port LEDs

The E2800 controller canister is equipped with two SAS expansion ports that are used to connect expansion drive shelves to the E2800 controller shelf. Figure 59 shows the SAS expansion port LEDs.

Figure 59) LEDs for drive expansion ports (no HIC installed).
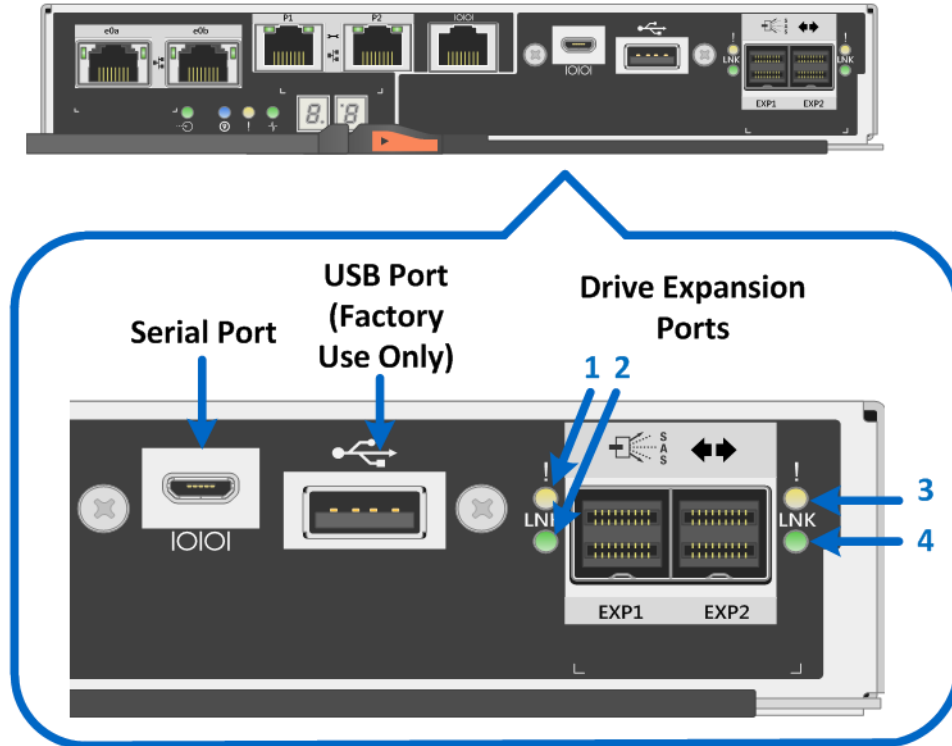
1. **Drive Expansion Port EXP1 Fault LED**
2. **Drive Expansion Port EXP1 Link LED**
3. **Drive Expansion Port EXP2 Fault LED**
4. **Drive Expansion Port EXP2 Link LED**

Table 22 defines each drive-side LED (LEDs 1 through 4 in Figure 59).

Table 22) Drive expansion port LED definitions.

LED Name	Color	LED On	LED Off
Drive expansion fault	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.	Port is optimal (all PHYs in the port are up).
Drive expansion link	Green	Link is up.	Link is down.

E2800 Optional Host Interface Cards

The E2800 supports several host interface expansion options, including SAS, FC, and iSCSI:

- When the baseboard host ports are optical, as shown in Figure 50, all five HIC options are available.
- When the baseboard host ports are 10Gb iSCSI Base-T, as shown in Figure 51, only the 2-port 10Gb iSCSI Base-T HIC or 2-port and 4-port 12Gb SAS HICs expansion HICs are supported.

2-Port 10Gb iSCSI RJ-45 HIC LEDs

The 2-port 10Gb iSCSI copper HIC has two standard RJ-45 connectors, as shown in Figure 60, and uses standard RJ-45 Twinax cables to connect to switches or directly to hosts.

Figure 60) LEDs on the 2-port 10Gb iSCSI RJ-45 HIC.
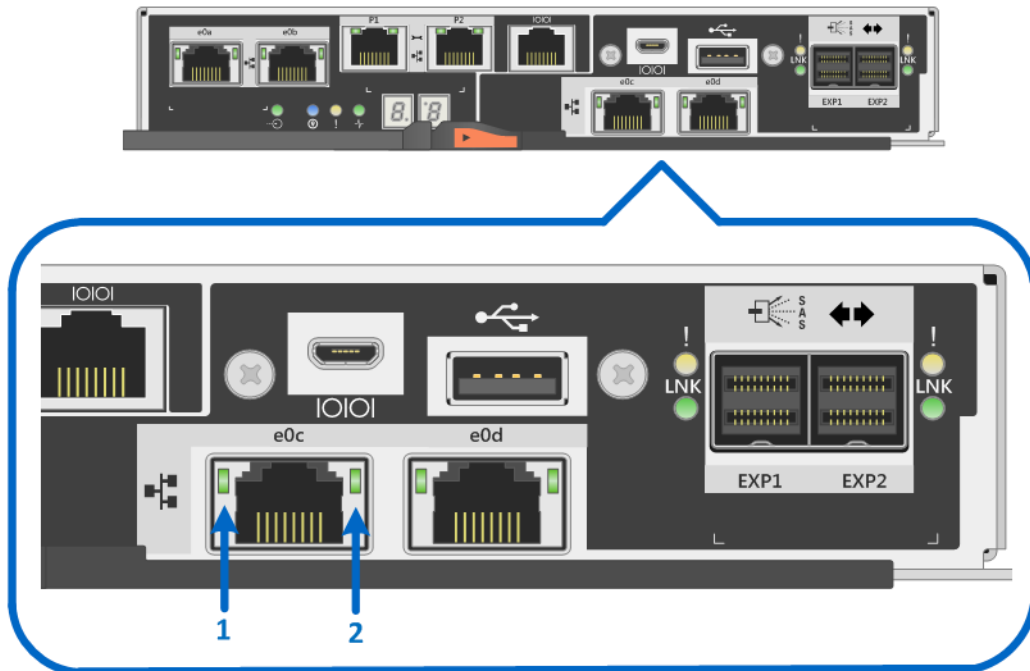
1. **Host iSCSI Expansion (RJ45) Port e0c Link State LED**
2. **Host iSCSI Expansion (RJ45) Port e0c Link Activity LED**

Table 23 defines the LEDs on the 2-port 10Gb iSCSI HIC.

Note: The drive expansion port LEDs are defined in Table 22.

Table 23) 2-port 10Gb iSCSI HIC LED definitions.

LED Name	Color	LED On	LED Off
Host port link state (top left)	Green	Link is up.	Link is down.
Host port link activity (top right)	Green	Link activity.	No link activity.

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

Figure 61 and Figure 62 show the LEDs for the 4-port and 2-port 12Gb SAS HICs. LEDs are called out for only the 4-port SAS HIC; the 2-port HIC LEDs are the same.

Note: The SAS expansion HICs are the same for both E2800 controller models. Figure 61 shows the E2800 controller with the 2-port optical onboard ports and the 4-port optional SAS HIC installed.

Figure 61) LEDs for the 4-port 12Gb SAS HIC.
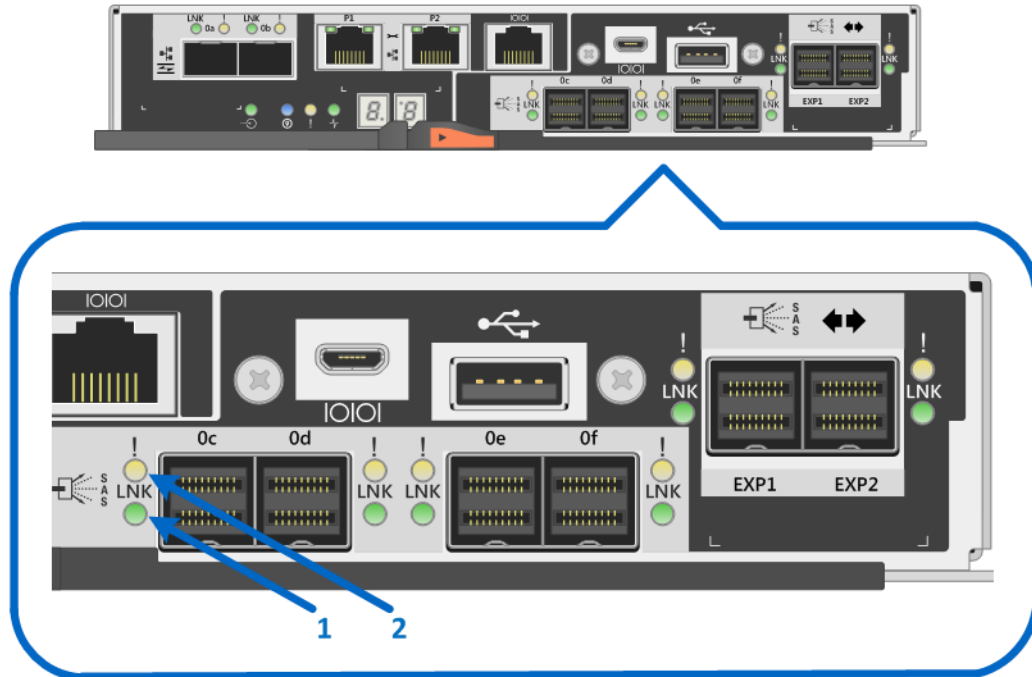
1. **Host SAS Expansion Port 0c Link LED**
2. **Host SAS Expansion Port 0c Fault LED**

Figure 62) LEDs for the 2-port 12Gb SAS HIC.
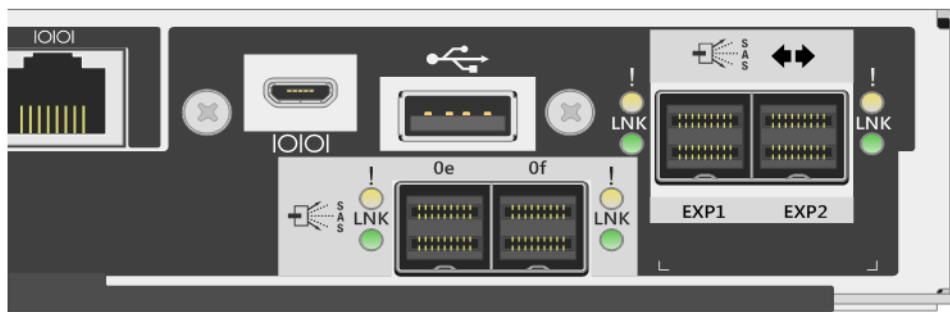
Table 24 defines the LEDs for the 12Gb SAS HICs.

Note: Table 22 defines the drive expansion port LEDs.

Table 24) 2-port and 4-port 12Gb SAS HIC LED definitions.

LED Name	Color	LED On	LED Off
Drive expansion link	Green	Link is up.	Link is down.

LED Name	Color	LED On	LED Off
Drive expansion fault	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.	Port is optimal (all PHYs in the port are up).

2-Port and 4-Port Optical HIC (16Gb FC or 10Gb iSCSI) LEDs

The E2800 controller supports a 2-port or 4-port optical HIC that offers 16Gb FC protocol or 10Gb iSCSI protocol. The 2-port HIC is functionally equivalent to the 4-port HIC. When using the 4-port HIC and dual controllers, the E2800 storage system provides a maximum of 12 16Gb FC or 12 10Gb iSCSI ports or a mixture of 16Gb FC and 10Gb iSCSI ports.

Figure 63 and Figure 64 show the LEDs for the 4-port and 2-port optical HIC. LEDs are called out for only the 4-port optical HIC; the 2-port HIC LEDs are the same.

Figure 63) LEDs for the 4-port optical HIC (16Gb FC or 10Gb iSCSI).
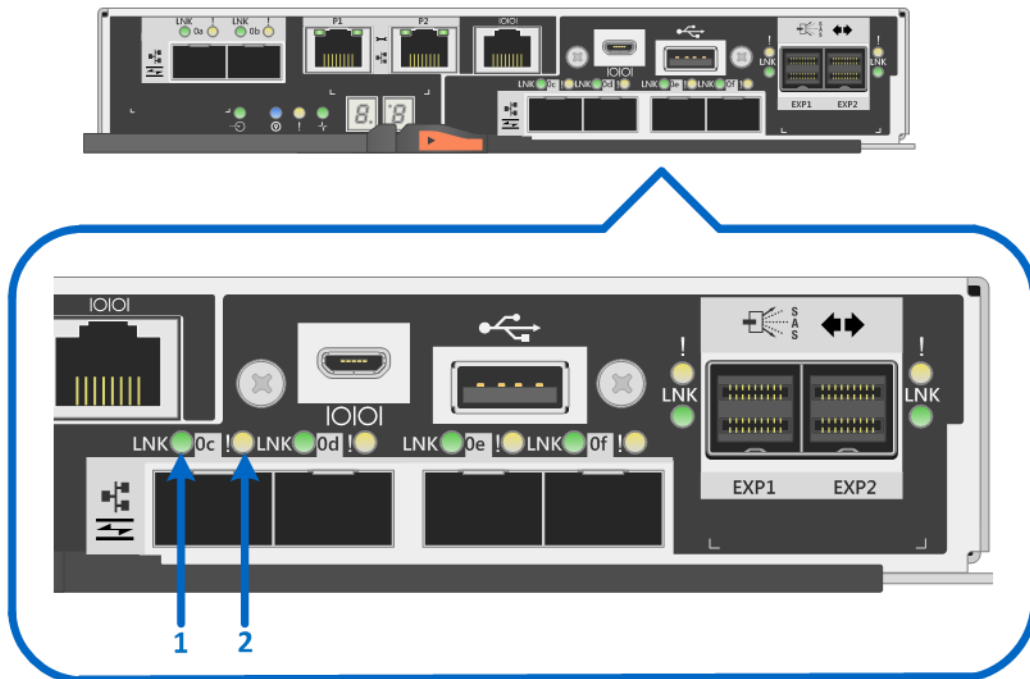
1. Host 16Gb FC / 10Gb iSCSI Expansion Port 0c Link LED
2. Host 16Gb FC / 10Gb iSCSI Expansion Port 0c Fault LED

Figure 64) LEDs for the 2-port optical HIC (16Gb FC or 10Gb iSCSI).
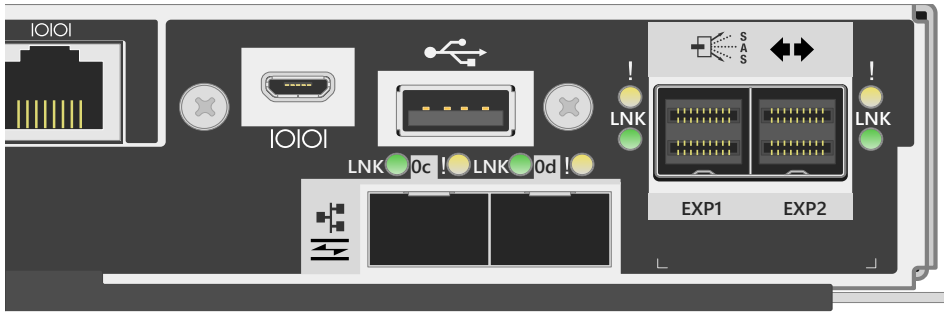
Table 25 defines the LEDs on the 2-port and 4-port optical HICs (16Gb FC or 10Gb iSCSI).

Note: Table 22 defines the drive expansion port LEDs.

Table 25) 2-port and 4-port optical HIC (16Gb FC or 10Gb iSCSI) LED definitions.

LED Name	Color	LED On	LED Off
Host port link/activity	Green	• Solid: link up with no activity. • Blinking: link up with activity.	Link is down.
Host port attention	Amber	Port requires operator attention.	Normal status.

4-Port 32Gb FC HIC LEDs

The E2800 controller beginning with SANtricity 11.50 supports a 4-port 32Gbps FC HIC that offers the ability to auto-negotiate down to 16Gbps by using the 32Gbps SFP or the 16Gbps SFP. The new 32Gb FC HIC does require OM4 fiber cable to connect to switches or to connect directly to hosts. Figure 63 shows the LEDs for the 4-port 32Gbps FC HIC.

Figure 65) LEDs for the 4-port 32Gb FC HIC.
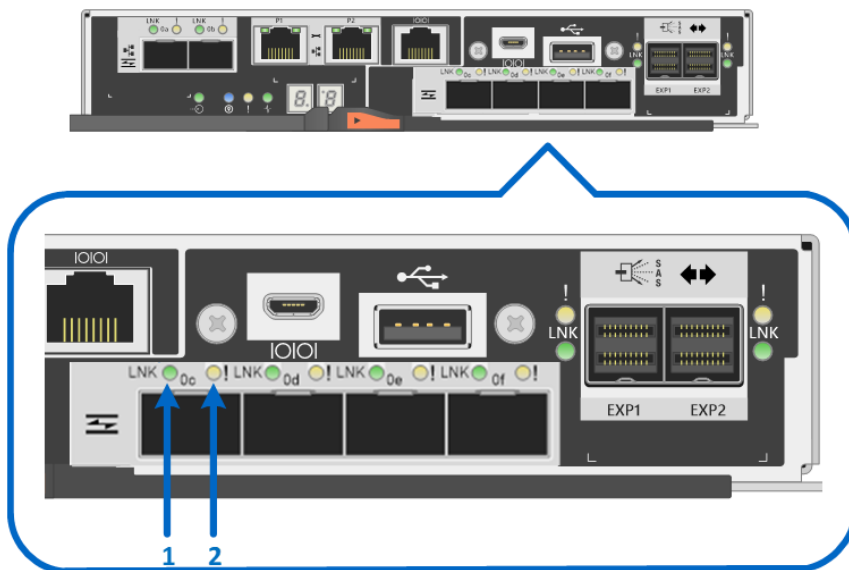
1. **Host 32Gb FC Port 0c Link LED**
2. **Host 32Gb FC Port 0c Fault LED**

Table 26 defines the LEDs on the 4-port 32Gbps FC HIC.

Table 26) LED definitions for the 4-port 32Gbps FC HIC.

LED Name	Color	LED On	LED Off
Host port link/activity	Green	• Solid: link up with no activity. • Blinking: link up with activity.	Link is down.
Host port attention	Amber	Port requires operator attention.	Normal status.

Note: The LED definitions for port 0c repeat for ports 0d, 0e, and 0f.

4-Port 25Gb iSCSI HIC LEDs

The E2800 controller beginning with SANtricity 11.50 supports a 4-port 25Gbps iSCSI HIC that offers the ability to also run at 10Gbps by changing the port speed on each controller by using SANtricity System Manager without changing the 25Gbps SFP (25Gbps SFP supports 10Gbps speed). The new 25Gb iSCSI HIC does require OM4 fiber cable to connect to switches or directly to hosts. Figure 66 shows the LEDs for the 4-port 25Gbps iSCSI HIC.

Figure 66) LEDs for the 4-port 25Gb iSCSI HIC.
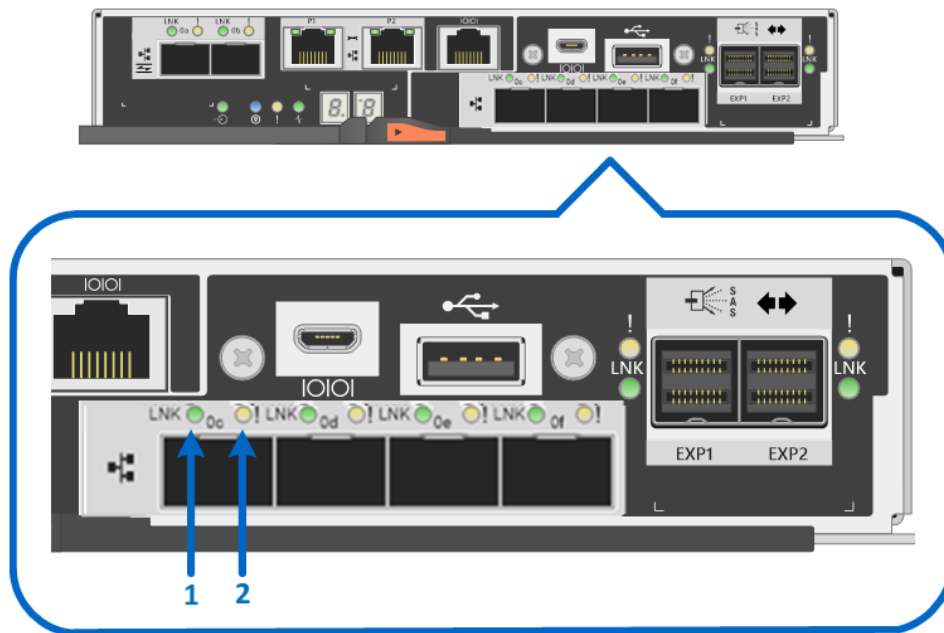
1. **Host 25Gb iSCSI Port 0c Link LED**
2. **Host 25Gb iSCSI Port 0c Fault LED**

Table 27 provides the LED definitions for the 4-port 25Gb iSCSI HIC.

Table 27) LED definitions for the 4-port optical 25Gb iSCSI HIC.

LED Speed (Left Side)	LED Activity (Right Side)	Link Rate	Color
On	On	Link operating at 25Gbps; no activity	Green

LED Speed (Left Side)	LED Activity (Right Side)	Link Rate	Color
	Blinking	Link operating at 25Gbps with active I/O in progress	Green
Off	On	Link operating at 10Gbps; no activity	Green
	Blinking	Link operating at 10Gbps with active I/O in progress	Green
Off	Off	Link down	N/A

Note: The LED definitions for port 0c repeat for ports 0d, 0e, and 0f.

5.4 Setting the Shelf ID with the ODP Pushbutton

The shelf ID for the controller shelves and drive shelves can be changed externally by using the ODP push button. Figure 67, Figure 68, and Figure 69 show the push button for the E2812 (DE212C), E2824 (DE224C), and E2860 (DE460C), respectively.

Figure 67) ODP on the E2812 or DE212C (front bezel or end caps removed).
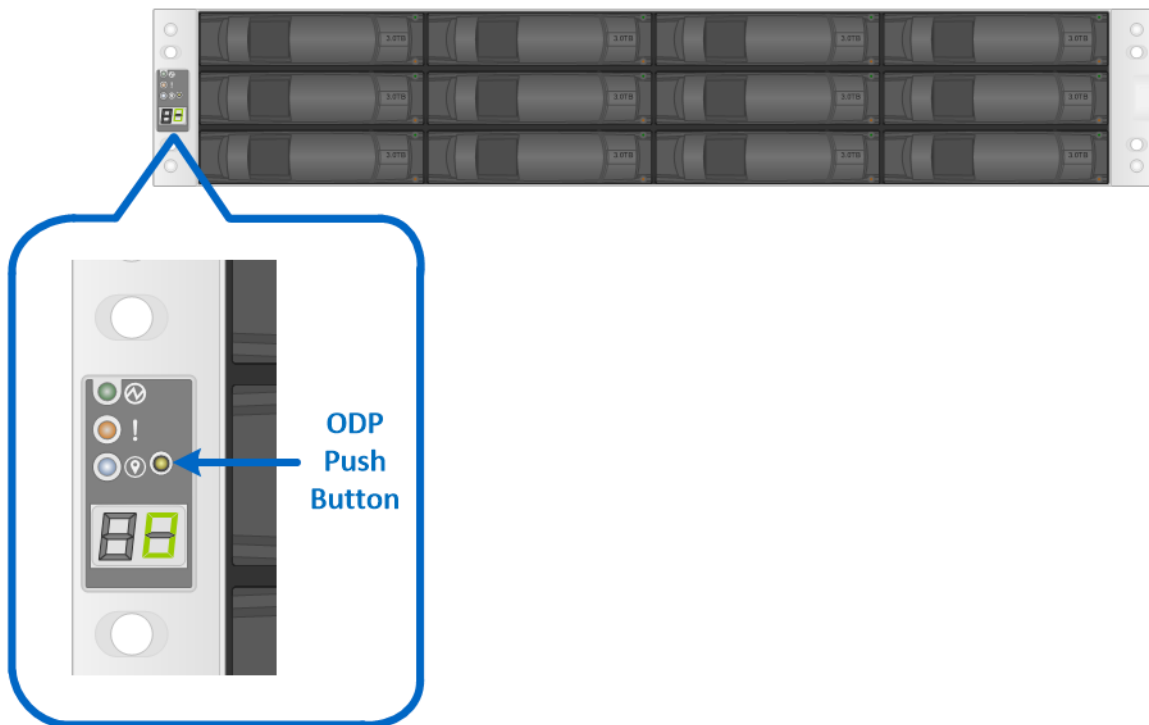
Figure 68) ODP on the E2824 or DE224C (front bezel or end caps removed).
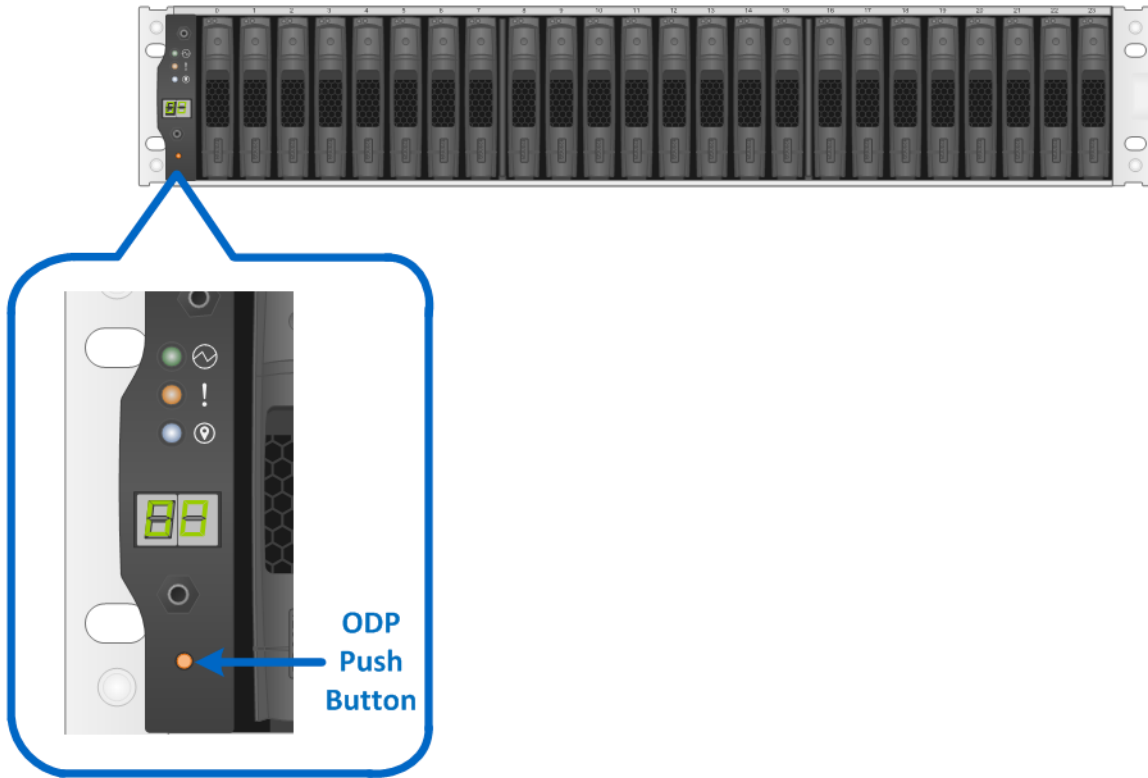
Figure 69) ODP on the E2860 or DE460C (front bezel removed).

Follow these steps to modify the shelf ID:

1. Turn on the power to the shelf if it is not already on.

2. Remove either the front bezel or the left end cap to locate the ODP push button.

3. Change the first number of the shelf ID by pressing and holding the button until the first number on the digital display blinks, which can take two to three seconds.

4. If the ID takes longer than two to three seconds to blink, press the button again, making sure to press it in all the way. This action activates the shelf ID programming mode.

5. Press the button to advance the number until you reach the desired number from 0 to 9. The first number continues to blink.

6. Change the second number of the shelf ID by pressing and holding the button until the second number on the digital display blinks, which can take two to three seconds. The first number on the digital display stops blinking.

7. Press the button to advance the number until you reach the desired number from 0 to 9. The second number continues to blink.

8. Lock in the desired number and exit the programming mode by pressing and holding the button until the second number stops blinking, which can take two to three seconds.

9. Repeat steps 1 through 8 for each additional shelf.

Note: It is also possible to modify the shelf ID using SANtricity System Manager.

For additional information about the E2800 storage systems and related hardware, refer to the E2800 series documentation at http://mysupport.netapp.com/eseries.

6 Drive Shelves

The E2800 controller shelf supports 12, 24, or 60 drives based on the shelf model (DE212C, DE224C, or DE460C, respectively), but the system capacity can be further expanded by adding additional expansion drive shelves to the controller shelf. The E2800 supports up to 4 total shelves, the controller shelf plus three expansion drive shelves, for a maximum of 180 HDDs (120 SSDs). Table 28 shows the drive shelf options.

Table 28) Drive shelf options for E2800.

Property	DE212C	DE224C	DE460C	DE1600	DE5600	DE6600
Form factor	2RU	2RU	4RU	2RU	2RU	4RU
Drive size	3.5" 2.5" (with bracket)	2.5"	3.5" 2.5" (with bracket)	3.5"	2.5"	3.5" 2.5" (with bracket)
Drive types	NL-SAS SSD	SAS SSD	SAS NL-SAS SSD	NL-SAS	SAS SSD	SAS NL-SAS SSD
Total drives	12	24	60	12	24	60
Drive interface	12Gb SAS	12Gb SAS	12Gb SAS	6Gb SAS	6Gb SAS	6Gb SAS

Note: DE1600, DE5600, and DE6600 are supported only as part of in-place data migration from E2700/E5400/E5500/E5600 to E2800.

6.1 Drive Shelf Configurations

E2800 controllers can be paired with all six E-Series shelves, and the shelves can be mixed in the same storage system. The older 6Gb SAS 2 drive shelves (DE1600, DE5600, and DE6600) are not covered in detail in this document. For more information, see the E-Series Disk Shelves documentation. The following sections provide detailed information about the 12Gb SAS 3 drive shelves (DE212C, DE224C and DE460C).

DE212C Drive Shelf

The DE212C is a 2RU shelf that holds up to twelve 3.5-inch drives or 2.5-inch SSDs with adapter. It features dual high-speed 12Gb SAS 3 I/O modules (IOMs) and dual ENERGY STAR Platinum certified high-efficiency power supplies (913W) with integrated fans, in a duplex system. It is fully redundant with hot-swappable components.

Figure 70, Figure 71, and Figure 72 show the front and rear views of the DE212C drive shelf.

Figure 70) DE212C front view with end caps.

Figure 71) DE212C front view without end caps.

Figure 72) DE212C rear view.
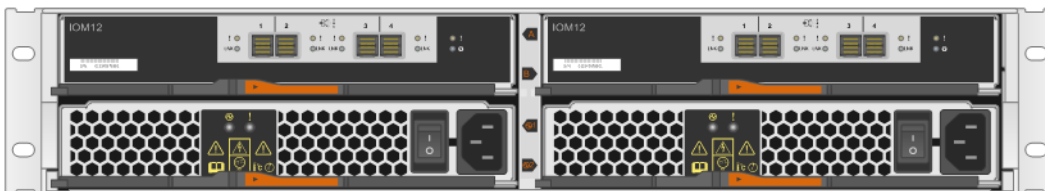
DE224C Drive Shelf

The DE224C is a 2RU shelf that holds up to twenty-four 2.5-inch drives. It features dual high-speed 12Gb SAS 3 IOMs and dual ENERGY STAR Platinum certified high-efficiency power supplies (913W) with integrated fans, in a duplex system. It is fully redundant with hot-swappable components.

Figure 73, Figure 74, and Figure 75 show the front and rear views of the DE224C drive shelf.

Figure 73) DE224C front view with end caps.

Figure 74) DE224C front view without end caps.

Figure 75) DE224C rear view.
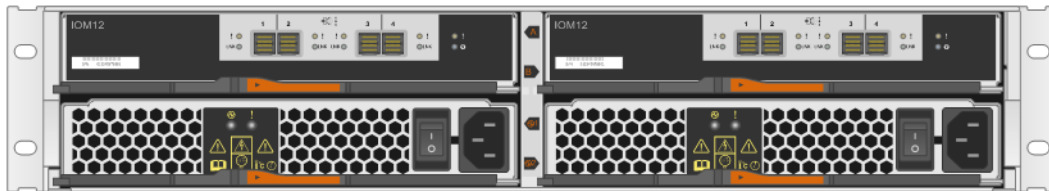
DE460C Drive Shelf

The DE460C is a 4RU shelf that holds up to sixty 3.5-inch or 2.5-inch drives. It features dual high-speed 12Gb SAS 3 IOMs and dual ENERGY STAR Platinum certified high-efficiency power supplies (2325W) with separate dual fan modules, in a duplex system. From a controller, power, and cooling perspective, it is fully redundant with hot-swappable components. From a drive maintenance perspective, simply open a running drawer and insert new drives in open slots or replace a defective drive nondisruptively to other running drives in the drawer.

Figure 76, Figure 77, and Figure 78 show the front and rear views of the DE460C drive shelf.

Figure 76) DE460C front view with bezel.
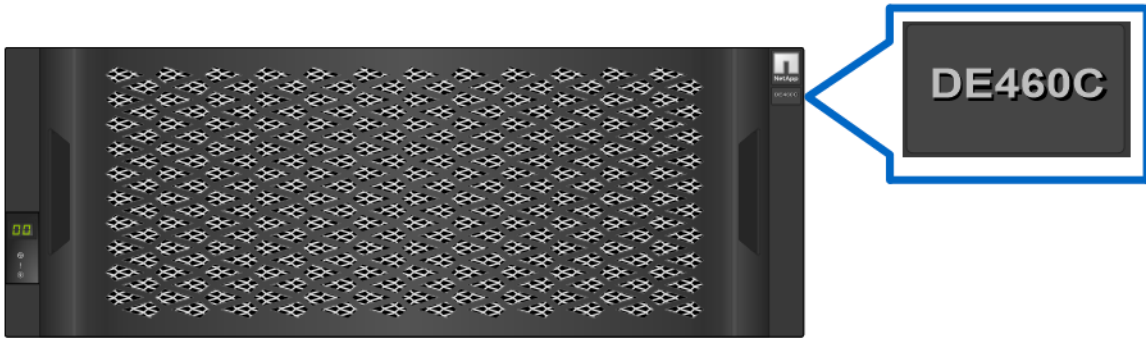
Figure 77) DE460C front view without bezel.
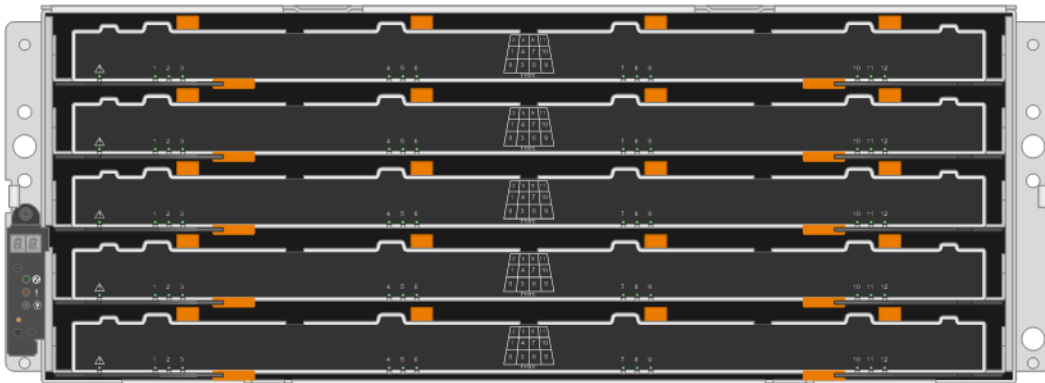
Figure 78) DE460C rear view.

IOM LED Definitions

Figure 79 shows the LEDs for the 4-port 12Gb SAS 3 IOM. LEDs are highlighted only for SAS expansion port 1 and for the IOM. SAS expansion ports 2 through 4 have similar LEDs.

Figure 79) LEDs for IOM.
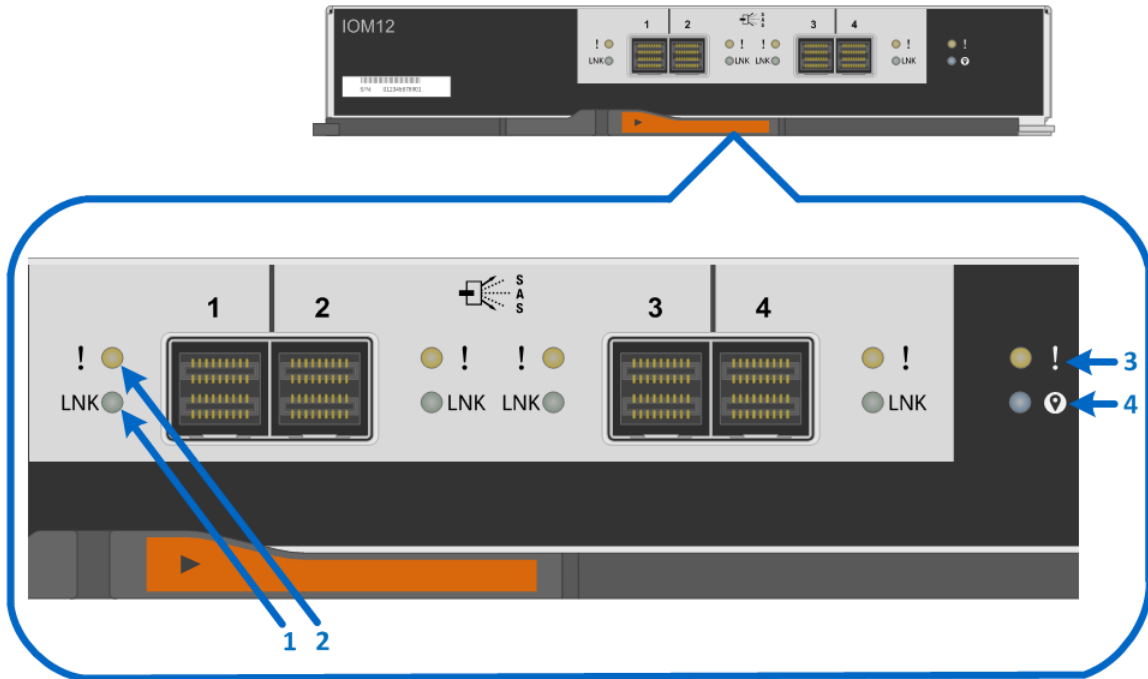
1. **Drive Expansion Port 1 Link LED**
2. **Drive Expansion Port 1 Fault LED**
3. **Attention LED**
4. **Locate LED**

Table 29 defines the LEDs for the IOM.

Table 29) IOM LED definitions.

LED Name	Color	LED On	LED Off
Drive expansion link	Green	Link is up.	Link is down.
Drive expansion fault	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.	Port is optimal (all PHYs in the port are up).
Attention	Amber	Some fault exists in the IOM.	Normal status.
Locate	Blue	Request to locate the enclosure is active.	Normal status.

Drive LED Definitions

Figure 80 and Figure 81 show the LEDs on the drive carriers for the E2812 and E2824, respectively.

Figure 80) E2812 drive carrier LEDs.

1. **Activity LED**
2. **Attention LED**
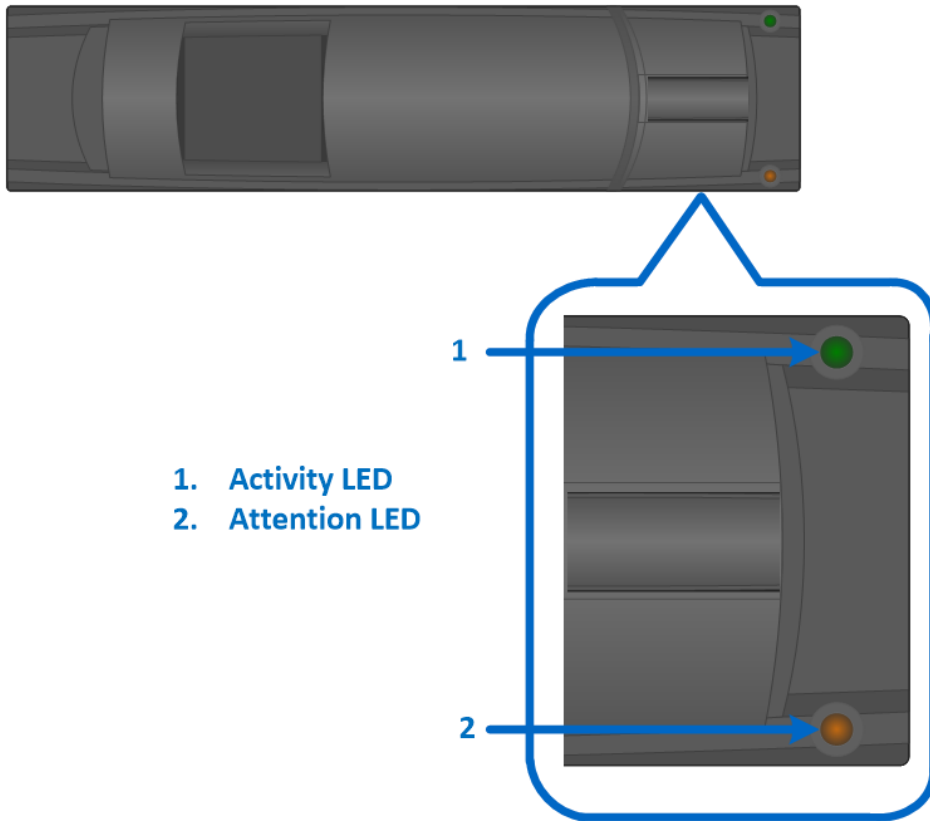
Figure 81) E2824 drive carrier LEDs.

1. **Activity LED**
2. **Attention LED**
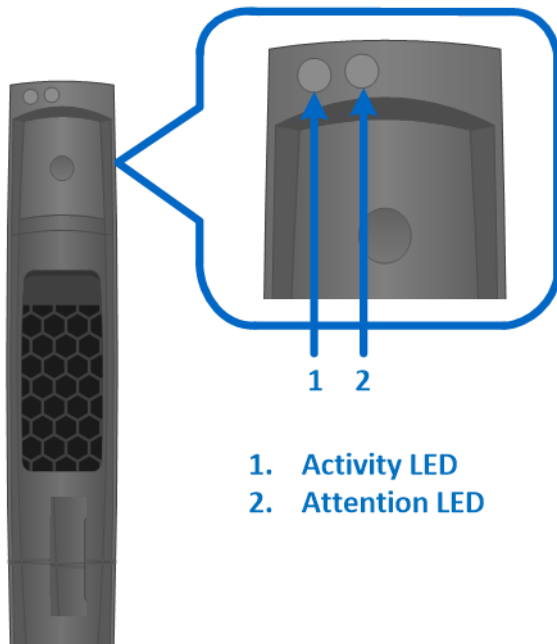
Table 30 defines the LEDs for the drives.

Table 30) E2812 and E2824 drive LED definitions.

LED Name	Color	LED On	LED Off
Activity	Green	Drive has power.	Drive does not have power.
	Blinking green	The drive has power, and I/O is in process.	No I/O is in process.
Attention	Amber	An error occurred with the functioning of the drive.	Normal status.
Attention	Blinking amber	Drive locate turned on.	Normal status.

For the DE460C shelf, the drive activity and attention LEDs are displayed on the drawer (Figure 82). It has an attention LED (Figure 83) that displays when the drawer is open. The drawer and shelf also have attention LEDs to indicate the location of the drive (Figure 82). Note that the drive activity LED is not illuminated for a failed drive.

Figure 82) E2860 shelf and drawer attention LEDs.

1. **Shelf Attention LED**
2. **Drawer Attention LED**
3. **Drive Activity LED**
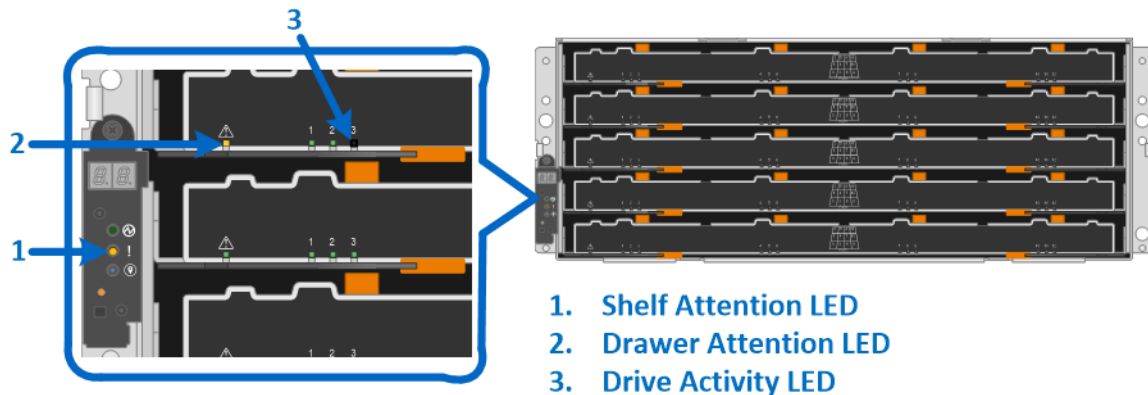
Figure 83) E2860 drive attention LED.

Drive Attention LED

Table 31 defines the LEDs for the drives, drawers, and shelf of the E2860.

Table 31) E2860 drive LED definitions.

LED Name	Color	LED On	LED Off
Drive activity	Green	Drive has power.	Drive does not have power, or an error occurred with the functioning of the drive.
	Blinking green	The drive has power, and I/O is in process.	Drive does not have power, or an error occurred with the functioning of the drive.
Shelf attention	Amber	An error occurred with the functioning of a drive.	Normal status.
Drawer attention	Amber	An error occurred with the functioning of a drive.	Normal status.
Drawer attention	Blinking amber	Drive locate turned on.	Normal status.
Drive attention	Amber	An error occurred with the functioning of the drive.	Normal status.
Drive attention	Blinking amber	Drive locate turned on.	Normal status.

6.2   Greenfield Installation

E2800 storage systems use two cabling methods: single stack and dual stack. The single-stack method is used only when the storage system has a controller shelf and a single drive shelf, as shown in Figure 84.

Figure 84) E2800 single-stack system configuration.
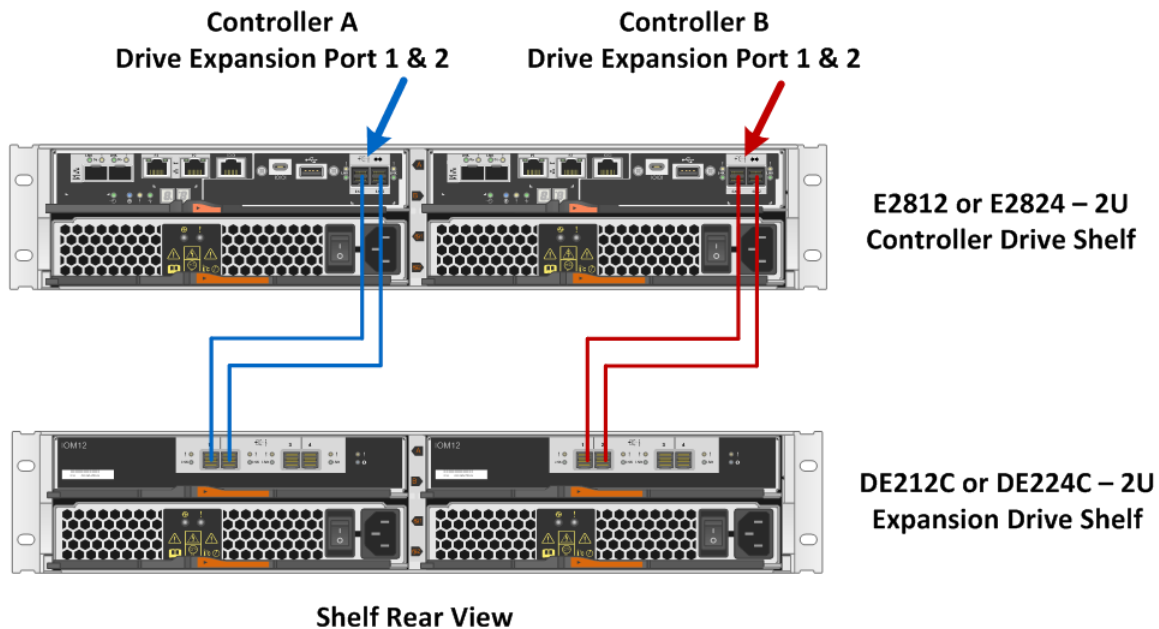
For E2800 storage systems with two or more drive shelves or a mix of SAS 3 and SAS 2 drive shelves, use the dual-stack cabling method (Figure 85).

Note: For optimal performance, SAS 2 and SAS 3 drive shelves should be isolated into different stacks.

Figure 85) E2800 storage system dual-stack configuration with SAS 3 and SAS 2 shelves.
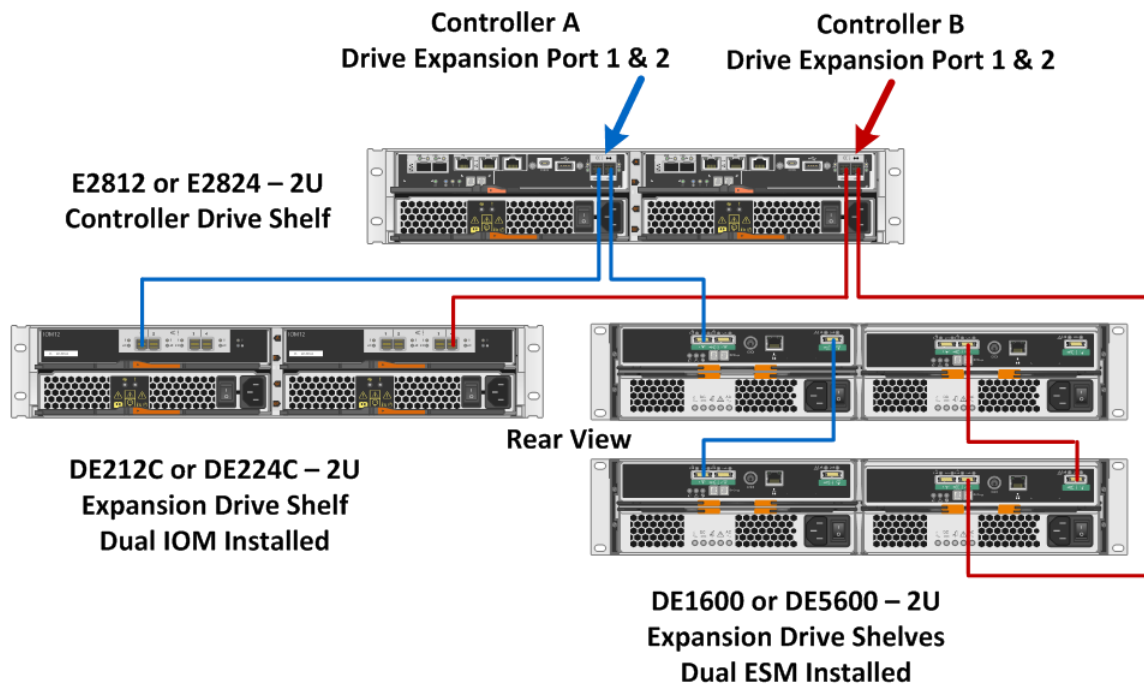
For simplex controller systems, use the same cabling methods shown in Figure 84 and Figure 85 (blue paths) for the A-side controller as appropriate based on whether the system has just 12Gb drive shelves versus 12Gb shelves and 6Gb shelves connected to the same E2800 controller shelf.

Note: Only use dual-stack cabling if you have a mix of 12Gb and 6Gb expansion drive shelves. Otherwise, use the single-stack cabling method when all expansion drive shelves are new generation 12Gb shelves.

Failure to cable 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.

6.3   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 recommended by NetApp. 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.

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 volume groups and disk pools.

When adding a 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 E-Series Hardware Cabling Guide.

Note: For more information and assistance with adding a 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 86 and Figure 87 show the hot-add connectivity when a drive shelf is added as the last shelf in the system. The E2812 and E2824 are shown; the cabling for E2860 is similar.

Figure 86) Drive shelf hot-add A-side cabling.
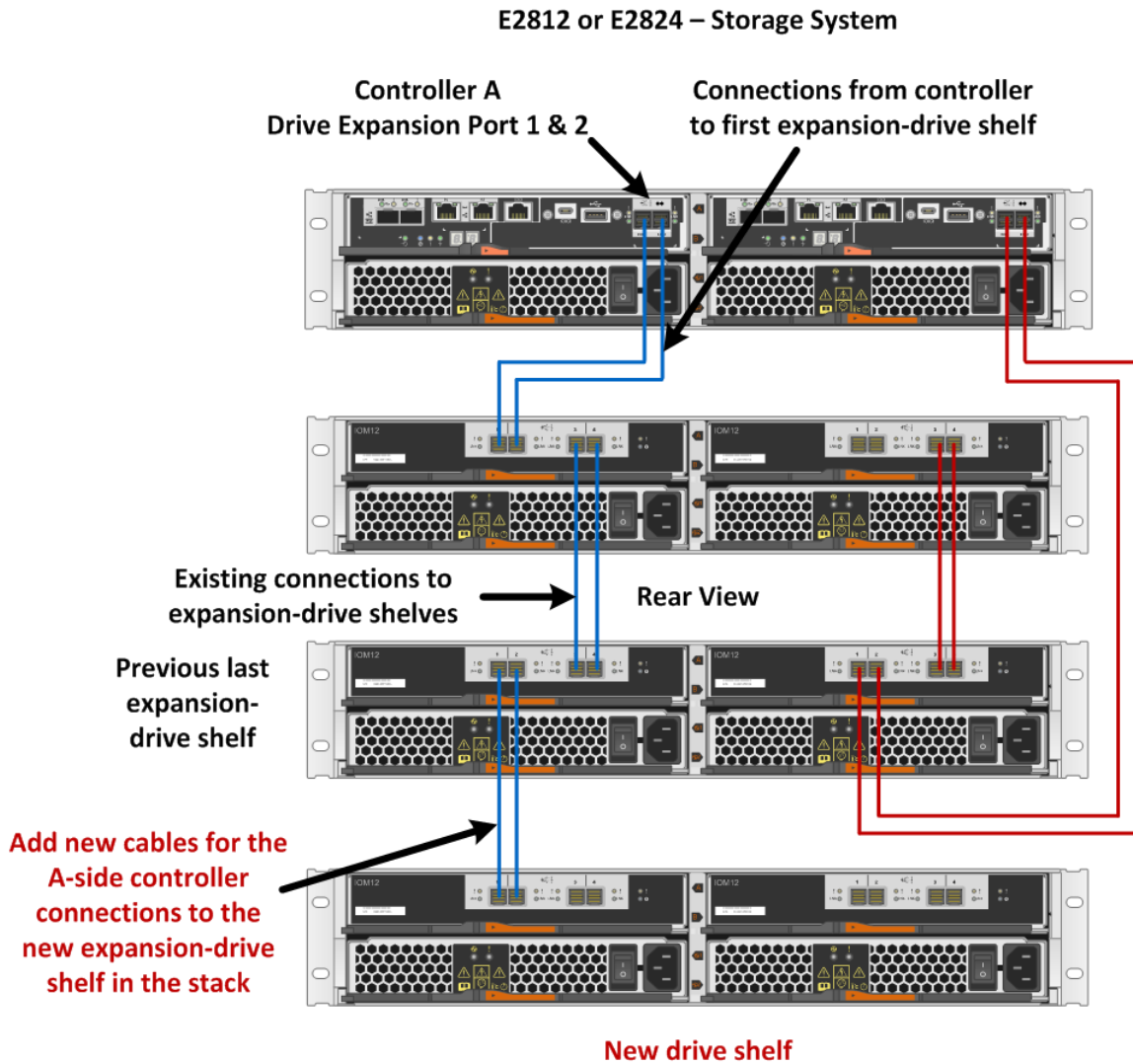
Figure 87) Drive shelf hot-add B-side cabling.

E2812 or E2824 – Storage System

Controller A
Drive Expansion Port 1 & 2

Connections from controller
to first expansion-drive shelf

Rear View

Previous last
expansion-drive
shelf

Connections added
previously to new
expansion-drive
shelf, IOM A

New drive shelf

Add new cables for the B-
side controller connections
to the new expansion-drive
shelf in the stack

Move B-side SAS cables from
previous last expansion-drive
shelf in the stack IOM B in ports
to the new last expansion-drive
shelf IOM B in ports

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. • The new expansion port 1 path is confirmed to be valid, and the new shelf is visible in the SANtricity management software before the expansion path 2 is disconnected and moved to the new shelf. **Note:** Failure to preserve one active path to existing drive shelves during the procedure could potentially result in degradation/failure of LUNs during I/O activity.

7 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 in 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.

7.1 Controller Shelf Serial Number

The E2800 storage systems are shipped preconfigured from the factory (controllers have HICs and batteries installed, and controllers are installed in the controller shelf). The chassis serial number is printed on a white label affixed to the controller shelf behind the right end cap on the front of the chassis. The SN is identified by the text "SN," which is shown in Figure 88.

Figure 88) Controller shelf SN.

The 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 chassis serial number is also available through SANtricity System Manager by selecting the Support tab and positioning your cursor over the Support Center tile, as shown in Figure 89.

Figure 89) SANtricity System Manager Support Center tile showing chassis serial number.
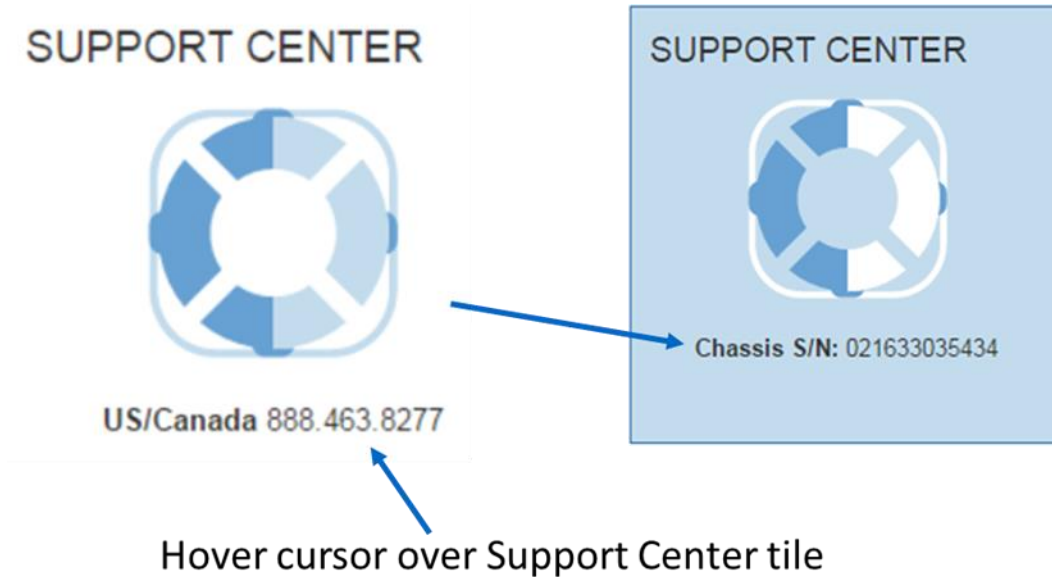
7.2 License Keys

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). For the E2800, all features are enabled out of the box.

Note: The encryption feature is disabled for systems sold in export-limited countries.

When E2800 controllers are equipped with either the 2-port optical baseboard or the 2 or 4-port optical 16Gb FC or 10Gb iSCSI HIC, feature pack keys are used to 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 generating a premium feature key, except that the 11-digit key activation code for each package is available at no additional cost. This process is listed in the hardware upgrade instructions per controller type, at https://mysupport.netapp.com/eseries.

After the feature pack file is downloaded to the host server, click Change Feature Pack (Figure 90). Follow the prompts, beginning with browsing to the feature pack file (Figure 91).

Figure 90) Change feature pack from Settings>System view.
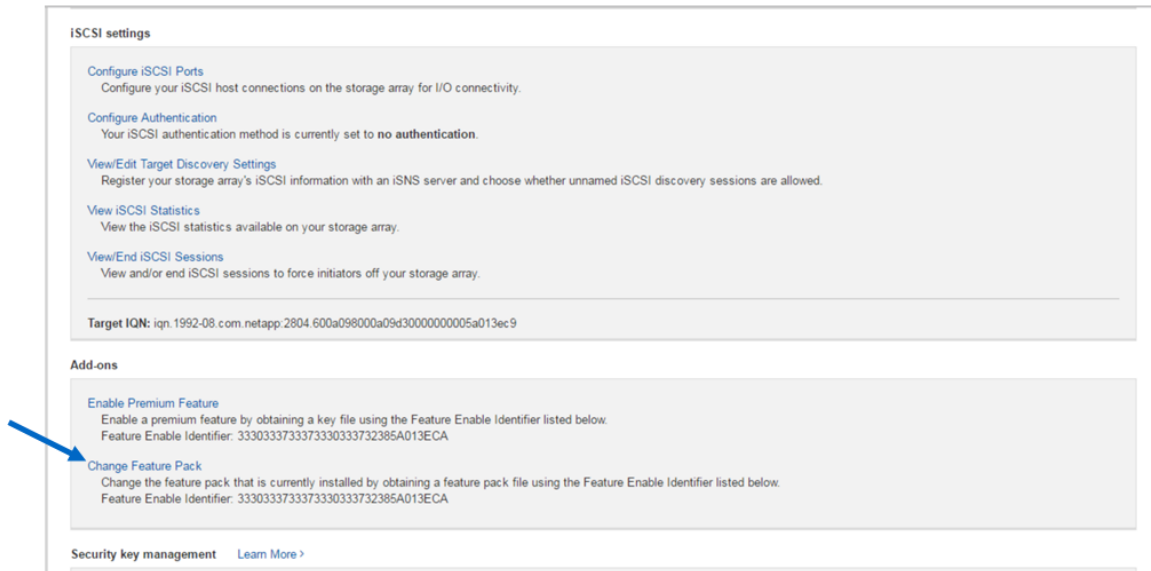
Figure 91) Change feature pack.
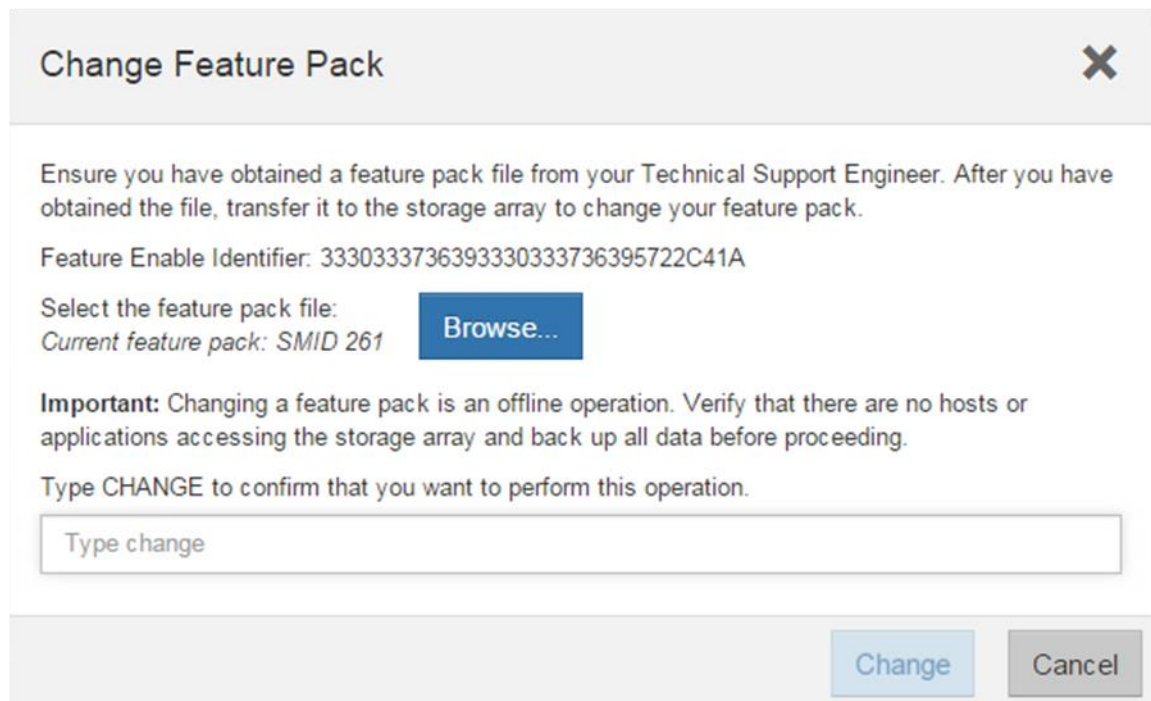
Note: This causes the storage array to reboot. The new protocol is active after the system is back online.

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

Summary

The E-Series E2800 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 System Manager web-based GUI.

E2800 storage systems offer balanced throughput performance for backup, video, and analytical environments and other sequential workloads. It also supports demanding IOPS workloads in small and medium enterprise data centers. The wide choice of drive speeds, capacities, and storage features with multiple host connectivity interface options make the E2800-based storage system the optimal choice for environments where simplicity, seamless integration with wide-ranging workloads, and a streamlined price/performance product focus are the key elements for customer success.

With the new SANtricity Unified Manager capabilities, you can securely manage new generation arrays (LDAP, RBAC, and time-saving array configuration features) and the new higher bandwidth host interfaces.

Appendix

System Manager Tables

SANtricity System Manager includes many of the same array-based tasks for the E2800 series storage arrays that are also included in the SANtricity AMW for other types of arrays. If you previously used the AMW, but are now using System Manager, you can refer to the following tables for a list of AMW functions and their corresponding locations in System Manager. The SANtricity System Manager online help is also an excellent reference guide.

Storage Array Options

Table 32 details how functions performed on the storage array are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 32) Storage array options: AMW compared to System Manager.

Function	AMW	System Manager		
	Storage Array > Option	Page	Tile	Option
Enable Premium features and feature pack	Premium Features	Settings	System	• Enable Premium Feature • Change Feature Pack
Set array password	Security > Set Password	Top, right area	N/A	• Preferences > Change Password • When you first log in and a password has not been set, you are required to enter a password.
Use drive security feature	Security > Create Key & Change Key	Settings	System	Change/Create Key
	Security > Save Key			Back Up Key
	Security > Validate Key			Validate Key
	Security > Import Key			Unlock Secure Drives
Change cache settings	Change > Cache Settings	Settings	System	Change Cache Settings
Set failover alert delay	Change > Failover Alert Delay	CLI/script editor only: Default is 5 minutes.		
Change iSCSI settings	iSCSI > Manage Settings	Settings	System	Configure Authentication View/Edit Target Discovery Settings
	iSCSI > View/End Sessions			View/End iSCSI Sessions; also available under Support >

Function	AMW	System Manager		
				Support Center > Diagnostics tab
Set automatic configuration	Configuration > Automatic > Disk Pools	Storage	Pools & Volume Groups	More > Launch pool autoconfiguration
	Configuration > Automatic > Volume Groups	CLI/script editor only		
Set automatic load balancing	Configuration > Automatic Load Balancing > Enable/Disable	Settings	System	Enable/Disable Automatic Load Balancing
Configure hot spares	Configuration > Hot Spare Coverage	Hardware	N/A	Highlight a drive and select Assign hot spare
Clear configuration	Configuration > Clear > Storage Array	Settings	System	Clear Storage Array Configuration
	Configuration > Clear > Volume			Clear Storage Array Configuration
Rename array	Rename			Select Name field edit icon
Set preferences	Preferences	Top, right area	N/A	Preferences > Set preferences
Quit the program	Exit			Logout

Disk Pool Options

Table 33 details how functions performed on disk pools are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 33) Disk pool options: AMW compared to System Manager.

Function	AMW	System Manager		
	Storage > Disk Pool > Option	Page	Tile/Tab	Option
Create pools	Create	Settings	Pools & Volume Groups > All Capacity tab	Create > Pool Also available on Home under the Storage Hierarchy, Pool Object
Locate pools	Locate			More > Turn on locator lights
View associated physical components	View Associated Physical Components	Hardware	N/A	Use filter control in top area

Function	AMW	System Manager		
Enable security for pools	Secure Drives	Storage	Pools & Volume Groups > All Capacity tab	More > Enable security
Add drive capacity	Add Drives (Capacity)			Add Capacity
Remove drive capacity	Remove Drives (Capacity)			More > Remove capacity
Replace drives (logical replacement)	Replace Drives	Hardware	N/A	Highlight a drive and select Logically replace
Change capacity settings	Change > Settings	Storage	Pools & Volume Groups > All Capacity tab	View/Edit Settings
Change ownership	Change > Ownership/Preferred Path	Storage	Volumes	More > Change ownership
Rename disk pool	Rename	Storage	Pools & Volume Groups > All Capacity tab	• View/Edit Settings • Edit directly in the table view by selecting the pencil icon in the Edit column
Delete disk pool	Delete			Uncommon Tasks > Delete
Check volume redundancy	Advanced > Check Redundancy			Uncommon Tasks > Check volume redundancy

Volume Group Options

Table 34 details how functions performed on volume groups are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 34) Volume group options: AMW compared to System Manager.

Function	AMW	System Manager		
	Storage > Volume Group > Option	Page	Tile/Tab	Option
Create volume group	Create	Settings	Pools & Volume Groups > All Capacity tab	• Create > Volume group • Also available on Home under the Storage Hierarchy, Volume Group Object
Locate volume group	Locate			More > Turn on locator lights
View associated	View Associated Physical Components	Hardware	N/A	Use filter control in top area

Function	AMW	System Manager		
physical components				
Enable security	Secure Drives	Storage	Pools & Volume Groups > All Capacity tab	More > Enable security
Add capacity	Add Drives (Capacity)			Add Capacity
Replace drives (logical replacement)	Replace Drives	Hardware	N/A	Highlight a drive and select Logically replace
Change ownership	Change > Ownership/Preferred Path	Storage	Volumes	More > Change ownership
Change RAID level	Change > RAID level	Storage	Pools & Volume Groups > All Capacity tab	View/Edit Settings
Rename volume group	Rename	Storage	Pools & Volume Groups > All Capacity tab	• View/Edit Settings • Edit directly in the table view by selecting the pencil icon in the Edit column
Delete volume group	Delete			Uncommon Tasks > Delete
Export and import volume group	Advanced > Export & Import	CLI/script editor only		
Initialize volumes	Advanced > Initialize	Storage	Volumes	More > Initialize volumes
Defragment volume groups	Advanced > Defragment	Storage	Pools & Volume Groups > All Capacity tab	• Uncommon Tasks > Consolidate volume group free capacity • Also available on the Home page in the notification area if there is a volume group with more than one free capacity area
Check redundancy	Advanced > Check Redundancy			Uncommon Tasks > Check volume redundancy

Volume Options

Table 35 details how functions performed on volumes are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 35) Volume options: AMW compared to System Manager.

Function	AMW	System Manager		
	Storage > Volume > Option	Page	Tile/Tab	Option
Create volume	Create	Storage	Volumes > All Volumes tab or Applications & Workloads tab	• Create > Volume • Also available on Home under the Storage Hierarchy, Volume Object • Also available under the Pools & Volume Groups tile and the Host tile
Increase volume capacity	Increase Capacity			Increase Capacity
Increase or decrease repository capacity	Increase/Decrease Repository Capacity	Storage	Pools & Volume Groups > Reserved Capacity tab	• Increase Capacity • Decrease Capacity
Enable or disable SSD cache	SSD Cache > Enable/Disable	Storage	Volumes > All Volumes tab or Applications & Workloads tab	View/Edit Settings
Change modification priority	Change > Modification Priority			View/Edit Settings
Change cache settings	Change > Cache Settings			More > Change cache settings
Change media scan settings	Change > Media Scan Settings			More > Change media scan settings
Change preread redundancy check	Change > Pre-Read Redundancy Check			View/Edit Settings
Change ownership/ preferred path	Change > Ownership/Preferred Path	Storage	Volumes > All Volumes tab or Applications & Workloads tab	More > Change ownership
Change segment size	Change > Segment Size			View/Edit Settings (only on volumes in volume groups)
Change repository settings	Change > Repository Settings	Storage	Pools & Volume Groups > Reserved Capacity tab	View/Edit Settings
Add volume to consistency group	Add to Consistency Group	Storage	Snapshots > Snapshot	Add Members

Function	AMW	System Manager		
Remove volume from consistency group	Remove from Consistency Group		Consistency Group tab	Remove: must expand consistency group and highlight individual volume member
View associated physical components	View Associated Physical Components	Hardware	N/A	Use filter control in top area; can perform the filter on only a volume group or disk pool, not an individual volume
Rename volume	Rename	Storage	Volumes > All Volumes tab or Applications & Workloads tab	View/Edit Settings Edit directly in the table view by selecting the pencil icon in the Edit column
Delete volume	Delete			Delete
Disable data assurance (DA)	Advanced > Disable Data Assurance (DA)	Storage	Volumes > All Volumes tab or Applications & Workloads tab	View/Edit Settings
Initialize volumes	Advanced > Initialize			More > Initialize volumes
Place volumes online	Advanced > Place Volumes Online	CLI/script editor only		
Redistribute volumes	Advanced > Redistribute Volumes	Storage	Volumes > All Volumes tab or Applications & Workloads tab	More > Initialize volumes
View repository expansion history	Advanced > View Repository Expansion History	Storage	Volumes > Thin Volume Monitoring tab	Select and expand a thin volume to see expansion history

SSD Cache Options

Table 36 details how functions performed on the SSD cache are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 36) SSD read cache options: AMW compared to System Manager.

Function	AMW	System Manager		
	Storage > SSD Cache > Option	Page	Tile/Tab	Option
Create SSD cache	Create	Storage	Pools & Volume	Create > SSD Cache

Function	AMW	System Manager		
Add capacity	Add Drives (Capacity)		Groups > All Capacity tab	Add Capacity
Remove drives	Remove Drives (Capacity)			More > Remove capacity
Suspend or resume	Suspend/Resume			More > Suspend/Resume SSD Cache
View statistics	View Statistics link (in right side properties)			More > View SSD Cache Statistics
Rename	Rename			• View/Edit Settings • Edit directly in the table view by selecting the pencil icon in the Edit column
Delete	Delete			Uncommon Tasks > Delete
Locating SSD cache	Locate			More > Turn on locator lights
View associated physical components	View Associated Physical Components	Hardware	N/A	Use filter control in top area
Run performance modeling	Run Performance Modeling	CLI/script editor only		

Copy Services Options

Snapshot Group

Table 37 details how functions performed on Snapshot groups are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 37) Snapshot group options: AMW compared to System Manager.

Function	AMW	System Manager		
	Copy Services > Snapshot Group > Option	Page	Tile/Tab	Option
Create, Create Snapshot Image, Revive, Overall Repository > Change Modification Priority, Change Media Scan Settings, Change Pre-Read Redundancy Check		The Snapshot group object has been abstracted as much as possible from the end user and is created as a result of other Snapshot operations. The only aspects that are still exposed are the items shown.		
Create or edit Snapshot image schedule	Create/Edit Snapshot Image Schedule	Storage	Snapshots > Schedule tab	All options (Create, Edit, Activate/Suspend, and Delete)

Function	AMW	System Manager		
Change Snapshot group settings, including rename and properties	Change Settings	Storage	Pools & Volume Groups > Reserved Capacity tab	View/Edit Settings
Increase or decrease capacity of overall repository	Overall Repository > Increase/Decrease Capacity			Increase Capacity and Decrease Capacity
Delete Snapshot group	Delete			Uncommon Tasks > Delete Snapshot group
Cancel pending Snapshot image	Cancel Pending Snapshot Image			Uncommon Tasks > Cancel pending Snapshot image

Snapshot Image

Table 38 details how functions performed on Snapshot images are completed in the SANtricity Storage Manager AMW and how the same function is completed employing the SANtricity System Manager.

Table 38) Snapshot image options: AMW compared to System Manager.

Function	AMW	System Manager		
	Copy Services > Snapshot Image > (Option)	Page	Tile/Tab	Option
Create Snapshot image	Create	Storage	• Volumes > All Volumes tab or Applications & Workloads tab • Snapshots > Snapshot Images tab	• Copy Services > Create instant Snapshot image • Create > Instant Snapshot images
Create Snapshot volume	Create Snapshot Volume	Storage	Snapshots > Snapshot Images tab	Create > Snapshot volume
Start or resume rollback	Rollback > Start/Resume			Rollback> Start or Resume
Change priority of rollback	Rollback > Change Priority			Available as part of the Rollback > Start option

Function	AMW	System Manager		
Cancel rollback	Rollback > Advanced > Cancel			Rollback > Cancel
Delete Snapshot image	Delete			Delete
View properties	Properties			View Settings

Snapshot Volume

Table 39 details how functions performed on Snapshot volumes are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 39) Snapshot volume options: AMW compared to System Manager.

Function	AMW	System Manager		
	Copy Services > Snapshot Volume > Option	Page	Tile/Tab	Option
Create Snapshot volume	Create	Storage	• Snapshots > Snapshot Images tab • Snapshots > Snapshot Volumes tab	• Create > Instant Snapshot image • Create
Create volume copy	Create Snapshot Volume	Storage	Snapshots > Snapshot Volumes tab	Copy Volume
Recreate and disable Snapshot volume	Rollback > Start/Resume			Uncommon Tasks > Re-create and Disable
Convert to read/write volume	Rollback > Change Priority			Convert to Read/Write
Enable or disable SSD cache for a Snapshot volume	Rollback > Advanced > Cancel			• As part of Create wizard • View/Edit Settings
Change settings	Change Settings			View/Edit Settings
Rename Snapshot volume	Rename			• View/Edit Settings • Edit directly in the table view by selecting the pencil icon in the Edit column

Function	AMW	System Manager		
Delete Snapshot volume	Delete			Uncommon Tasks > Delete
View properties of a Snapshot volume	Properties			View/Edit Settings
Increase or decrease overall repository capacity	Overall Repository > Increase and Decrease Capacity	Storage	Pools & Volume Groups > Reserved Capacity tab	Increase Capacity and Decrease Capacity
Revive Snapshot volume	Advanced > Revive	CLI/script editor only		
Modify overall repository	Overall Repository > Change > Modification Priority > Media Scan Settings > Pre-Read Redundancy Check	CLI/script editor only: These are normally not changed by the end user. The defaults should suffice.		

Volume Copy

Table 40 details how functions performed for volume copy are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 40) Volume copy options: AMW compared to System Manager.

Function	AMW	System Manager		
	Copy Services > Volume Copy > Option	Page	Tile/Tab	Option
Copy volume	Create	Storage	Volumes > All Volumes tab or Applications & Workloads tab	Copy services > Copy volume
Manage copies	Manage Copies	CLI/script editor only: You can also stop a volume copy and change priority in the Operations in Progress from Home.		

Asynchronous Mirroring

Table 41 details how functions performed for asynchronous mirroring are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 41) Asynchronous mirroring options: AMW compared to System Manager.

Function	AMW	System Manager		
	Copy Services > Asynchronous Mirroring > Option	Page	Tile/Tab	Option
Activate mirroring	Activate	The activation takes place automatically when the first mirror consistency group is created.		
Deactivate mirroring	Deactivate	Storage	Asynchronous Mirroring > Mirror Consistency Groups tab	Uncommon Tasks > Deactivate
View mirroring port connections	View Mirroring Port Connections	CLI/script editor only: Although some of the same information is included in the Test Communication option.		
Create mirror group	Mirror Group > Create	Storage	Asynchronous Mirroring > Mirror Consistency Groups tab	• Create Mirrored Pair: If needed, the mirror group is created as part of this sequence. **Note:** You can also mirror a volume from the Volumes tile by highlighting a volume and selecting Copy Services > Mirror a volume asynchronously.
Create mirrored pair	Mirror Group > Create Mirrored Pair	Storage	Asynchronous Mirroring > Mirror Consistency Groups tab Asynchronous Mirroring > Mirrored Pairs tab	Create Mirrored Pair
Complete mirrored pair	Mirror Group > Complete Mirrored Pair	Storage	Asynchronous Mirroring > Mirrored Pairs tab	Complete link in table
Suspend or resume mirroring	Mirror Group > Suspend/Resume	Storage	Asynchronous Mirroring > Mirror Consistency Groups tab	More > Suspend/Resume
Manually resynchronize mirror group	Mirror Group > Manual Resynchronization			More > Manually resynchronize
Change sync settings	Mirror Group > Change > Synchronization Settings			More > Edit settings

Function	AMW	System Manager		
Change role from primary to secondary	Mirror Group > Change > Role to Primary or Secondary			More > Change role
Change communication settings	Mirror Group > Test Communication Link			Test Communication
Update remote IP address	Mirror Group > Update Remote IP Address			More > Update remote IP address
Rename mirror group	Mirror Group > Rename			Edit directly in the table view by selecting the pencil icon in the Edit column
Delete mirror group	Mirror Group > Delete			Uncommon Tasks > Delete
Cancel pending role change	Mirror Group > Advanced > Cancel Pending Role Change	CLI/script editor only		
Create mirrored pair	Mirrored Pair > Create	Storage	Asynchronous Mirroring > Mirror Consistency Groups tab Asynchronous Mirroring > Mirrored Pairs tab	Create Mirrored Pair
Remove mirrored pair	Mirrored Pair > Remove	Storage	Asynchronous Mirroring > Mirror Consistency Groups tab	Uncommon Tasks > Remove
Increase capacity and settings for overall repository	Mirrored Pair > Overall Repository > Increase Capacity and Settings	Storage	Pools & Volumes Groups > Reserved Capacity tab	Increase Capacity and View/Edit Settings
Modify overall repository	Mirrored Pair > Overall Repository > Change > Modification Priority > Media Scan Settings > Pre-Read Redundancy Check	CLI/script editor only: These are normally not changed by the end user. The defaults should suffice.		

Synchronous Mirroring

Table 42 details how functions performed for synchronous mirroring are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 42) Synchronous mirroring options: AMW compared to System Manager.

Function	AMW	System Manager		
	Copy Services > Snapshot Group > Option	Page	Tile/Tab	Option
Activate mirroring	Activate	The activation takes place automatically when the first mirrored pair is created.		
Deactivate mirroring	Deactivate	Storage	Synchronous Mirroring	Uncommon Tasks > Deactivate
View mirroring port connections	View Mirroring Port Connections	CLI/script editor only: Although some of the same information is included in the Test Communication option.		
Create mirrored pair	Create Mirrored Pair	Storage	Synchronous Mirroring	• Mirror volume or create mirrored pair **Note:** You can also mirror a volume from the Volumes tile by highlighting a volume and selecting Copy Services > Mirror a volume synchronously.
Suspend or resume mirroring	Suspend/Resume			More > Suspend or Remove
Change role from primary to secondary	Change > Role to Primary/Secondary			More > Change role
Change sync settings	Change > Synchronization Settings			More > View/Edit settings
Change write mode	Change > Write Mode	Obsolete; no longer applicable		
Remove mirror relationship	Remove Mirror Relationship	Storage	Synchronous Mirroring	Uncommon Tasks > Remove
Test communication link	Test Communication Link			Test Communication

Host Mapping Options

Table 43 details how functions performed for host mapping are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 43) Host mapping options: AMW compared to System Manager.

Function	AMW	System Manager		
	Host Mapping > Option	Page	Tile/Tab	Option
Define host group	Define Host Group	Storage	Hosts	Create > Host cluster
Define host	Define Host			Create > Host
Define storage partition	Define Storage Partition	N/A: Storage partition concept is abstracted from the end user.		
Add LUN mapping	LUN Mapping > Add	Storage	Hosts	Assign Volumes
Remove LUN mapping	LUN Mapping > Remove			Unassign Volumes
Change LUN mapping	LUN Mapping > Change	Storage	Volumes > All Volumes tab or Applications & Workloads tab	View/Edit Settings: can change host cluster/host assignment or LUN assignment
Manage host port identifiers	Manage Host Port Identifiers	Storage	Hosts	View/Edit Settings > Host Ports
View unassociated host port identifiers	View Unassociated Host Port Identifiers	Storage or CLI/Script Editor	Hosts	Create > Host and select the Host Ports drop-down menu to see any host ports that are currently not associated with a host
Change default host operating system	Default Group > Change Default Host Operating System **Note:** The default host cluster is shown in the GUI only if the user assigned at least one volume to it in the CLI.	Storage	Hosts	• View/Edit Settings • Edit directly in the table view by selecting the pencil icon in the Edit column
Rename host group	Host Group > Rename			• View/Edit Settings • Edit directly in the table view by selecting the pencil icon in the Edit column
Remove host group	Host Group > Remove			Delete
Move host group	Host > Move			• View/Edit Settings • Edit directly in the table view by selecting the pencil icon in the Edit column

Function	AMW	System Manager		
Change host operating system	Host > Change Host Operating System			• View/Edit Settings • Edit directly in the table view by selecting the pencil icon in the Edit column
Rename host	Host > Rename			• View/Edit Settings • Edit directly in the table view by selecting the pencil icon in the Edit column
Remove host	Host > Remove			Delete
View or edit host properties	Host > Properties			View/Edit Settings **Note:** Can also view/edit settings for a host cluster.

Hardware Options

Table 44 details how functions performed on hardware are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 44) Hardware options: AMW compared to System Manager.

Function	AMW	System Manager		
	Hardware > Option	Page	Tile/Tab	Option
Locate storage array	Locate Storage Array	Settings	System	Turn On Storage Array Locator Lights
Locate drive tray (shelf)	Locate (controller/drive tray, drive tray)	Hardware	N/A	Select Shelf Number drop-down menu on left side of each shelf and then select Turn on locator light
Locate drive	Locate Drive			Select drive and then select Turn on locator light
View tray (shelf) components	Tray > View/Edit (Controller/Drive Components, Drive Components)			• Select Shelf Number drop-down menu on left side of each shelf and then select View settings • Select one of the icons at the top of each shelf
View or edit drive channels	Tray > View/Edit Drive Channels			Select one of the controllers and then select View settings > Drive Interfaces tab
Change tray (shelf) ID	Tray > Change > ID			Select Shelf Number drop-down menu on left side of each shelf and then select Change ID

Function	AMW	System Manager		
Change tray (shelf) view order	Tray > Change > Hardware View Order			Select either the up or down arrow on the right side of the shelf to move it up or down in the view
Change tray (shelf) battery settings	Tray > Change > Battery Settings			• Select Shelf Number drop-down menu on left side of each shelf and then select View settings • Select the battery icon at the top of each shelf
Change tray (shelf) alarm settings	Tray > Change > Alarm Settings	Not applicable for hardware platforms managed by System Manager		
Synchronize controller clocks	Controller > Synchronize Clocks	Settings	System	Synchronize Storage Array Clocks
Configure controller ports	Controller > Configure (Management ports, iSCSI ports, DNS Server, NTP Server)	Hardware	N/A	• Select one of the controllers and then select the appropriate option • Configure iSCSI ports is also available under Settings > System
Change preferred loop ID	Controller > Change > Preferred Loop ID	Not applicable for hardware platforms managed by System Manager		
Change remote login	Controller > Change > Remote Login	Hardware	N/A	Select one of the controllers and then select Change remote login
Place controller online or offline	Controller > Advanced > Place > Online/Offline			Select one of the controllers and then select Place online or Place offline
Place controller in service mode	Controller > Advanced > Place > In Service Mode			Select one of the controllers and then select Place in service mode
Run controller diagnostics	Controller > Advanced > Run Diagnostics (all options)	CLI/script editor only: Many of these diagnostics are not applicable for hardware platforms managed by System Manager.		
Reset controller	Controller > Advanced > Reset	Hardware	N/A	Select one of the controllers and then select Reset
Enable data transfer	Controller > Advanced > Enable Data Transfer	CLI/script editor only		
Replace drive logically	Drive > Replace	Hardware	N/A	Select drive and then select Logically replace

Function	AMW	System Manager		
Erase a secure drive	Drive > Erase Security	Hardware	N/A	• Select a secure, unassigned drive and then select Secure Erase • The option also comes up when you are creating a new pool or volume group
Import security key	Drive > Import Security Key	Settings	System	Unlock Secure Drives
Initialize drive	Drive > Initialize	Hardware	N/A	Select drive and then select Initialize
Manually reconstruct drive	Drive > Manually Reconstruct	CLI/script editor only		
Manually fail a drive	Drive > Fail	Hardware	N/A	Select drive and then select Fail
Revive drive	Drive > Revive	CLI/script editor only		
Assign a hot spare	Hot Spare Coverage	Hardware	N/A	Highlight a drive and select Assign hot spare
Prepare for removal	Prepare for Removal	CLI/script editor only		

Monitor Options

Health

Table 45 details how functions performed for health monitoring are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 45) Health monitoring options: AMW compared to System Manager.

Function	AMW	System Manager		
	Monitor > Health > Option	Page	Tile/Tab	Option
View health (Recovery Guru)	View Health (Recovery Guru)	Home	N/A	Click Recover from <n> problems link at top of home page
View real-time performance	Monitor Performance > Real-time performance monitor (graphical/textual)	• Home • Storage	• N/A • Performance	• Performance shown at the storage array level • Various options
View background performance	Monitor Performance > Background performance monitor (all options)			

Function	AMW	System Manager		
Collect support data manually	Collect Support Data Manually	Support	Support Center > Diagnostics tab	Collect Support Data
Set AutoSupport options	AutoSupport (all options from both EMW and AMW)	Support	Support Center > AutoSupport tab	Various options
Retrieve trace buffers	Retrieve Trace Buffers	Storage	Support Center > Diagnostics tab	Retrieve Trace Buffers
Read link status	Storage Array Diagnostics > Read Link Status	Not applicable for hardware platforms managed by System Manager		
Collect I/O path statistics	Storage Array Diagnostics > Collect I/O Path Statistics	Support	Support Center > Diagnostics tab	Collect I/O Path Statistics
Validate configuration database	Storage Array Diagnostics > Validate Configuration Database	CLI/script editor only		
Retrieve controller health image	Storage Array Diagnostics > Retrieve Controller Health Image	Support	Support Center > Diagnostics tab	Retrieve Health Image
Collect drive data	Collect Drive Data (all options)	Support	Support Center > Diagnostics tab	Collect Drive Data
Capture state information	Capture State Information	CLI/script editor only		
View iSCSI statistics	iSCSI Statistics	• Support • Settings	• Support Center > Diagnostics tab • System	• View iSCSI Statistics Packages • iSCSI settings grouping > View iSCSI Statistics Packages
Clear recovery mode	Clear Recovery Mode	Support	Support Center > Diagnostics tab	Clear Recovery Mode
Reenable drive ports	Re-enable Drive Ports			Re-enable Drive Ports

Reports

Table 46 details how functions performed for reporting are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager.

Table 46) Report-monitoring options: AMW compared to System Manager.

Function	AMW	System Manager		
	Monitor > Reports > Option	Page	Tile/Tab	Option
View operations in progress	Operations in Progress	Home	N/A	View Operations in Progress
View storage array profile	Storage Array Profile	Support	Support Center > Support Resources tab	Storage Array Profile
View cable connections	Cable Connections	CLI/script editor only		
View event log	Event Log (all options)	Support	Event Log	Various options
View unreadable sectors log	Unreadable Sectors Log	Support	Support Center > Diagnostics tab	View/Clear Unreadable Sectors
View persistent reservations	Persistent Reservations	CLI/script editor only		

Upgrade Options

Table 47 details how functions performed for upgrading are completed in the SANtricity Storage Manager AMW and how the same functions are completed employing the SANtricity System Manager. For further information, see the E-Series Documentation Center.

Table 47) Upgrade options: AMW compared to System Manager.

Function	AMW	System Manager		
	Upgrade > Option	Page	Tile/Tab	Option
View firmware inventory	View Firmware Inventory	Support	• Upgrade Center • Support Center > Support Resources tab	• Software and Firmware Inventory • Software and Firmware Inventory
Upgrade controller firmware	Upgrade controller firmware (all options)	Support	Upgrade Center	All options. The SANtricity Software bundle includes management software, controller firmware, supervisor (DOM 0) software, and IOM (ESM) firmware.
Upgrade controller NVSRAM	Upgrade controller NVSRAM (all options)			Can upgrade NVSRAM only as part of the SANtricity Software bundle (see preceding entry). Can also use the CLI/script

Function	AMW	System Manager		
				editor to upgrade NVSRAM individually.
Upgrade drive firmware	Upgrade drive firmware (all options)			All options
Upgrade ESM firmware	Upgrade ESM firmware			Can upgrade IOM (ESM) firmware only as part of the SANtricity Software bundle (see earlier). Can also use the CLI/script editor to upgrade IOM (ESM) firmware individually.
Upgrade tray (shelf) configuration settings	Upgrade Tray Configuration Settings	CLI/script editor only		

Beginning with SANtricity Unified Manager 11.50.1, the SANtricity software version of each of the managed arrays can be seen on the landing page (Figure 10).

There is also the option to upgrade the SANtricity software and NVSRAM of multiple arrays of the same type of controller (Table 48).Table 48) SANtricity upgrade using Unified Manager.

Table 48) SANtricity upgrade using Unified Manager.

Function	Unified Manager		
	Page	Tile/Tab	Option
Import firmware to software repository	Landing page	Upgrade Center	Manage SANtricity Software Repository
Upgrade controller firmware and NVSRAM	Landing page	Upgrade Center	Upgrade SANtricity Software – SANtricity software bundle contains NVSRAM file as well.

Alert Options (EMW)

Table 49 details how functions performed for alerting are completed in the SANtricity Storage Manager EMW and how the same functions are completed employing the SANtricity System Manager.

Table 49) Alert options: EMW compared to System Manager.

Function	EMW	System Manager		
	Edit > Configure Alerts	Page	Tile/Tab	Option
Configure alerts	All options (e-mail, snmp)	Settings	Alerts > Email, SNMP, and Syslog tabs	Various options for e-mail, snmp, and syslog

Where to Find Additional Information

To learn more about the information that is described in this document, review the following documents and/or websites:

- E-Series E2800 datasheet
  https://mysupport.netapp.com/info/web/ECMP11752697.html#ESeriesDatasheets

- E-Series Documentation Center
  https://mysupport.netapp.com/info/web/ECMP1658252.html

- NetApp Product Documentation
  docs.netapp.com

Version History

Version	Date	Document Version History
Version 1.0	Nov 2018	Initial release concurrent with SANtricity 11.50
Version 1.1	Feb 2019	Updated for SANtricity 11.50.1 release
Version 1.2	June 2019	Updated for SANtricity 11.50.2 release

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.