Technical Report

Introduction to NetApp E-Series E5500 with SANtricity 11.20

Todd Edwards, NetApp
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Abstract

The NetApp® E-Series E5500 storage system is an excellent choice for wide-ranging data center storage requirements. This report provides detailed information about the multiple system configuration options. It is also a great starting point to introduce system details to sales engineers, partners, service providers, and customers who are purchasing the product.

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1   E-Series E5500 Storage Systems with SANtricity 11.20

NetApp E-Series E5500 based storage systems provide enterprise class tier 1 SAN storage for small and medium-sized businesses and for Fortune 100® companies with branch locations around the world. The combination of ultradense capacity, host interface flexibility, and best-in-class quality makes the E5500 a natural choice for customers who are focused on minimizing their total cost of ownership while maximizing the use of their current footprint.

1.1   E5500 Primary Use Cases

The E-Series E5500 is an industry-leading storage system that delivers high IOPS and bandwidth with consistently low latency to support the demanding performance and capacity needs of science and technology, simulation modeling, and decision support environments. But the E5500 is equally capable of supporting primary transactional databases, general mixed workloads, and dedicated workloads such as backup applications in a highly efficient footprint with extreme simplicity, reliability, and scalability. The E5500 provides the following benefits:

- Support for wide-ranging workloads and performance requirements

- Fully redundant I/O paths, advanced protection features, and proactive support monitoring and services for high levels of availability, integrity, and security

- Double the bandwidth performance of the previous high-performance generation of NetApp products that support data-intensive applications

- A level of performance, density, and economics that leads the industry

1.2   Positioning E5XXX Systems

The E5500 controller is one of three members in the E5XXX family of controllers. The E5400 controller is at the end of its production life (except for one special configuration with the 10Gb iSCSI host interface card [HIC]), and up to now, the E5500 has offered the best performance. Beginning with SANtricity 11.20, however, NetApp also offers the E5600 controller. Use the following guidelines when selecting the best E5XXX option for a given set of requirements:

- When the customer requires a mixed-protocol option for FC and iSCSI on the same storage system, use the E5400 with the optional 2-port 10Gb copper HIC (special order only—no other E5400 configuration is available because of EOL).

- When customers have already qualified the E5500 hardware and requalifying the E5600 hardware would delay deployment, offer the E5500 storage system.

- When customers have previously deployed E5500 hardware and want to remain with the E5500 platform, offer the E5500.

For all other cases when there is not an existing customer preference, the new E5600 offers increased performance, the same host interface options, and the same list price as the E5500 controller. As a result, NetApp recommends using the E5600 instead of the E5500.

1.3   E5500 Storage Systems

The E5500 controller is available in three shelf options: E5560 (DE6600), E5524 (DE5600), and E5512 (DE1600). These configuration options support both spinning media and solid-state drives (SSDs, although SSDs are not supported in the E5512) to meet a wide range of customer performance and application requirements.

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

- Tray = shelf = enclosure.
- Drive tray = drive shelf.
- Drive = disk.
- Canister = module.
- The term *drawer* is used to describe only the five drawers in the DE6600 shelf and does not apply to other shelf models.

All three shelf types support dual controller packs, dual power supplies, and dual fan units for redundancy (DE5600 and DE1600 shelves have integrated power and fan modules). The shelves are sized to hold 60 drives, 24 drives, or 12 drives, respectively, as shown in Figure 1.

Figure 1) E5500 controller-drive shelf options.
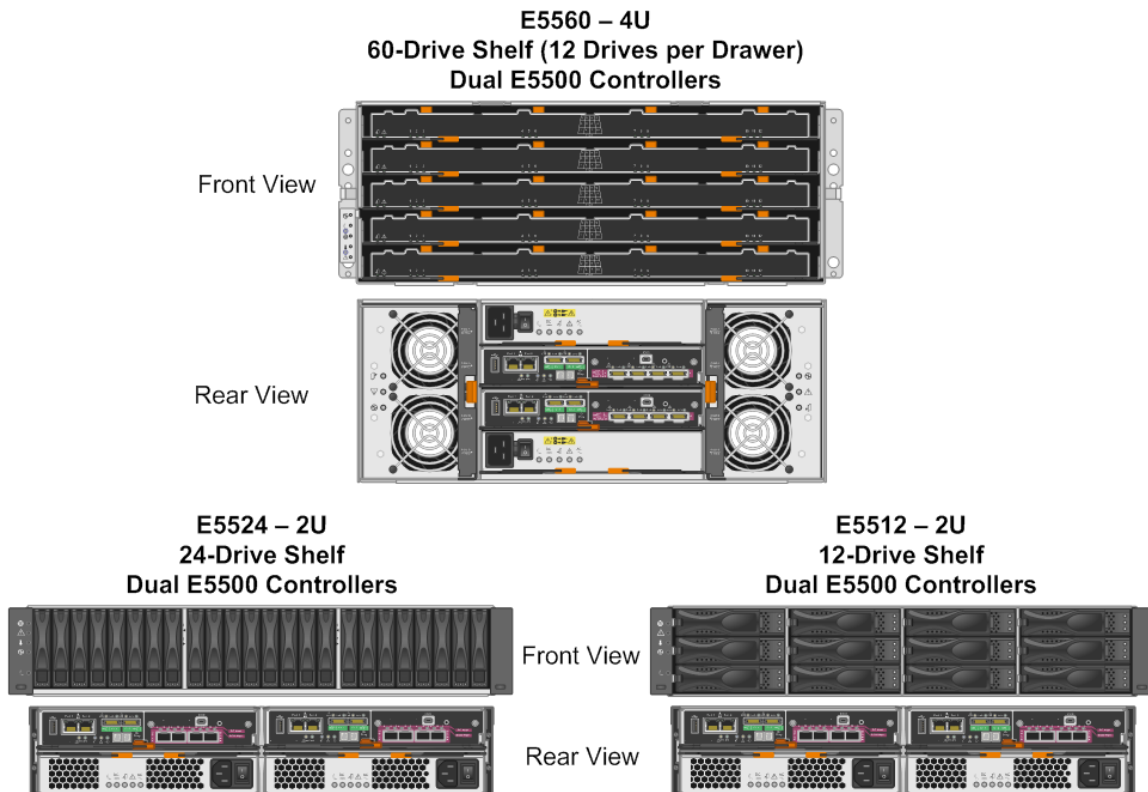
Each E5500 controller (there are two controllers in every E5500 system) has a combination of on-board storage-side SAS drive expansion ports and add-on host interface ports. The host ports protocol is determined by the type of host interface card (HIC) and one of two ID codes called the *submodel ID* (SMID) as shown in Table 1.

Table 1) E5500 submodel IDs and associated protocols.

SMID	Supported Protocol
197	FC, SAS, IB
230	iSCSI

The SMID for each controller can be viewed by using SANtricity Storage Manager and must match or else the system will not start up. When required, the SMID can be changed from the factory setting by using

SANtricity Storage Manager to change the controller feature pack. Feature pack changes are applied to both controllers in a storage system.

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

2 SANtricity 11.20 Product Enhancements

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

2.1 SANtricity Storage Manager 11.20

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

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

Note: Refer to the "Initial Configuration and Software Installation Guide for SANtricity Storage Manager 11.20" in the SANtricity Storage Manager product documentation for additional management configuration options.

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

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

  Note: For ASUP to function, the persistent monitor service must be running on the management station.

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

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

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

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

- **Enterprise Management Window (EMW).** When SANtricity Storage Manager is initiated, the EMW appears first. The EMW is used to add the storage systems that will be managed and monitored through SANtricity Storage Manager.

- **Array Management Window (AMW).** From the EMW, the AMW can be launched to access summary views and detailed information about individual storage systems. The AMW is used to configure, maintain, and manage a storage system and its components.

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

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

Figure 2) SANtricity Storage Manager 11.20 EMW.
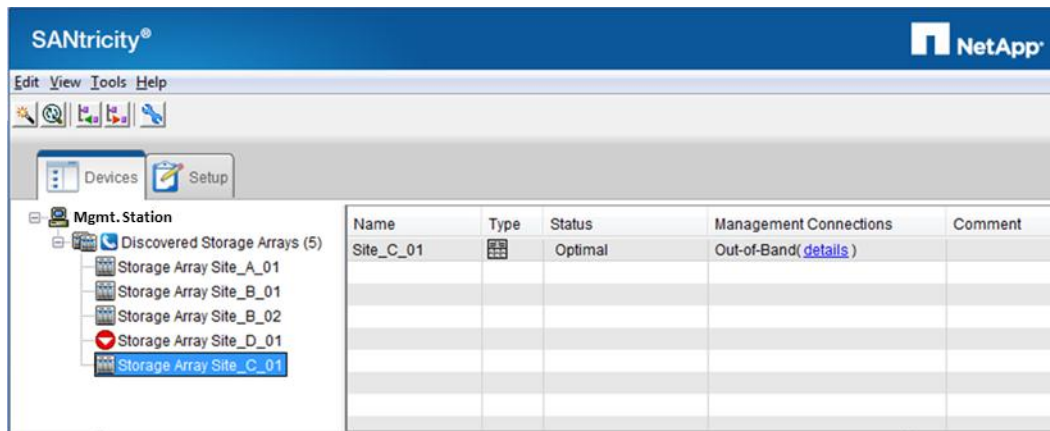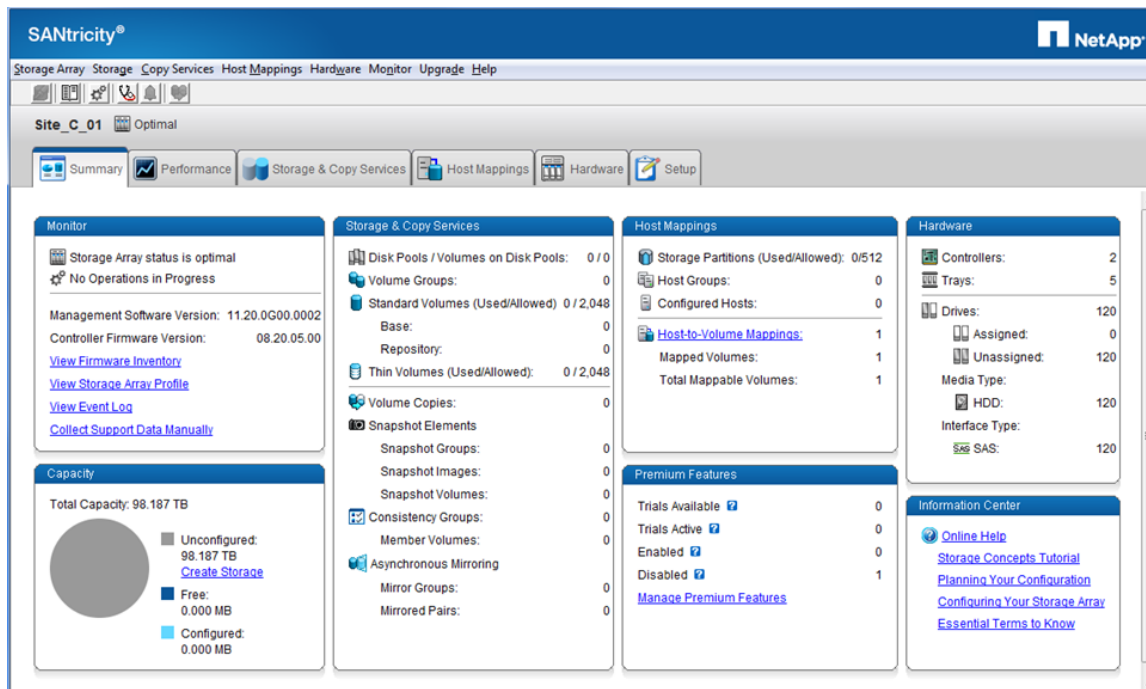

Figure 3) SANtricity Storage Manager 11.20 AMW storage system Summary tab view.

E5500 storage systems are shipped preloaded with the SANtricity 11.20 OS software. The SANtricity Storage Manager software, however, must be downloaded separately from the NetApp Support site and loaded on the management server prior to discovering storage systems running SANtricity 11.20 OS.

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

2.2 SANtricity Management Integration

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

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

- **Oracle Enterprise Manager Plug-Ins**—storage volume to database mapping, monitoring, and performance reporting
- **SQL Server Management Studio Plug-In**—performance monitoring and tuning for SQL database storage, and volume and snapshot creation for SQL databases.
- **VMware vCenter™ Plug-In** (the current version is 2.7; a web client will be supported in the next version, 3.0)—configuration, management, monitoring, and datastore to LUN mapping in VMware vSphere® client
- **VMware vCenter Site Recovery Manager™ Adapter**—automates disaster recovery failover and enables disaster recovery plan testing in VMware® environment
- **VASA (VMware vSphere APIs for Storage Awareness) Provider**—reporting of storage volume capabilities to vSphere for service-level objective management
- **System Center Operations Manager (SCOM) Management Pack**—monitors health status and sends storage alerts to Microsoft System Center

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

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

For the plug-ins and web services software and documentation, go to http://mysupport.netapp.com/NOW/cgi-bin/software/ and select E-Series/EF-Series SANtricity Management Plug-Ins. The PowerShell toolkit is available at http://mysupport.netapp.com/NOW/download/tools/santricity_powershell_toolkit/.

2.3 Enhanced Reliability, Availability, and Serviceability Features

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

Drive Evacuator

The new drive evacuator feature constantly monitors the health of all drives in the system by using a process called *predictive failure analysis*. When a drive displays characteristics indicative of a failing

drive, the SANtricity software automatically initiates movement of the data blocks on that drive to a spare drive or to another drive in the pool in the case of a Dynamic Disk Pool (DDP). If the drive in question completely fails during the drive evacuation process, the rebuild of the data associated with the failed drive picks up from the point where the evacuator feature stopped.

DCBX Support

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

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

Figure 4) New DCBX information in the iSCSI statistics report.
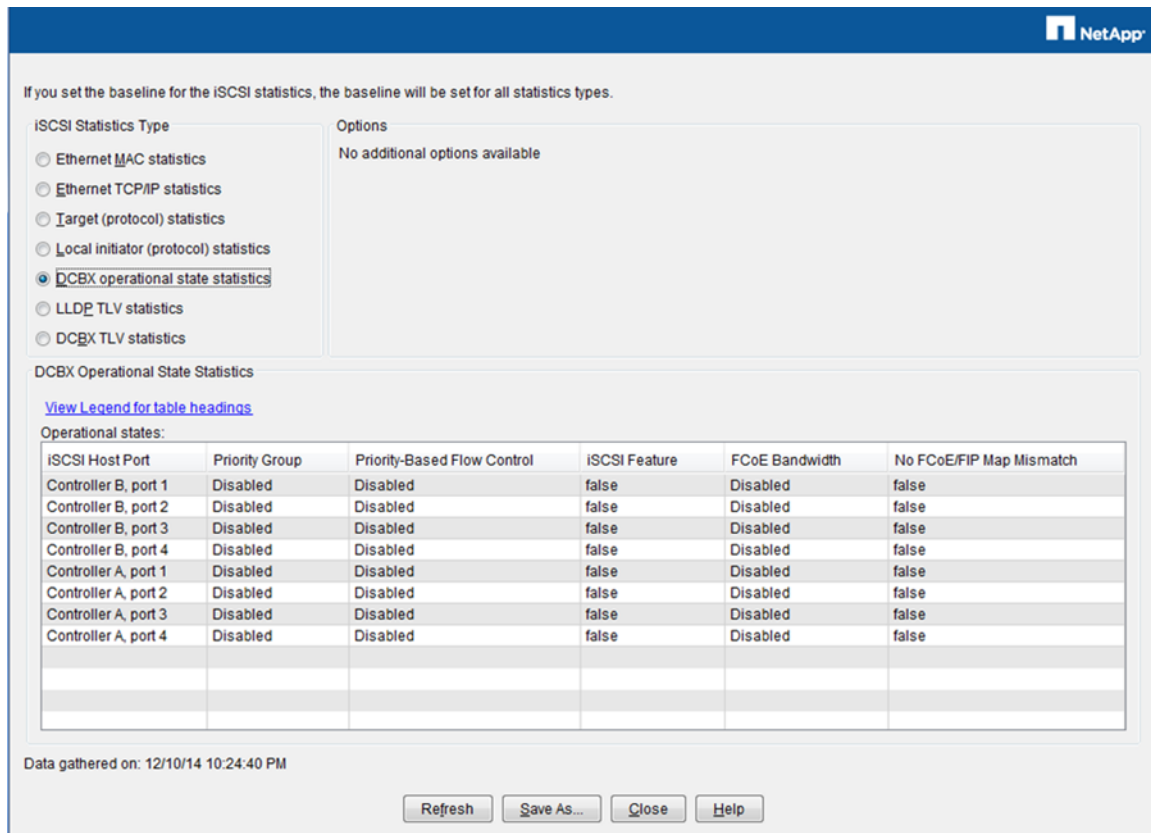
Drive Firmware Upgrade

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

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

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

Parallel Drive Firmware Upgrade

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

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

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

Online Drive Firmware Upgrade

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

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

Support Tool Enhancements

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

NetApp AutoSupport

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

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

Figure 5) EMW Devices tab with ASUP icon selected.
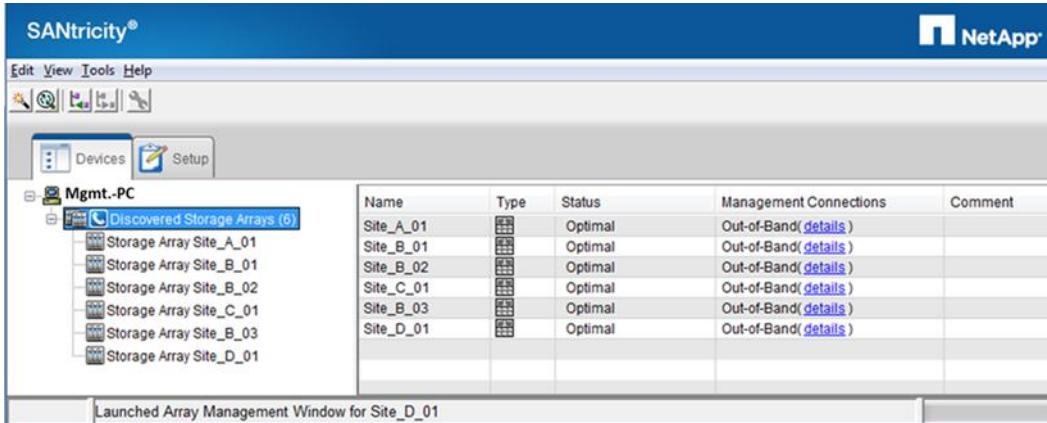
ASUP is enabled by default on all E-Series storage systems from the factory; however, the support bundle delivery configuration must be completed before support data can be sent to NetApp. This feature can be managed globally from the EMW, or individual storage systems can be managed from the AMW. Figure 6 shows the management options available from the EMW.

Figure 6) EMW ASUP settings and options.
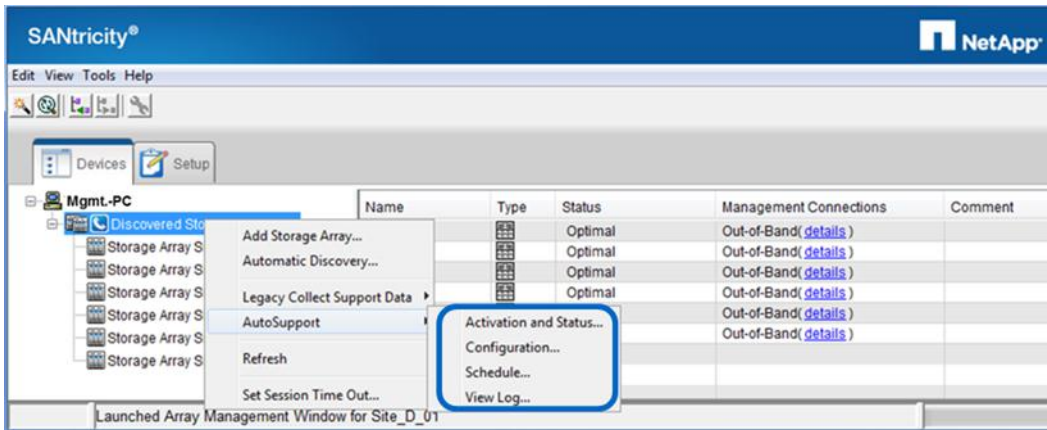
Note: ASUP can be enabled or disabled from the AMW for an individual storage system. All other ASUP settings are accessed from the EMW.

For more information about the ASUP feature, refer to the "Concepts Guide for SANtricity Storage Manager Version 11.20" in the SANtricity Storage Manager documentation page in the NetApp Documentation library.

E-Series Sizer

There are new enhancements to the E-Series Performance Sizing tool, which provides sales engineers and partners with the ability to predict performance ranges associated with their proposed configuration. The reverse sizing capability adds to the existing forward sizing ability, which prompts for performance

information and quickly provides a set of configurations that meet the given set of requirements. The third sizing approach in the tool, capacity sizing, takes into consideration overhead for specific RAID and other configurations to provide guidance on the total capacity required to meet the full set of objectives (primary capacity, RAID overhead, and spare drive capacity). Figure 7 shows the landing page for the E-Series sizing tool.

Figure 7) E-Series Performance Sizing tool.
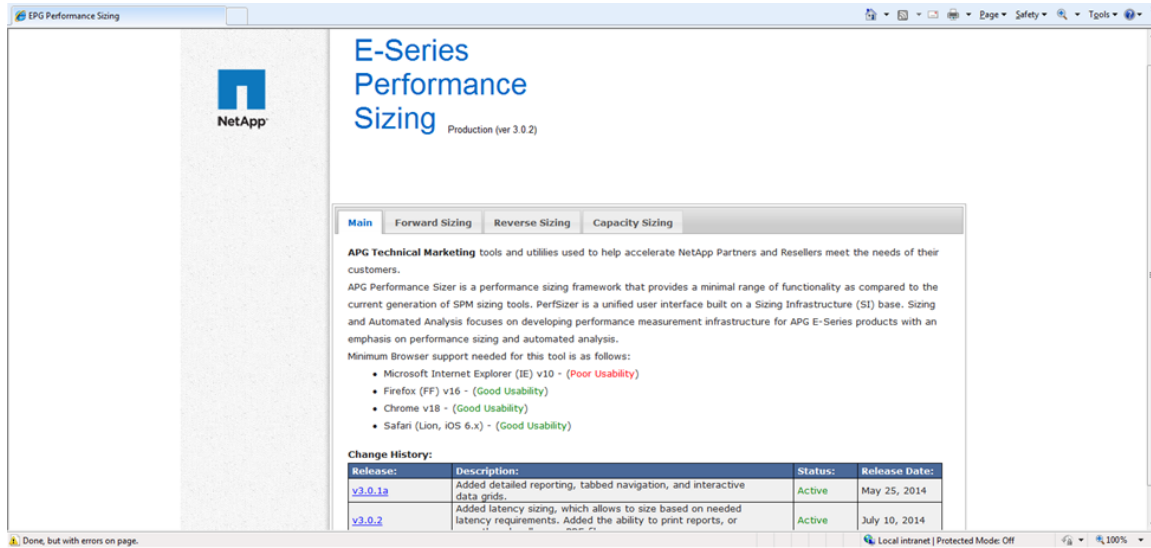
Host Utilities

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

2.4 SANtricity Software Specifications for E5500 Hardware

Table 2 lists the SANtricity software specifications for E5500 based storage systems.

Table 2) SANtricity software boundaries for E5500 based storage systems.

Components	Maximum
Storage Hardware Components	
Shelves (system and expansion)	16
Drives	384
SSD cache capacity per system	5TB
Logical Components	
Partitions	512
Volumes	2,048
Volumes per consistency group	64

Components	Maximum
Consistency groups per system	32
Thin volumes per system	2,048
Disk pools per system	20
Snapshot Copies	
Per Snapshot group	32
Per volume	128
Per storage system	2,048
Snapshot Volumes	
Per Snapshot copy	4
Per system	2,048
Snapshot Groups	
Per volume	4
Per system	1,024
Mirrors	
Legacy mirrors per system	128
Mirrors per system	128
Mirrors per volume	1
Mirrors per asynchronous mirror group	64
Asynchronous mirror groups per system	4

2.5   Performance Improvements

Running SANtricity 11.20 in new E5500 storage systems delivers enhanced system performance over the previous generation of E-Series storage systems running SANtricity 11.10. The faster host interfaces and improved SSD performance by using hybrid systems make the E5500 storage system a great choice to support performance-intensive data center workloads. The SANtricity 11.20 software is available for download from the NetApp Support site by anyone with a valid NetApp product support agreement and active Support site account.

New Host Interfaces with SANtricity 11.20

SANtricity 11.20 extends host interface choices on E5500 storage systems with the support of a 4-port 12Gb/sec SAS HIC and a new 56Gb/sec InfiniBand (IB) HIC. Both host interfaces are excellent choices for dedicated big data type applications that use high-speed direct-connect architectures between hosts and storage systems. The 56Gb IB can also connect through an existing or new IB network.

The 12Gb SAS HIC uses wide-port technology, so it actually consists of 4 PHYs, or physical lanes, each 12Gb/sec. As a result, the full link speed for the SAS3 link is 48Gb/sec. Both the 12Gb SAS HIC and the 56Gb IB HIC support autonegotiation of port speed to accommodate existing 6Gb SAS environments and 40Gb IB environments, respectively.

Hybrid Performance Enhancements

When mixing SSD volume groups or disk pools with HDD volume groups and disk pools, customers who run SANtricity 11.20 can expect a performance improvement of as much as 30% with small random I/O. Enhancements to the 11.20 software optimize I/O associated to SSD volume groups and DDPs while delivering consistent performance for HDD workloads when compared with E-Series systems that run SANtricity 11.10.

The SANtricity 11.20 software is available for download at no additional cost from the NetApp Support site for anyone with a valid CSS product support agreement.

New Drives Supported with SANtricity 11.20

New drives in this release include 6TB NL-SAS drives for superdense storage requirements; the 1.8TB 10K HDD that provides 10K RPM performance with twice the capacity per drive; and the 1.6TB SSD that combines enhanced performance with SANtricity 11.20, and, again, offers twice the physical capacity of drives currently supported with SANtricity 11.10.

Note: The planned availability for 1.8TB 10K HDDs is calendar Q2 2015, but is subject to change.

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

3   Hardware Configurations

E5500 storage systems use a modular approach to hardware configurations. This approach can meet most customer SAN storage requirements for flexible host interfaces and versatile drive choices without sacrificing supportability, ease of implementation, and long-term stability.

3.1   Controller-Drive Shelf Configurations

As previously noted, the E-Series E5500 storage system is supported in one of three configurations. For specialized use cases, it can be configured as a mix of shelf types, up to the maximum of 16 shelves total or 384 drives (maximum 120 SSDs).

E5560 Controller-Drive Shelf

The E5560 is a 4U shelf that holds up to sixty 3.5-inch or 2.5-inch drives in 5 horizontal drawers (12 drives per drawer). It features dual RAID controllers, dual power modules, and dual fan modules with two fans in each module.

An E5560 based storage system supports a maximum of 360 drives by using only 60-drive shelves or 384 drives by using a mix of expansion-drive shelf models. A minimum of 20 drives must be installed in the E5560 controller-drive shelf and in each 60-drive expansion-drive shelf that is added to the system. For purposes of airflow, these drives must be installed in the four front drive slots in each drawer.

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

Refer to Table 3 for more details about E5560 technical specifications. Figure 8 and Figure 9 show the front and rear views, respectively, of the E5560 controller-drive shelf.

Figure 8) E5560 front view without bezel.
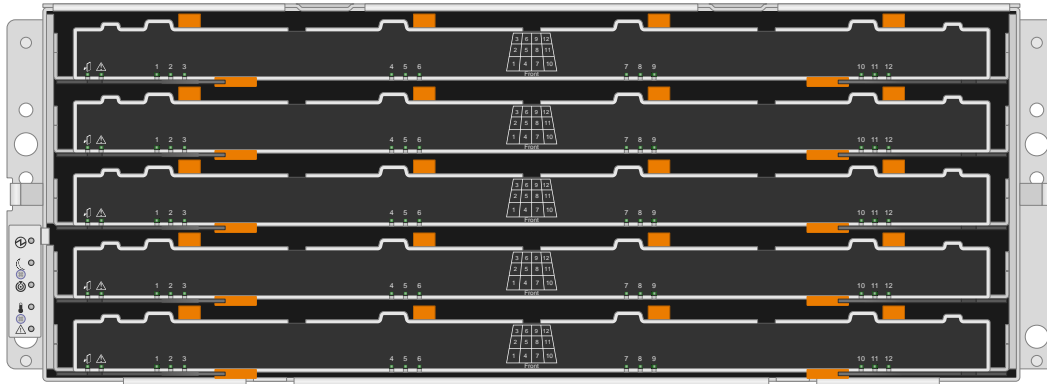
Figure 9) E5560 rear view with the new 4-port 12Gb SAS HIC installed.
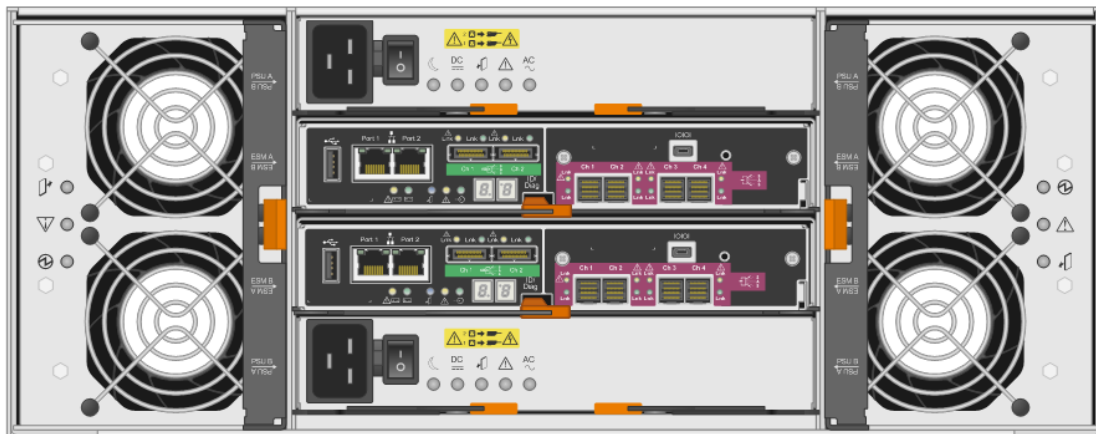
E5524 Controller-Drive Shelf

The E5524 is a 2U shelf that holds up to twenty-four 2.5-inch drives and features dual RAID controllers and dual power supplies with integrated fans. An E5524 based storage system supports a maximum of 384 drives and a mix of expansion-drive shelf models in a single system.

Note: Refer to Table 3 for more details about E5524 technical specifications.

The E5524 has a proven track record of reliability and is well suited for use in remote dedicated environments in which space is limited or in primary data centers.

Figure 10 and Figure 11 show the front and rear views, respectively, of the E5524 controller-drive shelf.

Figure 10) E5524 front view.

Figure 11) E5524 rear view with the 16Gb FC or 10Gb iSCSI HIC installed.
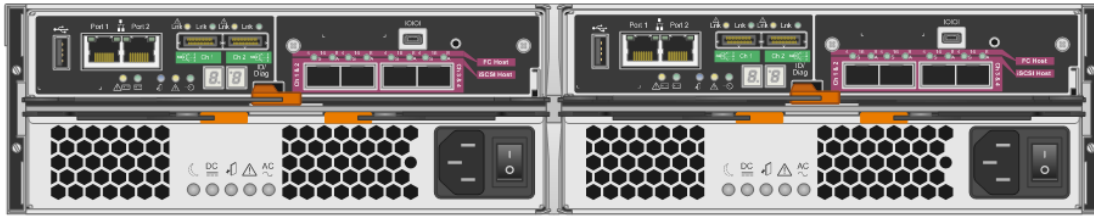
E5512 Controller-Drive Shelf

The E5512 is a 2U shelf that holds up to twelve 3.5-inch drives and features dual RAID controllers and dual power supplies with integrated fans. An E5512 based storage system supports a maximum of 192 drives by using only 12-drive shelves or 384 drives by using a mix of expansion-drive shelf models.

Note: Refer to Table 3 for more details about E5512 technical specifications.

The E5512 has a proven track record of reliability in remote dedicated environments. Figure 12 and Figure 13 show a front and a rear view, respectively, of the E5512 controller-drive shelf.

Figure 12) E5512 front view.
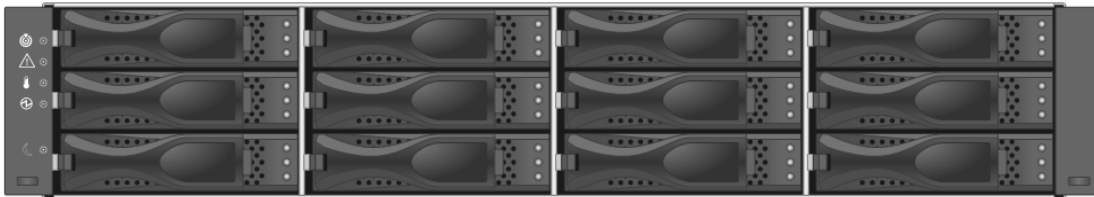
Figure 13) E5512 rear view with the 16Gb FC or 10Gb iSCSI HIC installed.
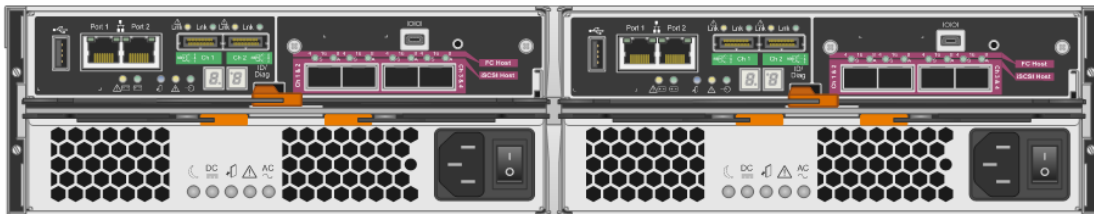
E5500 Hardware Specifications

The E5500 controller has the following base hardware features:

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

Note: One of the host I/O port options must be ordered when the controller is purchased.

Table 3 lists the physical characteristics of the E5560, E5524, and E5512 controller-drive shelves.

Table 3) E5500 physical characteristics.

Dimensions and Weight	E5560 Controller-Drive Shelf (DE6600 Shelf w/ 6TB HDD)	E5524 Controller-Drive Shelf (DE5600 Shelf w/ 1.8TB HDD)	E5524 Controller-Drive Shelf (DE5600 Shelf w/ 1.6TB SSD)	E5512 Controller-Drive Shelf (DE1600 Shelf w/ 6TB HDD)
Height	7.0" (17.78cm)	3.47" (8.81cm)	3.47" (8.81cm)	3.4" (8.64cm)
Width	19" (48.26cm)	19" (48.26cm)	19" (48.26cm)	19" (48.26cm)
Depth	32.5" (82.55cm)	19.6" (49.78cm)	19.6" (49.78cm)	21.75" (55.25cm)
Weight (max.)	240.7lb (109.4kg)	63.0lb (28.6kg)	60.1lb (27.3kg)	65.3lb (29.6kg)

Table 4 lists both the typical power specifications and the equipment-rated power specifications of the three E5500 controller-drive shelves. The table assumes that the shelves are in a dual-controller configuration and fully loaded with drives.

Table 4) E5500 maximum power specifications per shelf fully loaded with listed drive type.

E5500 Controller-Drive Shelf	Typical Operating Power			Equipment-Rated Power		
	kVA	Watts (AC)	BTU/hr	kVA	Watts (AC)	BTU/hr
E5560 with HIC: 1.8TB 10K RPM drives fully populated	0.968	958	3,269	1.178	1,166	3,978
E5560 with HIC: 4TB 7.2K RPM drives fully populated	1.056	1,045	3,566	1.265	1,253	4,275
E5560 with HIC: 6TB 7.2K RPM drives fully populated	1.075	1,064	3,632	1.285	1,272	4,342
E5524 with HIC: 900GB 10K RPM drives fully populated	0.479	474	1,618	0.629	623	2,124
E5524 with HIC: 1.2TB 10K RPM drives fully populated	0.487	482	1,644	0.637	630	2,150
E5524 with HIC: 1.8TB 10K RPM drives fully populated	0.512	507	1,729	0.662	655	2,235
E5524 with HIC: 1.6TB SSDs fully populated	0.438	434	1,481	0.588	582	1,987
E5512 with HIC: 4TB 7.2K RPM drives fully populated	0.433	429	1,464	0.583	577	1,970
E5512 with HIC: 6TB 7.2K RPM drives fully populated	0.437	433	1,476	0.587	581	1,982

Table 5 lists the technical specifications for the E5500 based storage systems.

Table 5) E5500 technical specifications.

Specification	E5560	E5524	E5512
Maximum system raw capacity	2160TB	691TB	1152TB

Specification	E5560	E5524	E5512
Maximum number of drives per system	360	384	192
Shelf form factor	4U, 60 drives	2U, 24 drives	2U, 12 drives
Drive types supported	800GB or 1.6TB 2.5" SSD (25 per shelf max., 120 per storage system max.)	800GB or 1.6TB 2.5" SSD (120 per storage system max.)	N/A
	1.8TB, 1.2TB, 900GB, or 600GB 2.5" 10K RPM SAS	1.8TB, 1.2TB, 900GB, or 600GB 2.5" 10K RPM SAS	600GB 3.5" 15K RPM SAS (restricted to add-on for existing system only—EOL)
	6TB, 4TB, 3TB, or 2TB 3.5" 7.2K RPM SAS	N/A	6TB, 4TB, 3TB, or 2TB 3.5" 7.2K RPM SAS
Memory	24GB (12GB per controller)		
Host I/O (one I/O type supported at a time; controllers must match)	8-port 6Gb SAS (4-port 6Gb SAS [wide-port] per E5500 controller)		
	8-port 12Gb SAS (4-port 12Gb SAS [wide-port] per E5500 controller)		
	8-port 16Gb FC (4-port 16Gb FC [SMID = 197] per E5500 controller)		
	8-port 10Gb iSCSI (4-port 10Gb iSCSI [SMID = 230] per E5500 controller)		
	4-port 40Gb IB (2-port 40Gb IB per E5500 controller)		
	4-port 56Gb IB (2-port 40Gb IB per E5500 controller)		
Drive shelves supported for expansion-drive offerings	DE6600 (4U, 60 drives): 5 expansion shelves max.; supports the same drive types as E5560 controller-drive shelf		
	DE5600 (2U, 24 drives): 15 expansion shelves max.; supports the same drive types as E5524 controller-drive shelf		
	DE1600 (2U, 12 drives): 15 expansion shelves max.; supports the same drive types as E5512 controller-drive shelf		
High-availability (HA) features	Dual active controllers with automated I/O path failover		
	Support for RAID levels 0, 1, 3 (10 for 4 drives or more), 5, and 6		
	Redundant, hot-swappable storage controllers, disk drives, power supplies, and cooling fans		
	SANtricity proactive drive health monitoring with the new drive evacuator feature to identify problem drives and begin removing data before hard failures occur		
	Automatic drive fault detection, failover, and rebuild by using global hot spare drives for standard RAID and spare pool capacity in the case of DDP		
	Mirrored data cache with battery backup and destage to flash		
	Online controller firmware and NVSRAM upgrade		
	Online ESM firmware and drive firmware upgrade (consult CSS for guidance before performing ESM or drive firmware upgrades)		

Specification	E5560	E5524	E5512
	SANtricity Persistent Monitor and AutoSupport, for making periodic copies of the storage system configuration		

For additional information, refer to the NetApp E5500 Datasheet.

3.2 Controller Host Interface Features

The E5500 controller by default includes two Ethernet management ports and two SAS drive expansion ports that provide out-of-band or in-band system management access and redundant drive expansion paths. E5500 controllers must be ordered with one of the supported host interface card (HIC) options per controller:

- 2-port 40Gb InfiniBand (IB) HIC
- 2-port 56Gb IB HIC
- 4-port 6Gb SAS HIC
- 4-port 12Gb SAS HIC
- 4-port optical 16Gb FC or 10Gb iSCSI HIC

For optical connections, the appropriate SFPs must be ordered for the specific implementation. Consult the Hardware Universe for a full listing of available host interface equipment. Figure 14 provides a close-up view of the E5500 HIC options.

Note: Both controllers in a storage system must be configured identically.

Figure 14) E5500 HIC options.

E5560 4U Shelf Rear View with Dual E5500 Controllers

E5500 Controller Canister with 2-Port
40Gb IB HIC Installed

E5500 Controller Canister with 2-Port
56Gb IB HIC Installed

E5500 Controller Canister with 4-Port
6Gb Wide-Port SAS HIC Installed

E5500 Controller Canister with 4-Port
12Gb Wide-Port SAS HIC Installed

E5500 Controller Canister with 4-Port Optical
16Gb FC / 10Gb iSCSI HIC Installed (SMID =
197 - 16Gb FC / SMID = 230 - 10Gb iSCSI)

Note: All HICs support link speed autonegotiation. One exception is the new unified SFP used with the 4-port optical HIC. This SFP does support 4/8/16Gb FC and 10Gb iSCSI, but it does not support 1Gb iSCSI. As a result, the unified SFP should not be used with iSCSI remote mirroring because it does not support a 10Gb/1Gb WAN link to the remote site.

3.3 Hardware LED Definitions

E5500 Controller-Drive Shelf LEDs

The E5500 controller-drive shelf has LED status indicators on the front of the shelf and on the power supply units and fan units installed at the rear of the shelf. The LEDs on the front panel indicate systemwide conditions, and the LEDs on the power supply units and fan units indicate the status of the individual units.

The LEDs on the front panel of the E5500 controller-drive shelf are visible with or without the bezel installed. Figure 15 shows the LEDs on the front panel of the E5560 controller-drive shelf.

Figure 15) LEDs on the front panel of the E5560 controller-drive shelf.

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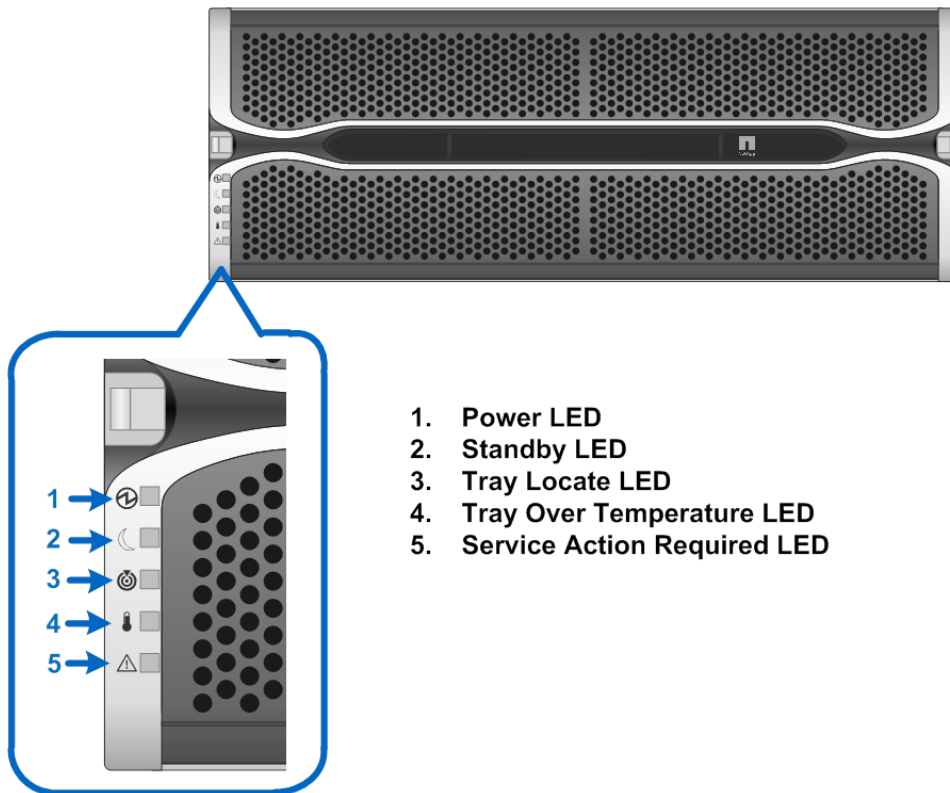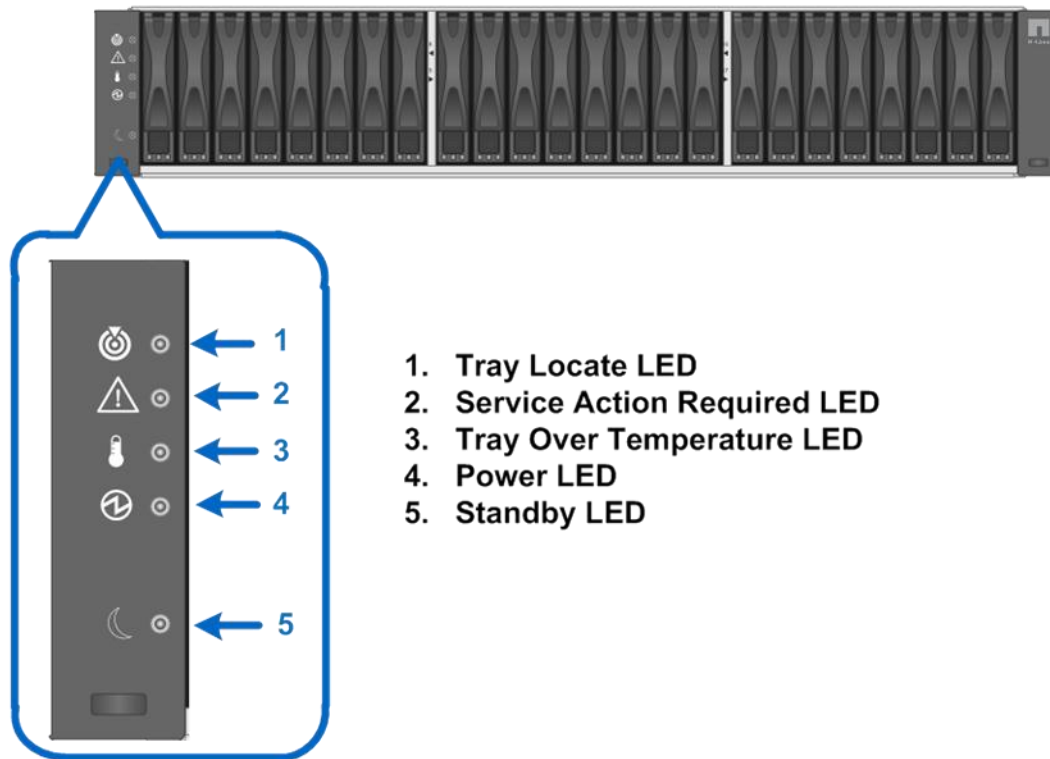5. **Service Action Required LED**

Figure 16 shows the LEDs on the front panel of the E5524 and E5512 controller-drive shelves.

Note: Figure 16 shows the E5524 front panel, but the LEDs are the same for the E5512.

Figure 16) LEDs on the front panel of the E5524 and E5512 controller-drive shelves.

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

Note: The LEDs on the front of the E5560 controller-drive shelf are ordered differently from those on the front of the E5524 and E5512 shelves.

Table 6 defines the front-panel LEDs on the E5560, E5524, and E5512 controller-drive shelves. The LEDs are listed in the order matching the layout on the E5560 controller-drive shelf.

Table 6) E5500 controller-drive shelf LED definitions (front panel).

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

Power Supply and Fan Unit LEDs

The E5500 controller-drive shelf supports dual power supplies and fan canisters. Each power supply and fan canister unit is equipped with status LEDs. Figure 17 shows the LEDs on the rear of the E5560 controller-drive shelf.

Figure 17) LEDs on the E5560 power supply and fan units (rear view).

1. Standby LED
2. Output DC Power LED
3. Power Service Action Allowed LED
4. Power Service Action Required LED
5. Input AC Power LED
6. Fan Unit Service Action Allowed LED
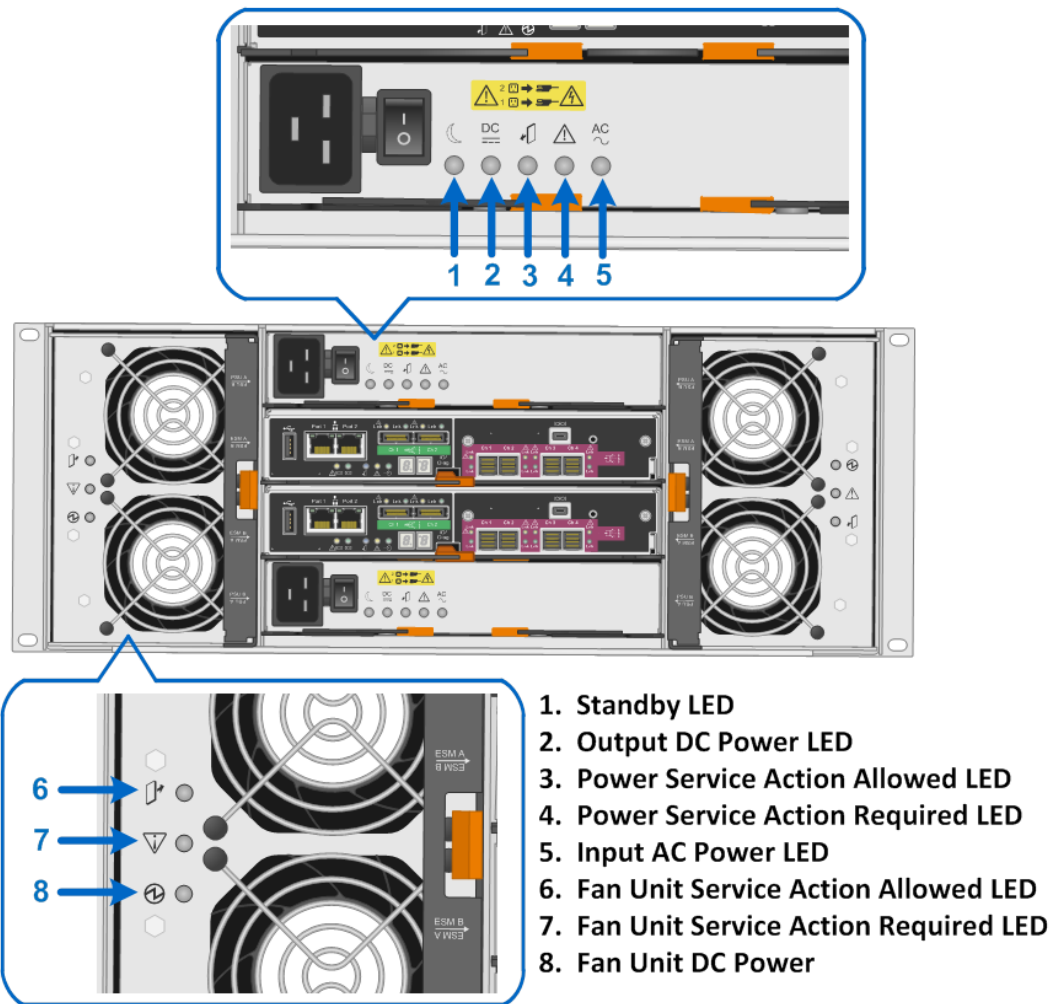7. Fan Unit Service Action Required LED
8. Fan Unit DC Power

Table 7 defines the power supply and fan unit LEDs on the E5560 controller-drive shelf.

Table 7) E5560 controller-drive shelf power supply and fan unit LED definitions.

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

LED Name	Color	LED On	LED Off
Fan Unit Service Action Required	Amber	The fan unit requires attention.	Normal status.
Fan Unit DC Power	Green	Fan AC power is present.	Fan AC power is not present.

The power supply and fan unit for the E5524 and E5512 controller-drive shelf are identical. The power supply LEDs are shown in Figure 18 and defined in Table 8.

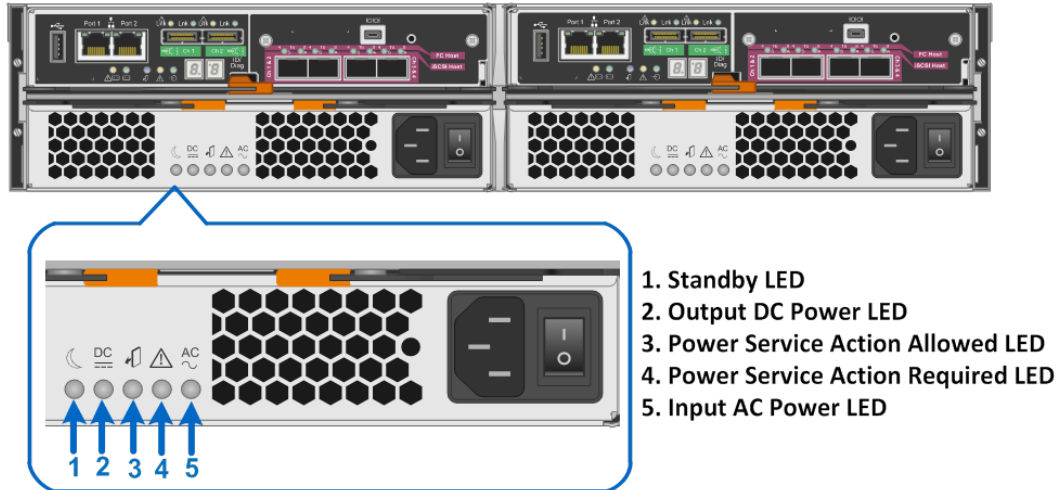**Figure 18) LEDs on the E5524 and E5512 integrated power supply units (rear view).**

1. Standby LED
2. Output DC Power LED
3. Power Service Action Allowed LED
4. Power Service Action Required LED
5. Input AC Power LED

Table 8) E5524 and E5512 controller-drive power supply LED definitions.

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

E5500 Controller Canister LEDs

The E5500 controller canister has several LED status indicators. The LEDs on the left side of the canister refer to the on-board ports, including the Ethernet management ports, the SAS drive expansion ports, and the overall controller status. The LEDs on the right side of the canister refer to the status of the host ports.

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

Figure 19) Controller Properties dialog box.
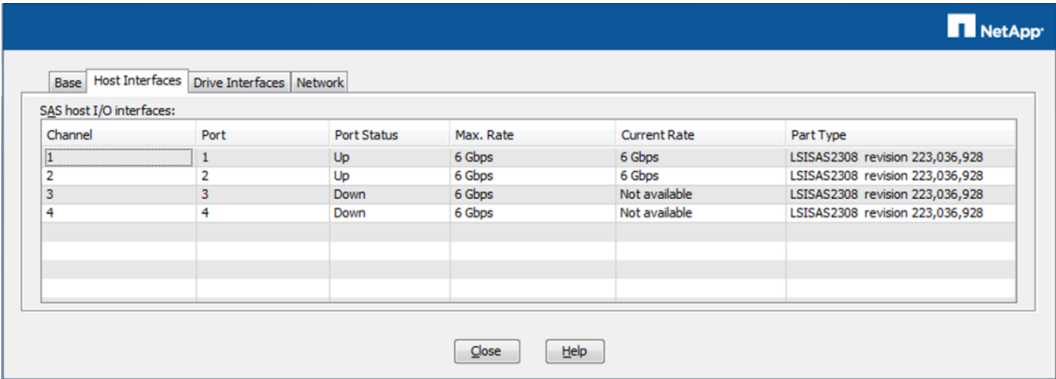
Controller Base Port Status LEDs

Figure 20 shows the on-board LED status indicators on the left rear side of the E5500 controller. Most of the LEDs are lit when a fault condition exists; however, the Battery Charging LED and the Cache Active LED are lit when the battery is fully charged and the cache is active. The seven-segment LEDs provide status codes for both normal operation and fault conditions; the dot in the first seven-segment LED is the controller heartbeat indicator, which comes on when an intercontroller communication link has been established.

Figure 20) LEDs on the left side of the E5500 controller canister.

1. Ethernet Management Port 1 Link Activity LED
2. Ethernet Management Port 1 Link Rate LED
3. Ethernet Management Port 2 Link Activity LED
4. Ethernet Management Port 2 Link Rate LED
5. Drive Expansion Channel 1 Fault LED
6. Drive Expansion Channel 1 Activity LED
7. Drive Expansion Channel 2 Fault LED
8. Drive Expansion Channel 2 Activity LED
9. Battery Service Action Required LED
10. Battery Charging LED
11. Controller Service Action Allowed LED
12. Controller Service Action Required LED
13. Cache Active LED
14. Flashing Dot – Heartbeat Indicator
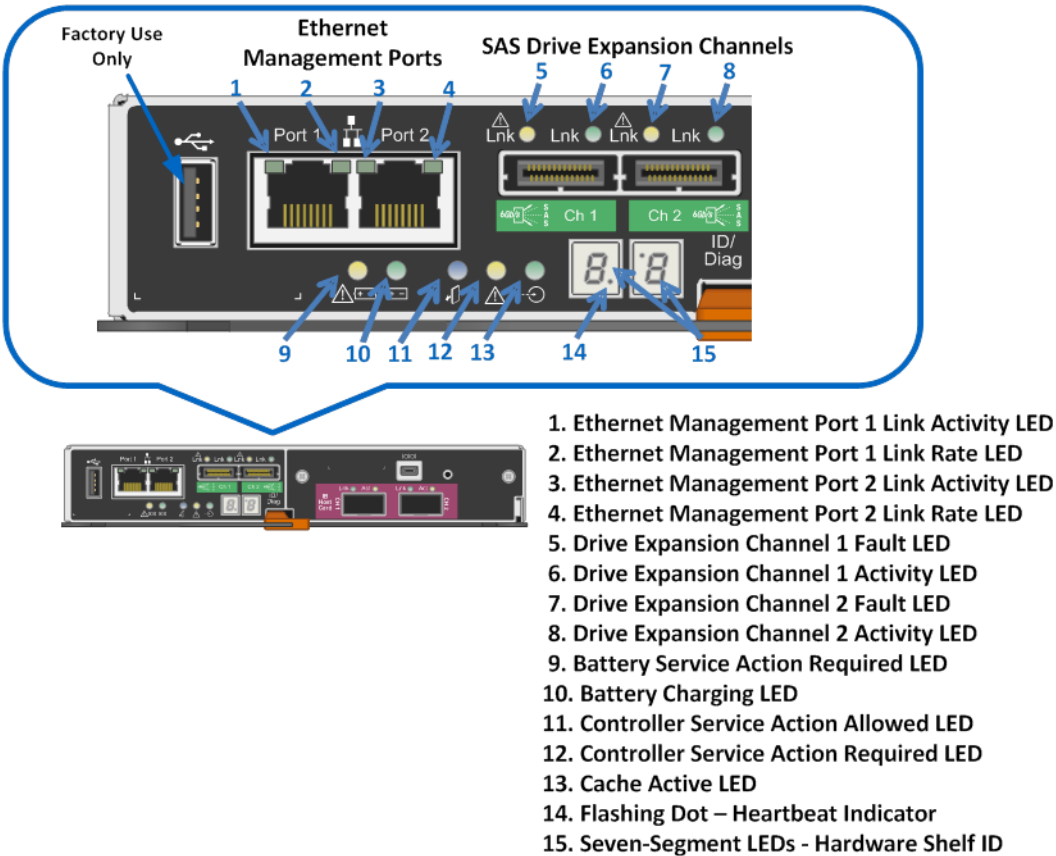15. Seven-Segment LEDs - Hardware Shelf ID

Table 9 defines the Ethernet management port LEDs on the controller (LEDs 1 through 4 in Figure 20).

Table 9) Ethernet management port LED definitions.

LED Name	Color	LED On	LED Off
Ethernet Management Port Link Activity (top left corner of management port RJ-45 connectors)	Green	• Solid: The link is up without activity. • Blinking: The link is up with activity.	A link error has occurred (link down).
Ethernet Management Port Link Rate (top right corner of management port RJ-45 connectors)	Green	There is a 1000BASE-T rate.	There is a 10/100BASE-T rate.

Table 10 defines the LEDs for the SAS drive expansion ports used to connect expansion-drive shelves to the E5500 controller-drive shelf (LEDs 5 through 8 in Figure 20).

Table 10) SAS drive expansion channel LED definitions.

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

Table 11 defines the controller or system status LEDs (LEDs 9 through 15 in Figure 20).

Table 11) Controller base feature LED definitions.

LED Name	Color	LED On	LED Off
Battery Service Action Required	Amber	The battery in the controller canister has failed.	Normal status.
Battery Charging	Green	• Solid: The battery is fully charged. • Blinking: The battery is charging.	The controller canister is operating without a battery, or the existing battery has failed.
Controller Service Action Allowed	Blue	The controller canister can be removed safely from the controller-drive shelf.	The controller canister cannot be removed safely from the controller-drive shelf.
Controller Service Action Required	Amber	Some fault exists within the controller canister.	Normal status.
Cache Active	Green	• Solid: The cache is active. • Blinking: After AC power failure, the cache offload is in process.	The cache is inactive, or the controller canister has been removed from the controller-drive shelf.

LED Name	Color	LED On	LED Off
Dot in lower right corner of first seven-segment LED	Green	A flashing dot indicates that the controller heartbeat is active.	If the dot is not lit, the controller heartbeat is not active (that is, the controller is not in service).
Two seven-segment LEDs	Green	• If the controller status code equals 99, then the controller is in service. • If the controller status code does not equal 99, then a fault condition exists. Contact technical support for further assistance.	The controller is not powered on.

Note: The Battery Service Action Required LED indicates that the battery timer has expired or the battery has failed the automatic battery test. This condition can seriously affect the system write performance because the write cache feature is disabled by default when the battery is not functioning normally.

The seven-segment LEDs display the shelf ID, and 99 is the normal ID for controller-drive shelves. Expansion-drive shelves display numbers starting with 00 and increasing as drive shelves are added to the storage system. These shelf IDs can be changed from the default numbering by using the SANtricity management interface. The seven-segment LEDs also display status codes under start-up conditions and some error conditions.

4-Port 6Gb Wide-Port SAS HIC LEDs

The host-side connection ports have status LEDs to indicate the connection status for each link between the storage system and various host-side hardware devices. Figure 21 shows the LEDs on the 4-port 6Gb wide-port SAS HIC for the E5500 controller.

Figure 21) LEDs on the 4-port 6Gb wide-port SAS HIC.

1. Mini-SAS Host Port 1
2. Mini-SAS Port 1 Link Fault LED
3. Mini-SAS Port 1 Link Activity LED
4. Mini-SAS Host Port 2
5. Mini-SAS Port 2 Link Fault LED
6. Mini-SAS Port 2 Link Activity LED
7. Mini-SAS Port 3 Link Fault LED
8. Mini-SAS Host Port 3
9. Mini-SAS Port 3 Link Activity LED
10. Mini-SAS Port 4 Link Fault LED
11. Mini-SAS Host Port 4
12. Mini-SAS Port 4 Link Activity LED
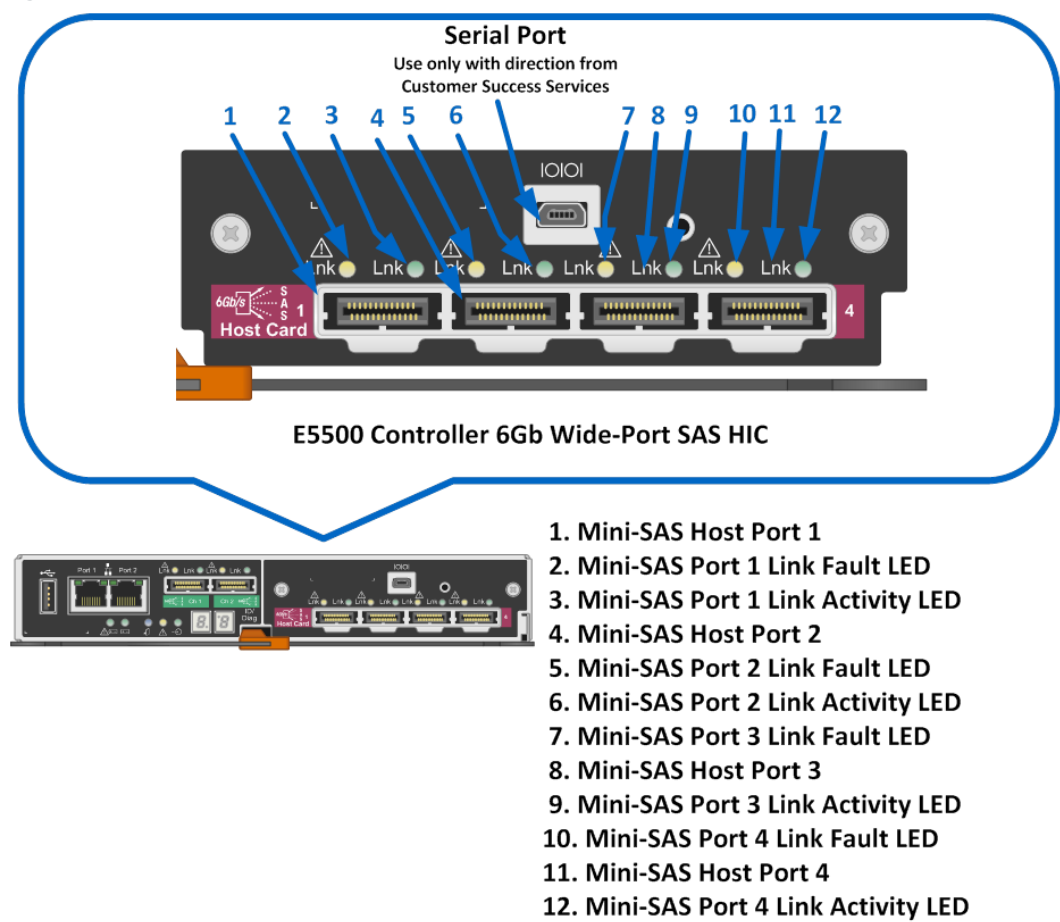
Note: E-Series controller-drive shelves ship with a serial port cable in the packaging. The cable is required only for advanced maintenance procedures led by NetApp authorized service personnel. When the system arrives, retrieve the cable and keep it in a location that is accessible to the storage system. The maintenance port is password-protected, and commands run in the maintenance shell must be performed with care, especially on production storage systems.

Table 12 defines the LEDs on the 4-port 6Gb wide-port SAS HIC.

Table 12) 4-port 6Gb wide-port SAS HIC LED definitions.

LED Name	Color	LED On	LED Off
Mini-SAS Port Link Fault	Amber	At least one of the four PHYs is working, but another PHY cannot establish the same link to the device connected to the host input port connector.	Normal status.
Mini-SAS Port Link Activity	Green	At least one of the four PHYs in the host input port is working, and a link exists to the device connected to the input port connector.	A link error has occurred.

4-Port 12Gb Wide-Port SAS HIC LEDs

New with SANtricity 11.20 is the 4-port 12Gb wide-port SAS HIC shown in Figure 22.

Figure 22) LEDs on the 4-port 12Gb wide-port SAS HIC.

1. Host SAS Ch 1 Fault LED
2. Host SAS Ch 1 Activity LED
3. Host SAS Ch 2 Fault LED
4. Host SAS Ch 2 Activity LED
5. Host SAS Ch 3 Fault LED
6. Host SAS Ch 3 Activity LED
7. Host SAS Ch 4 Fault LED
8. Host SAS Ch 4 Activity LED
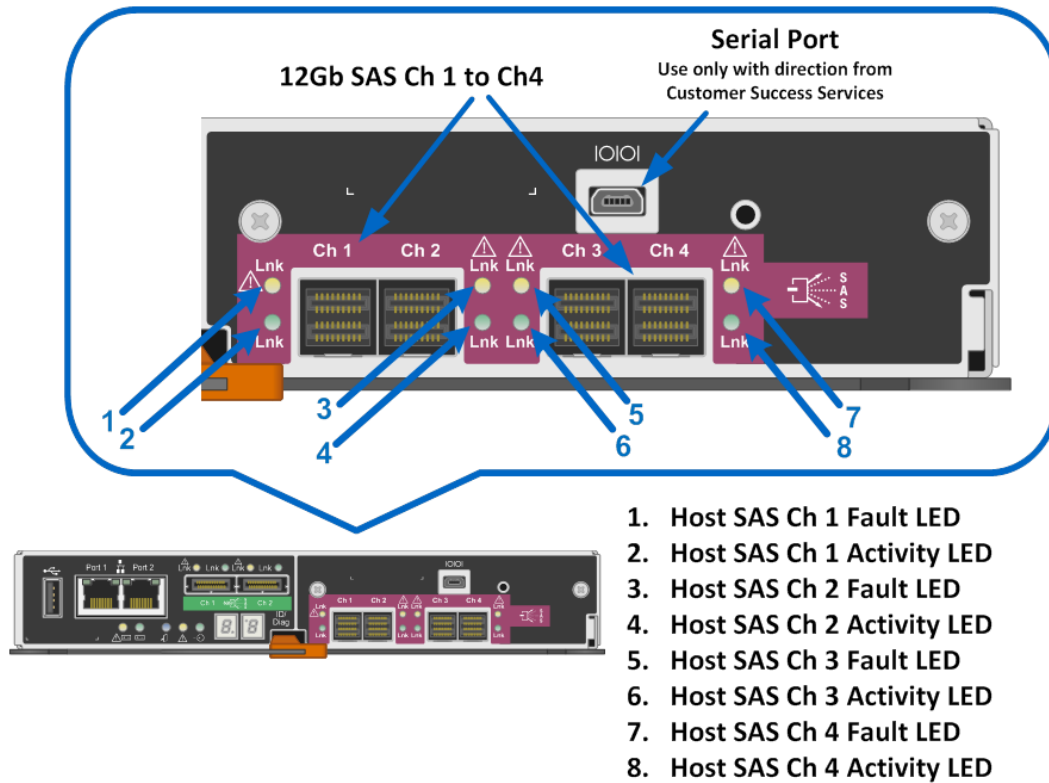
Note: The 12Gb SAS3 HIC uses mini-SAS HD (SFF-8643/8644) connectors.

Table 13 provides the definitions for the 12Gb SAS HIC LEDs.

Table 13) 4-port 12Gb SAS HIC LED definitions.

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

4-Port Optical 16Gb FC or 10Gb iSCSI HIC LEDs

The E5500 supports a 4-port optical HIC that can function by using 16Gb FC or 10Gb iSCSI protocols, for a maximum of eight 16Gb FC or eight 10Gb iSCSI ports per E5500 storage system (dual controllers required). Figure 23 shows the LEDs on the 4-port optical 16Gb FC or 10Gb iSCSI HIC for the E5500 controller.

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

- SMID = 197: Controller is set for FC when using the optical HIC.
- SMID = 230: Controller is set for iSCSI when using the optical HIC.

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

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

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

1. FC or iSCSI Channel 1
2. FC or iSCSI Channel 2
3. FC or iSCSI Channel 3
4. FC or iSCSI Channel 4
5. Host Ch 1 Link LED 0
6. Host Ch 1 Link LED 1
7. Host Ch 2 Link LED 0
8. Host Ch 2 Link LED 1
9. Host Ch 3 Link LED 0
10. Host Ch 3 Link LED 1
11. Host Ch 4 Link LED 0
12. Host Ch 4 Link LED 1
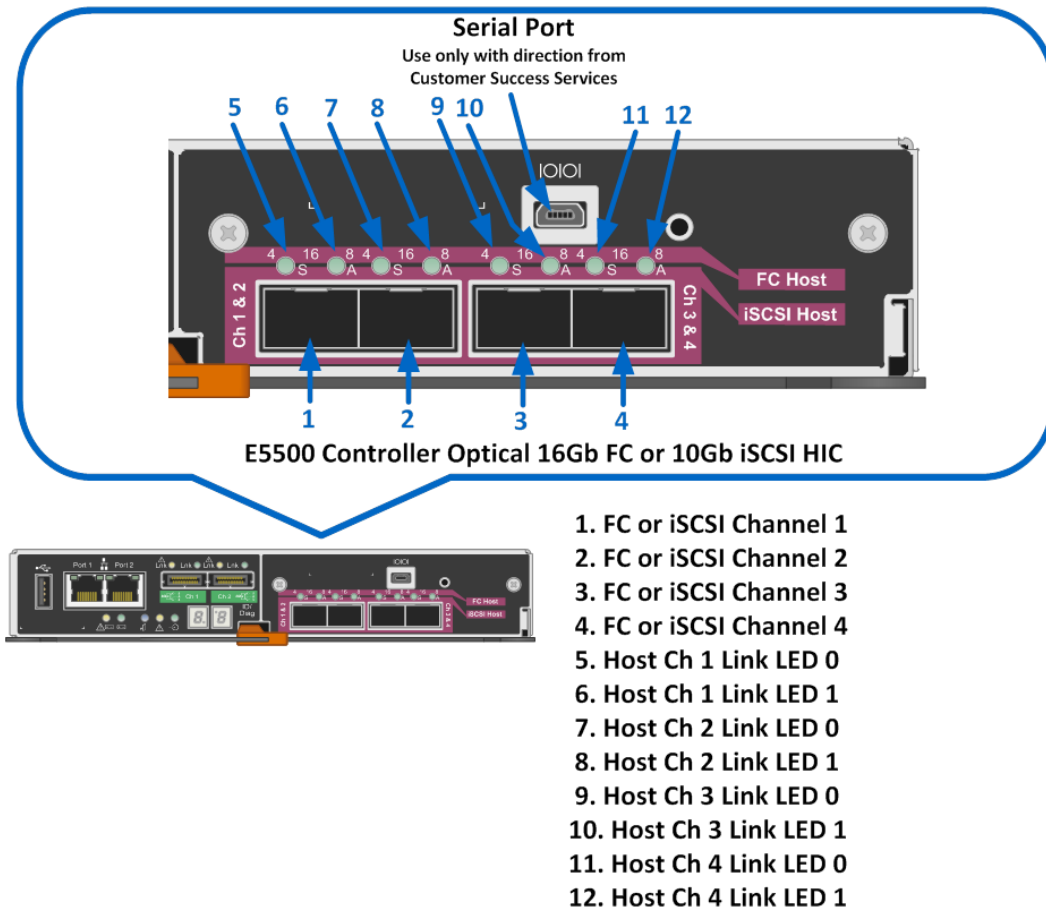
Table 14 defines the LEDs on the 4-port optical HIC when the FC protocol is used.

Table 14) 4-port optical 16Gb FC HIC LED definitions.

LED 0	LED 1	Link Rate	Color
Off	Off	Link down	NA
On	Off	Link operating at 4Gb/sec	Green
Off	On	Link operating at 8Gb/sec	Green

LED 0	LED 1	Link Rate	Color
On	On	Link operating at 16Gb/sec	Green

Table 15 provides the 4-port optical HIC LED definitions when the iSCSI protocol is used.

Table 15) 4-port optical 10Gb iSCSI HIC LED definitions.

LED Speed (Left Side)	LED Activity (Right Side)	Link Rate	Color
On	On	Link operating at 10Gb/sec— no activity	Green
	Blinking	Link operating at 10Gb/sec— with active I/O in progress	Green
Off	On	Link operating at 1Gb/sec— no activity	Green
	Blinking	Link operating at 1Gb/sec— with active I/O in progress	Green
Off	Off	Link down	NA

2-Port 40Gb or 56Gb InfiniBand HIC LEDs

Beginning with SANtricity 11.20, the E5500 controller supports a 56Gb IB HIC in addition to the existing 40Gb IB HIC. Both HICs have 2 ports, and the LED functionality is identical. Figure 24 shows the LEDs on the 2-port 40Gb and 56Gb IB HIC for the E5500 controller.

Figure 24) LEDs on the 2-port 40Gb or 56Gb IB HIC.

1. QSFP Channel 1
2. QSFP Channel 1 Physical Link LED
3. QSFP Channel 1 Activity LED
4. QSFP Channel 2 Physical Link LED
5. QSFP Channel 2 Activity LED
6. QSFP Channel 2
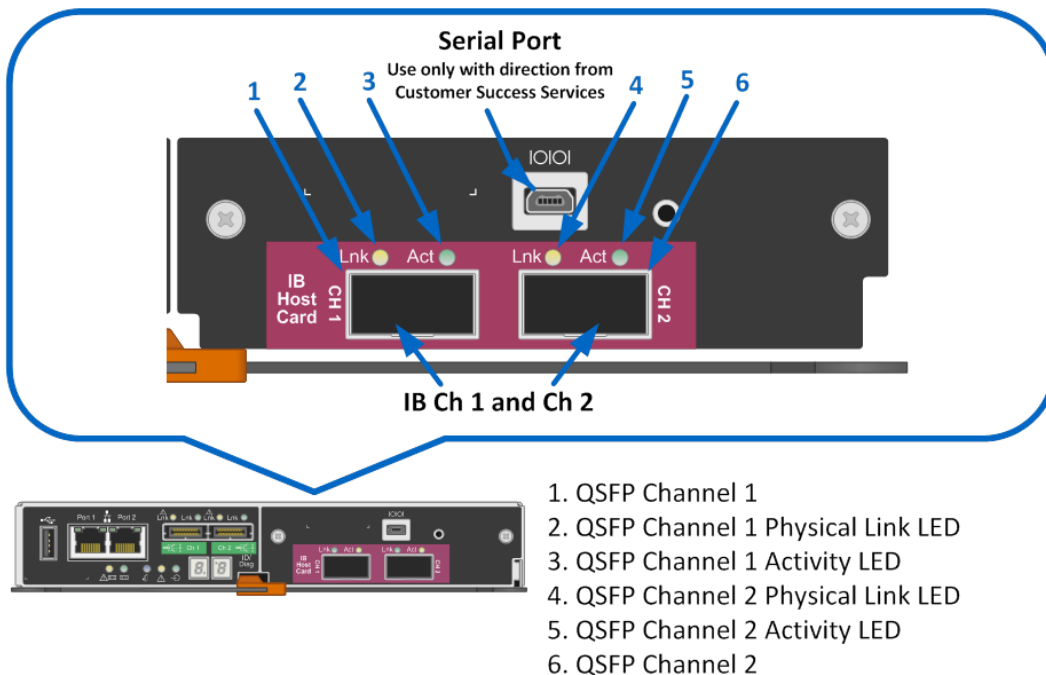
Note: 40Gb HIC and 56Gb IB HIC use same faceplate

Table 16 defines the LEDs on the 2-port 40Gb and 56Gb IB HIC.

Table 16) 2-port 40Gb and 56Gb IB HIC LED definitions.

LED Name	Color	LED On	LED Off
QSFP Channel Physical Link	Amber	The physical link is active.	The physical link is not active.
QSFP Channel Activity	Green	• Solid: The link is up without activity. • Blinking: The link is up with activity.	The controller has not yet loaded the driver for the ConnectX host channel adapter.

For additional information about the E5500 controller and related hardware, refer to the E5500 Series documentation in the NetApp Support site Documentation library.

4   Expansion-Drive Shelves

E5500 storage systems support scale-out architectures through the use of expansion-drive shelves that are added on to the controller-drive shelf. This add-on requires a very specific single-stack architecture that is different from the single stack used with the E-Series E2700 storage systems. Failure to cable the drive shelves correctly results in a fault condition on the storage system that must be cleared before most configuration changes can be allowed.

4.1   Green Field Installation

The E5500 single-stack layout is shown in Figure 25. The top-down and bottom-up approach is used to guard against a lost-shelf fault condition and to enable hot-adding a shelf in the future.

Figure 25) E5524 storage system with five expansion-drive shelves.
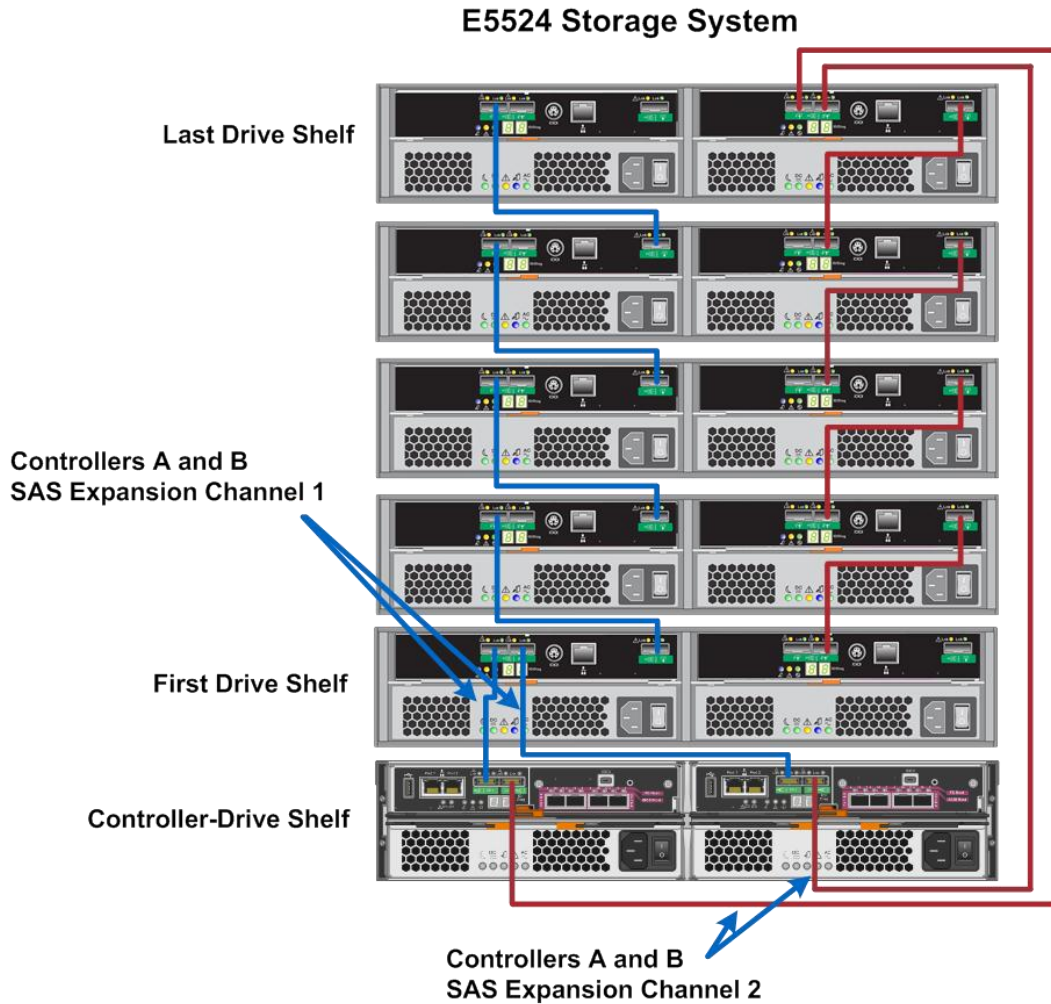
The E5500 cabling is innovative because the dual ports on each controller are split across the A and B sides of the attached drive shelves. To verify correct drive shelf cabling, use the cable report located in the SANtricity Storage Manager, AMW > Monitor > Reports > Cable Connections, to trace each path as shown in Figure 25.

Note: The report in Figure 26 shows a five-shelf system as opposed to the six-shelf system depicted in Figure 25.

Figure 26) SANtricity Storage Manager cable connections report.

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

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

4.2   Expansion-Drive Shelf Hot-Add

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

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

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

Figure 27 and Figure 28 show the hot-add connectivity when a storage system is added as the last shelf in the system.
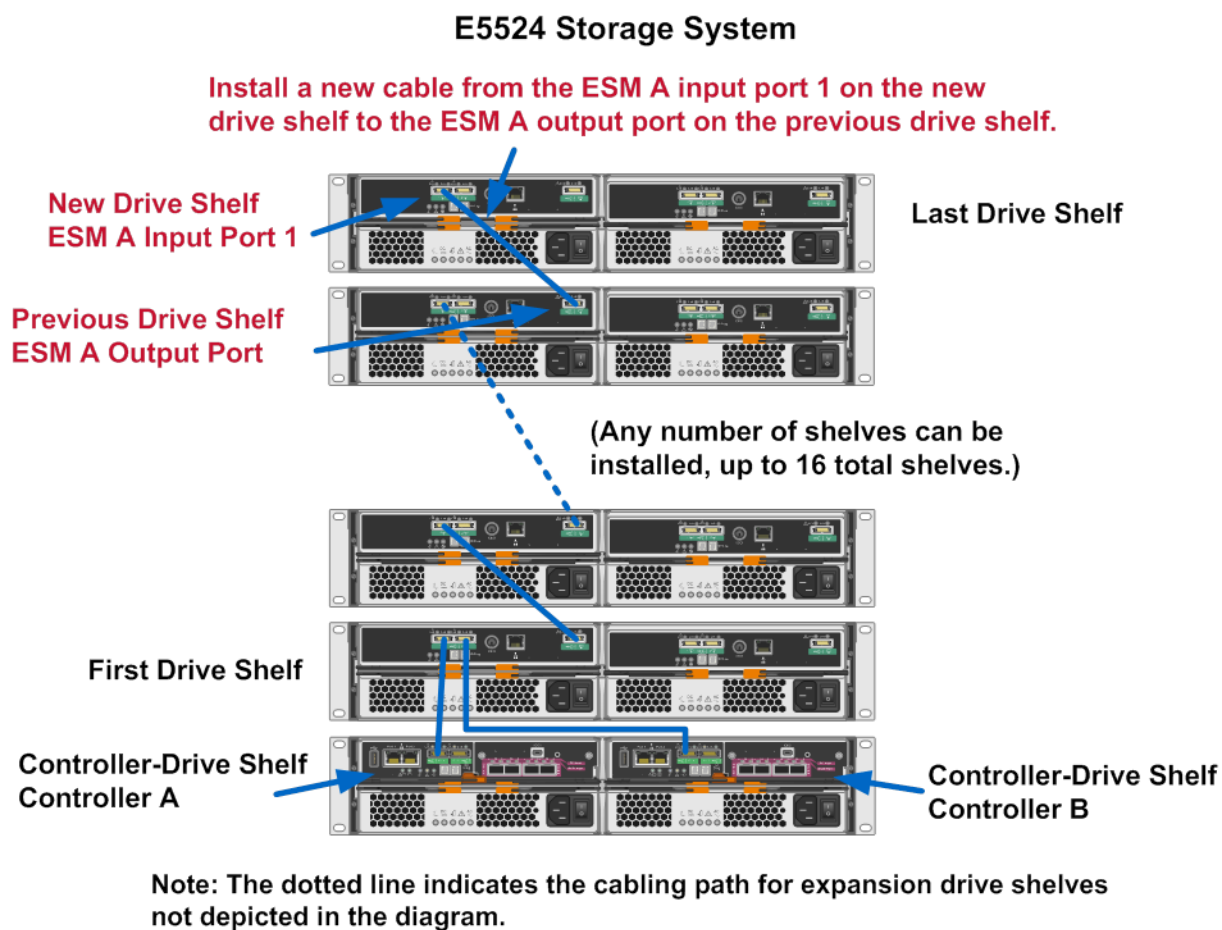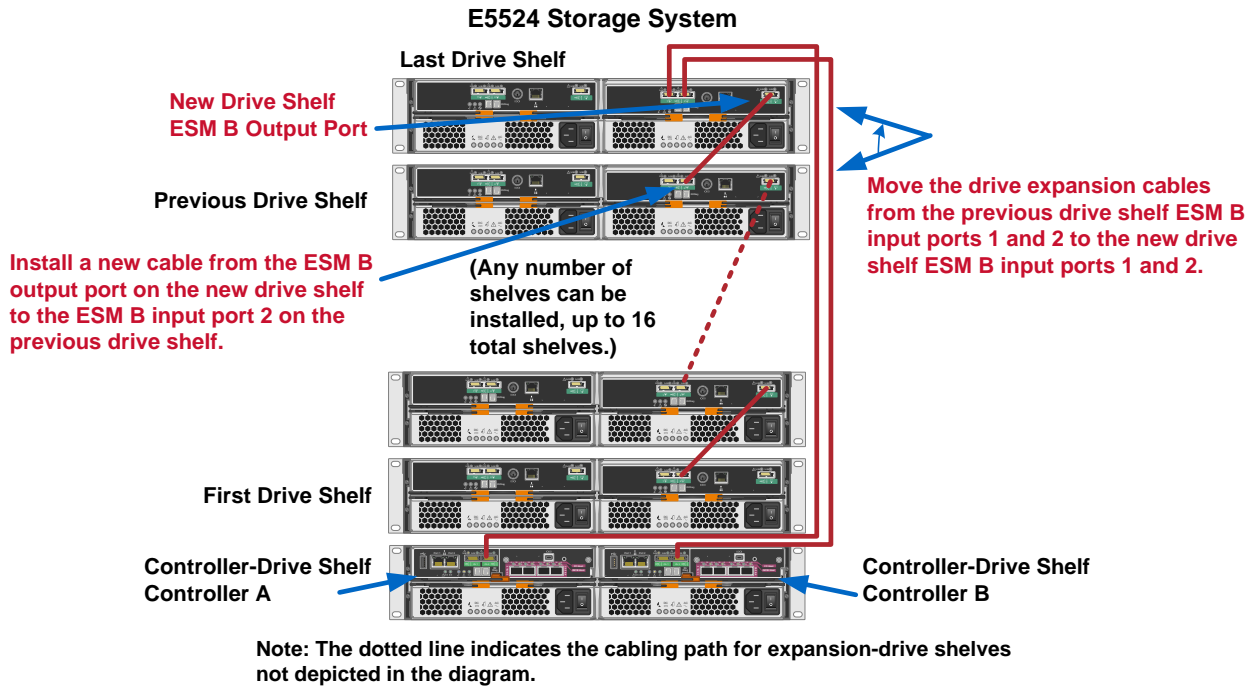
Figure 27) Drive shelf hot-add A-side cabling.

E5524 Storage System

Install a new cable from the ESM A input port 1 on the new drive shelf to the ESM A output port on the previous drive shelf.

New Drive Shelf
ESM A Input Port 1

Last Drive Shelf

Previous Drive Shelf
ESM A Output Port

(Any number of shelves can be installed, up to 16 total shelves.)

First Drive Shelf

Controller-Drive Shelf
Controller A

Controller-Drive Shelf
Controller B

Note: The dotted line indicates the cabling path for expansion drive shelves not depicted in the diagram.

Figure 28) Drive shelf hot-add B-side cabling.

E5524 Storage System

Last Drive Shelf

**New Drive Shelf
ESM B Output Port**

**Move the drive expansion cables
from the previous drive shelf ESM B
input ports 1 and 2 to the new drive
shelf ESM B input ports 1 and 2.**

Previous Drive Shelf

**Install a new cable from the ESM B
output port on the new drive shelf
to the ESM B input port 2 on the
previous drive shelf.**

**(Any number of
shelves can be
installed, up to 16
total shelves.)**

First Drive Shelf

**Controller-Drive Shelf
Controller A**

**Controller-Drive Shelf
Controller B**

**Note: The dotted line indicates the cabling path for expansion-drive shelves
not depicted in the diagram.**

Best Practice

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

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

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

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5   E-Series Product Support

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

5.1   Controller-Drive Shelf Serial Number

E-Series storage systems are shipped preconfigured from the factory (controllers have HICs and batteries installed, and controllers are installed in the controller-drive shelf). The shelf SN is printed on a silver label affixed to the controller-drive shelf, and its location can vary depending on the chassis. The shelf SN is identified by the text "Serial" or "SN," which is shown in Figure 29 for different system types.

Figure 29) Controller-drive shelf SN.

DE1600 and DE5600 (12 drive and 24 drive enclosure)

- Right-hand side of the bottom lip of the tray. Rear View below.

類型 Class 5350
型號 Model 0834
Serial 0804L003379

DE6600 (60 drive enclosure)

- Front of the enclosure, on right ear of enclosure. Remove small bezel. Front View below.

SN: 1109FG000417
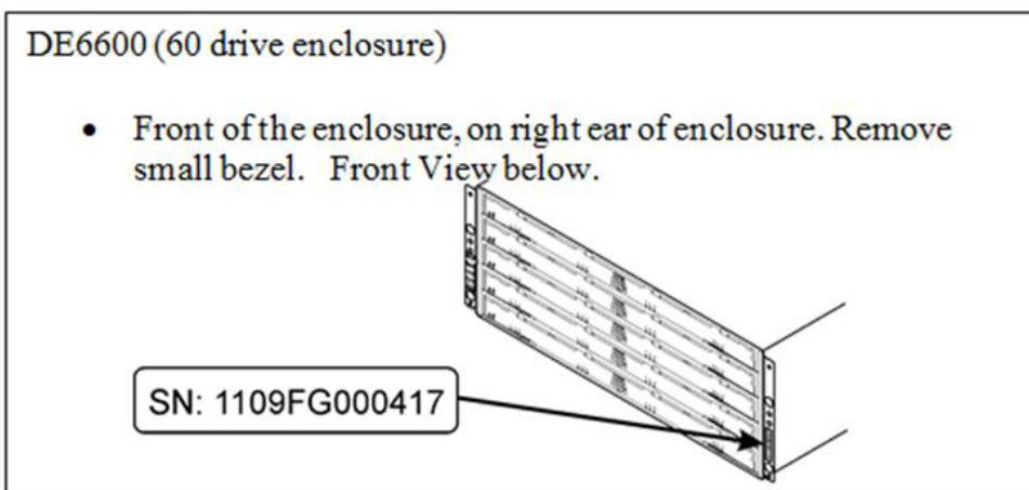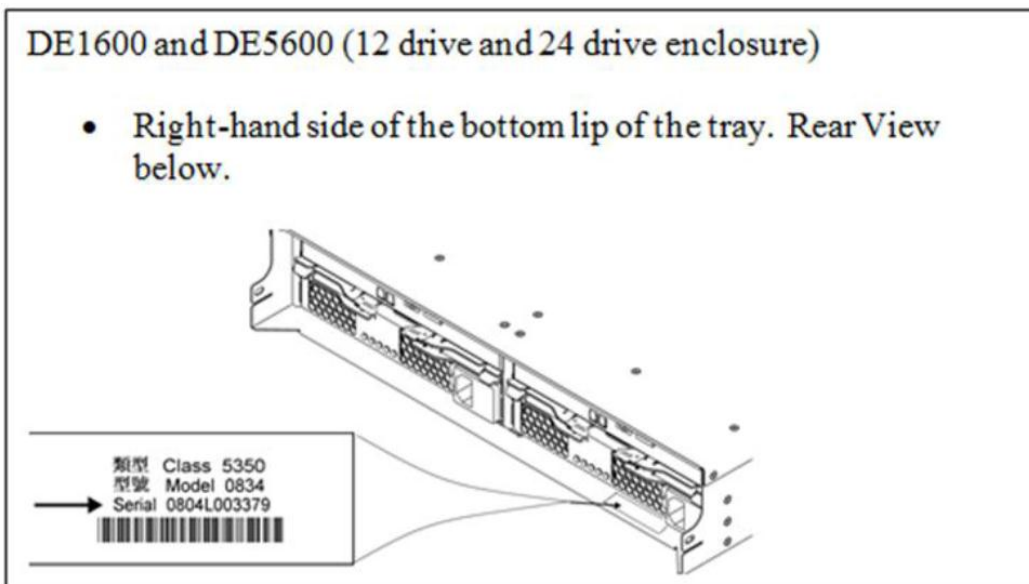
The shelf SN is also included on the shelf UL sticker; however, this sticker is often not visible after the shelves are installed in a rack.

On a running storage system, the SN is also available through SANtricity Storage Manager by viewing the storage array profile shown in Figure 30.

Figure 30) SANtricity Storage Manager AMW storage array profile.
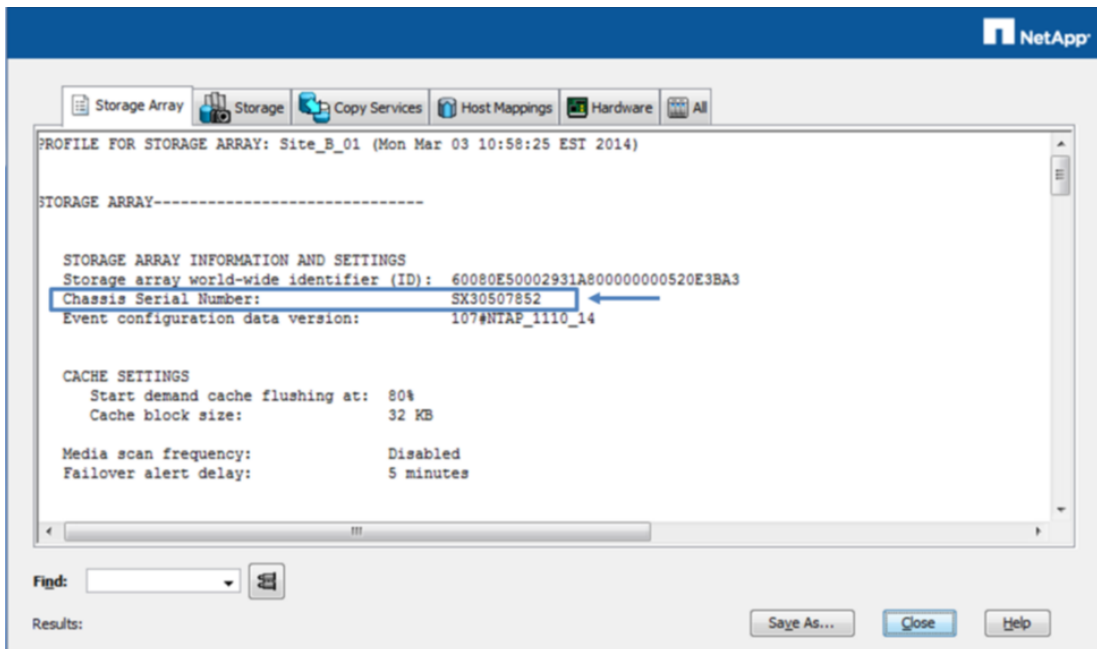
5.2 License Keys

Drive security is the only premium feature in SANtricity 11.20; it requires a license key file to activate the functionality. License keys for premium features are system specific and can be purchased by sending a request to a sales representative. The request must include the feature-enable identifier that is listed in the Premium Features and Feature Pack Information dialog box (shown in Figure 31) and the storage system serial number (the serial number of the E-Series controller-drive shelf).

Figure 31) SANtricity 11.20 Premium Features and Feature Pack Information dialog box.

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

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

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

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

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

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

6   Summary

The NetApp E5500 storage system leads the industry in meeting demanding high-performance computing requirements, supporting wide-ranging transactional database workloads, and acting as tier one storage for data center dedicated and mixed workloads. It delivers outstanding performance, density, energy efficiency, and ease of integration to enable successful outcomes for wide-ranging IT operations.

The modular flexibility of the multiple E-Series host interfaces, drive shelf options, and drive offerings enables custom configurations to grow both performance and capacity as needed. Combining E-Series hardware quality with SANtricity management and application integration (plug-ins, management applications, web services, and so on) enables E5500 storage systems to fit into existing data centers without having to reinvent day-to-day operations.

Backed by over 20 years of NetApp storage development experience and over 750,000 storage systems in the field, the E5500 provides a field-proven architecture with superior reliability and 99.999% availability. In addition, E-Series offers the NetApp AutoSupport feature to enhance customer service and avoid issues before they happen. The system's advanced protection features, redundant components, automated path failover, remote administration, and extensive diagnostic capabilities allow E-Series customers to consistently achieve high levels of data integrity and availability.

References

The following references were used in this TR:

- E-Series E5500 Product Datasheet
  https://fieldportal.netapp.com/Core/DownloadDoc.aspx?documentID=87757&contentID=114779
- E-Series Product Documentation (both online help in SANtricity 11.20 and from the NetApp Product Documentation Library)
- E-Series SANtricity 11.20 Scope of Work (not publicly available)

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