Installing and Configuring for Solaris®

Power Guide for Advanced Users

∩ NetApp®

Contents

Deciding whether to use this Power Guide

You can customize the installation and configuration of the management software and E-Series storage array to fit your data storage requirements. The quickest path is described in the SANtricity Express Guide for your operating system. This Power Guide provides additional options beyond those included in the Express Guides. You can use a mixture of express methods and power methods to customize your installation.

Use this document for one of the following reasons:

You have...	...and you want to...
Planned for an express installation of SANtricity Storage Manager or an express configuration of SANtricity System Manager on your operating system	1. Review the options for managing your storage array by exploring the table of contents of the Express Guide and this Power Guide. 2. Verify your decisions by using the *Configuration worksheet* on page 10. 3. Proceed through the Express Guide for your operating system. Review the options in this Power Guide and choose the variations you want to consider for your storage installation.
Completed an express method install using one of the E-Series Express Guides	Review the options for managing your storage arrays. See *Configuration options* on page 6.
An active E-Series configuration	Consider adding options or modifying your installation: 1. Verify your decisions by using the *Configuration worksheet* on page 10. 2. Read the conceptual information and optional procedures in this Power Guide. 3. Follow the procedures that are appropriate for your data storage requirements.

Related information

NetApp E-Series and EF-Series Systems Documentation Center

Configuration options

When planning the installation of an E-Series or EF-Series storage array, you can consider a number of options beyond the express method, including how to install the storage management software, how to manage the domain, and how to configure AutoSupport and alerts.

Type of storage array

If you have E-Series or EF-Series storage arrays, you could have one or more of these models:

- E2800

- E2700

- E5600

- EF560

Your options for storage management software vary depending on the array type.

Storage management software

NetApp's two software interfaces, SANtricity **Storage** Manager and SANtricity **System** Manager, are each appropriate in specific use cases:

- SANtricity Storage Manager is compatible with the E2700, E5600, and EF560. SANtricity Storage Manager's client-based user interface has an **Enterprise Management Window (EMW)** and an **Array Management Window (AMW)**.

    ◦ The EMW provides functions for configuring and managing multiple arrays.

    ◦ The AMW provides functions for configuring and managing a single array. You launch the AMW from within the EMW.

- SANtricity System Manager's browser-based user interface is appropriate for managing either single or multiple E2800 arrays. You launch SANtricity System Manager differently, depending on whether you want to manage a single E2800 array or multiple E2800 arrays:

    ◦ To manage one or more E2800s as single arrays, launch System Manager in a browser.

    ◦ To manage one or more E2800s as a multiple-array configuration, launch System Manager from the EMW.

Use the following decision tree to help you determine which storage management software you will use.

```
                        ┌─────────────────┐
                        │  What type of   │
                        │  storage array do│
                        │   you have?     │
                        └─────────────────┘
          E2800                              E2700, E5600, or
                                                  EF560
                  ┌─────────────────┐
                  │  How do you     │
                  │  want to manage │
                  │  your E2800?    │
                  └─────────────────┘
  I want to              I want to use
  manage my              EMW to manage
  E2800s as single       multiple E2800s
  arrays

┌─────────────────┐  ┌─────────────────┐  ┌─────────────────┐
│ Use System Manager│ │ Manage your domain│ │ Manage your domain│
│ as the embedded UI│ │ using these methods│ │ using these methods│
│ for single-array  │ │                 │ │                 │
│ functions         │ │                 │ │                 │
└─────────────────┘  └─────────────────┘  └─────────────────┘

        ┌─────────────────┐  ┌─────────────────┐  ┌─────────────────┐
        │ Use System Manager│ │ Use EMW for     │ │ Use AMW launched│
        │ launched from EMW │ │ multi-array     │ │ from EMW for    │
        │ for single-array  │ │ functions*      │ │ single-array    │
        │ functions         │ │                 │ │ functions       │
        └─────────────────┘  └─────────────────┘  └─────────────────┘
```

The following configuration examples further illustrate the use of the appropriate storage management software.

- **Single E2800 storage array** — If you have a single new E2800 array and are not using either the Synchronous Mirroring or Asynchronous Mirroring feature, all configuration can be handled from SANtricity System Manager. .

E2800 with embedded software, web services, Event Monitor, and AutoSupport

Network

SANtricity System Manager running in a web browser
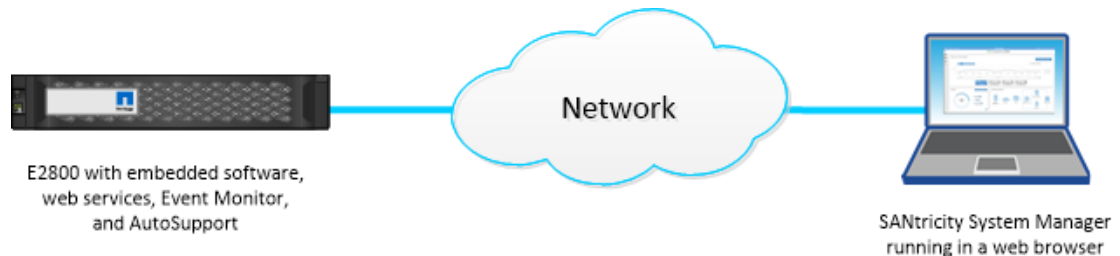
- **Multiple E2800 storage arrays** — If you have more than one E2800 storage array, you can install the EMW to manage your storage environment while handling storage array-based configuration through SANtricity System Manager. The EMW is included with SANtricity Storage Manager.

SANtricity System Manager in a web browser - only for E2800s

Enterprise Management Window

Network

{REST}

Web services proxy

E2800 arrays with embedded software, web services, Event Monitor, and AutoSupport
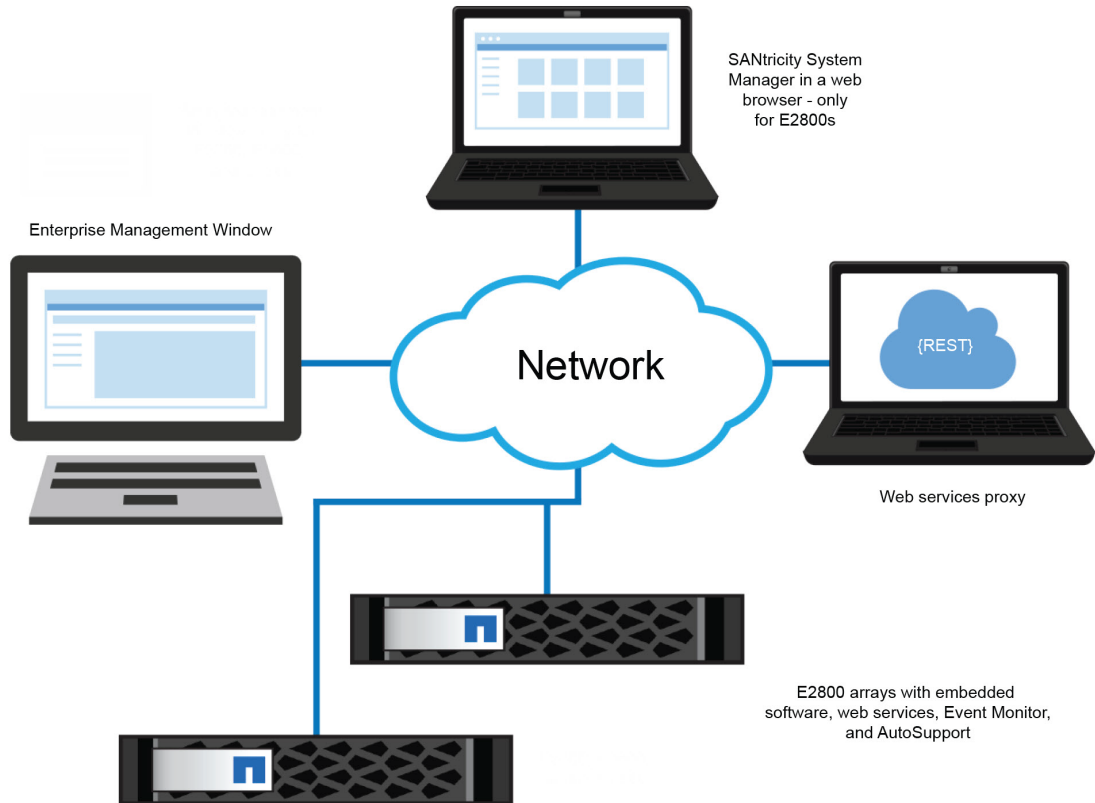
Note: If you are not using Synchronous or Asynchronous Mirroring features, you do not need to install the EMW. Instead, you can bookmark multiple SANtricity System Manager storage arrays in a browser.

- **Mixed array environment** — You must use the EMW that is part of the SANtricity Storage Manager installation if either of the following statements is true:

  ◦ You have one or more E2800 storage arrays and any E2700, E5600, or EF560 storage arrays and want to have the E2800 storage array included in your aggregate view.

  ◦ You want to use Synchronous or Asynchronous Mirroring.

For array-based tasks on the E2800 storage arrays, use SANtricity System Manager launched from the EMW. For array-based tasks on E2700, E5600, or EF560 storage arrays, use the AMW launched from the EMW.
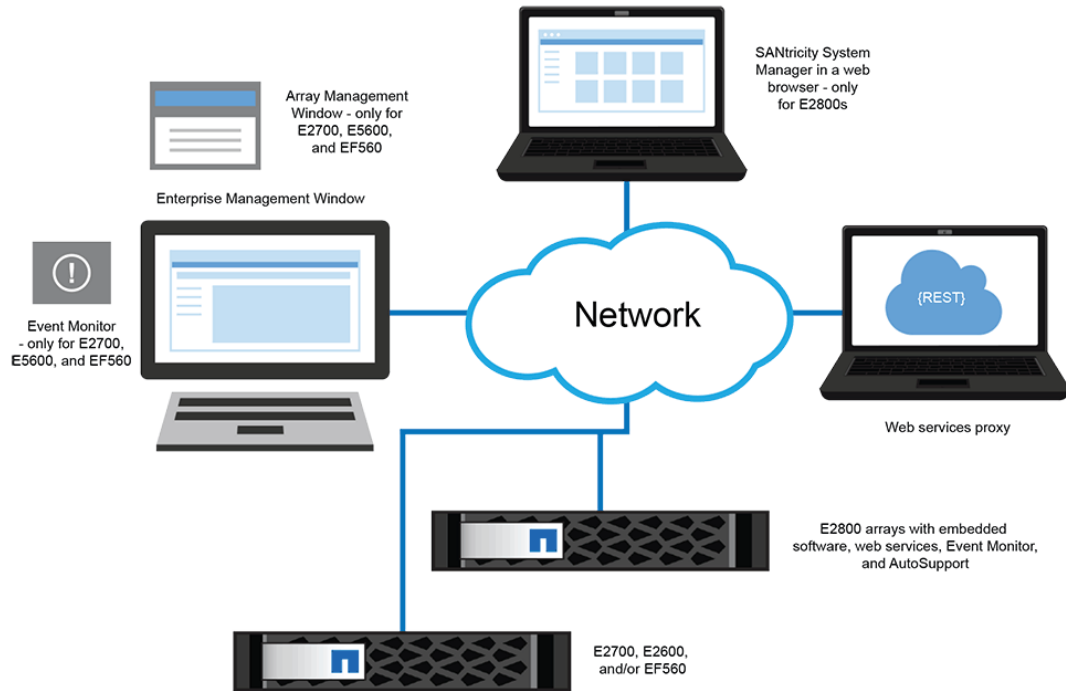
AutoSupport and alerts

You configure AutoSupport (ASUP) and email and syslog alerts differently, depending on the type of storage array:

* **E2800 —**You must configure AutoSupport and alerts on each E2800 storage array. These components are embedded in the E2800 controllers.

* **E2700, E5600, and EF560 —** You can configure AutoSupport and alerts globally by using the EMW.

Related information

SANtricity Storage Manager 11.30 Installing and Configuring for Solaris Express Guide
SANtricity System Manager 11.30 Installing and Configuring for Solaris Express Guide

Configuration worksheet

The storage configuration worksheet allows you to track your decisions about your E-Series configuration. Express methods and power methods are listed.

Circle your components and options in the table. For express method instructions, see the Express Guide for your operating system (OS).

Decision/Component	Express method	Power method (described in this Power Guide)
Controller model	• E2800 • E2700 • E5600 • EF560	• E2800 • E2700 • E5600 • EF560 See *Configuration options* on page 6.
Storage management method (physical connectivity)	Out-of-band	In-band See *Deciding on the management method* on page 12.

Management software components
You use SANtricity **Storage** Manager or SANtricity **System** Manager for different storage arrays and different purposes. See *Configuration options* on page 6.
	• SANtricity Storage Manager
	
	  ◦ Enterprise Management Window (EMW)
	
	  ◦ Array Management Window (AMW)
	
	  ◦ CLI
	
	  ◦ Event Monitor
	
	• SANtricity System Manager
	
	  ◦ For E2800 controller shelves
	
	  ◦ Not a separate installation
	
	  ◦ Browser-based
	
	• Multipath driver
	
	• Unified Host Utilities
		• SMagent (part of the host manager installation)
		
		• Multipath driver
		
		• Other utilities, such as SMdevices
		
		See *Deciding which packages to install* on page 17.

Using the storage array as a boot device	No	Yes See *Installing the storage array as a boot device* on page 16.

Decision/Component	Express method	Power method (described in this Power Guide)
Using Silent Mode when installing SANtricity Storage Manager	No	Yes See *Installing SANtricity Storage Manager packages using silent mode* on page 17.
I/O protocol	All protocol-specific tasks are described in Express Guides.	No additional protocol-specific options.
Management IP addressing method	Dynamic host configuration protocol (DHCP)	• Static IP • Service interface • IPv6 stateless address auto configuration See *Setting IP addresses* on page 19 and *Choosing the method for adding the storage array to the management domain* on page 22.
Disk pools (pools) or volume groups	Disk pools (pools)	Disk pools (pools) or volume groups See *Deciding whether to use disk pools or volume groups* on page 52.

Use the following table to record your storage array names and passwords.

Storage array name:
Storage array password (Admin):
Storage array password (Monitor):
Storage array name:
Storage array password (Admin):
Storage array password (Monitor):
Storage array name:
Storage array password (Admin):
Storage array password (Monitor):
Storage array name:
Storage array password (Admin):
Storage array password (Monitor):

Related references

Configuration options on page 6

Deciding on the management method

Before you install and use either SANtricity System Manager software or SANtricity Storage Manager software, you need to know which storage management method you plan to use.

Storage management includes these activities:

- Configuring available storage array capacity to maximize data availability, optimize application performance, and make the most of storage resources

- Configuring destinations to receive alert messages for critical problems concerning one or more storage arrays

- Monitoring storage arrays for problems or conditions that require attention

- Recovering from storage array problems to maximize data availability

Management methods

You can choose the best management method based on your system configuration and management goals. You manage a storage array from a management station or from a host.

Management methods include:

- Out-of-band management

- In-band management

- A combination of out-of-band and in-band management

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- Configuring available storage array capacity to maximize data availability, optimize application performance, and make the most of storage resources

- Configuring destinations to receive alert messages for critical problems concerning one or more storage arrays

- Monitoring storage arrays for problems or conditions that require attention

- Recovering from storage array problems to maximize data availability

Out-of-band and in-band requirements

To determine whether to use out-of-band or in-band management, consider the requirements, advantages, and disadvantages of each method.

Management method	Requirements	Advantages	Disadvantages
All out-of-band methods	Connect separate Ethernet cables to each controller.	This method does not use I/O path bandwidth for storage array management functions. This method does not use the SAS, Fibre Channel or iSCSI bandwidth for storage array management functions.	Ethernet cables are required. Does not allow you to choose which controller is used for the EMW. Controller A is used until SANtricity Storage Manager has difficulty communicating on that path. Then the system switches to controller B.
Out-of-band *without* a DHCP server	Manually configure the network settings on the controllers.	--	You must manually configure the network settings on the controllers.
Out-of-band – IPv6 stateless address auto-configuration *without* a DHCP server (IPv6 networks only)	Connect at least one router for sending the IPv6 network address prefix in the form of router advertisements. The router is necessary to route the IPv6 packets outside the local network.	No additional manual network configuration is required on the controllers. By default, the controllers automatically obtain their IP addresses by combining the auto-generated link local address and the IPv6 network address prefix after you turn on the power to the controller-drive tray.	A router is required.

Management method	Requirements	Advantages	Disadvantages
Out-of-band *with* a DHCP server (IPv4 networks only)	Connect separate Ethernet cables to each controller. Assign either static IP addresses or dynamic IP addresses to the controllers using your DHCP server. Alternatively, both the SANtricity System Manager and the SANtricity Storage Manager AMW can be used to set the IP addresses after the storage array has been discovered. It is recommended that you either reserve the controller IPs in the DHCP server or assign a static IP address so that the management port addresses will not change if the power to the storage array is disrupted. Check your DHCP server for the IP addresses that are associated with the media access control (MAC) addresses of the controllers. The MAC address appears on a label on each controller in the form: *xx.xx.xx.xx.xx.xx* . 00.A0.B8.00.00.00 00.A0.B8.00.00.00 1T 12345678 1T 12345678	No additional manual network configuration is required on the controllers. By default, the controllers automatically obtain their IP addresses from the DHCP server after you turn on the power to the controller-drive tray. This method does not use a special Access Volume to communicate with the host.	No additional disadvantages.

Management method	Requirements	Advantages	Disadvantages
In-band		No additional manual network configuration is required on the controller.	This method: • Uses both a LUN on the host and the SAS, Fibre Channel, or iSCSI bandwidth for storage array management functions. • Is not supported on System Manager; you must use the CLI. • Does not allow you to choose which controller is used for the command-line interface (SMcli).

Installing SANtricity Storage Manager

If the express method of installing SANtricity Storage Manager does not meet the requirements of your configuration, you can consider alternate power methods. These methods apply to Storage Manager only, and not System Manager. System Manager is embedded in the controller, so you do not need to install it.

Related information

SANtricity Storage Manager 11.30 Installing and Configuring for Solaris Express Guide
SANtricity System Manager 11.30 Installing and Configuring for Solaris Express Guide

Installing the storage array as a boot device

Before you install the storage management software components on the host, you must prepare the storage array and the host. Because E-Series storage behaves as a block device, you can install an operating system on it and boot that operating system from an E-Series storage array, instead of relying on local storage.

Using the E-Series storage array as a boot device serves as a less expensive, potentially faster alternative to internal storage. For example, if operating a Blade system, this process is much less expensive than purchasing internal storage for all blades. This process is called SAN booting - or relying on the SAN to boot a host. The concept of SAN boot is straight forward; however, the execution can become complicated.

The following describes the overall workflow required for setting up a SAN boot on E-Series storage:

- The host, and more specifically the adapter attached to E-Series storage, is directed to present a mapped or assigned volume from storage prior to boot (in BIOS, uEFI, or another appropriate type of firmware).
  This process is vendor-specific, protocol-specific, and architecture specific.

- The host can boot using the installation media.

- The installation selects the volume provided by storage to install.
  Sometimes this requires a driver update disk (DUD). Additionally, failover might or might not have to be loaded during this step, depending on the operating system.

- After reboot, the boot options must set the newly-installed volume as the primary boot option. This step is vendor-specific for the adapter as well as the server.

  Note: NetApp recommends using LUN 0 for booting, and some operating systems might require it.

Boot device support

Not all operating systems support the use of a storage array as a boot device. Support for using a boot device also depends on the type of host connection. For example, Fibre Channel and SAS connections are supported, while InfiniBand and some iSCSI connections are not supported.

The following table shows which operating systems support this configuration, but you should consult the *Interoperability Matrix Tool* to ensure that your HBA and operating system are supported.

Operating system	Boot device support	Recommended number of paths for installation
AIX	Yes, where supported by the HBAs	2
HP-UX	Yes, where supported by the HBAs	2
Linux	Yes, where supported by the HBAs	2
Mac OS X	No	1
Solaris	Yes, where supported by the HBAs	2
VMware	Yes, where supported by the HBAs	2
Windows	Yes, where supported by the HBAs	1 (works with 2, but 1 is recommended)

Installing SANtricity Storage Manager packages using silent mode

You can use the Silent installation mode for any OS that is supported by Install. Silent mode requires minimal user interactions and is useful when deploying a large number of servers that are not connected to terminals.

To install the storage manager packages using the Silent mode, locate the specified components in the `installer.properties` file by entering the following command for your operating system:

This command creates the `installer.properties`.

Deciding which packages to install

Different storage management software components and packages are required for different machines. Additionally, you will install different components depending on the environment you need to support for your particular configuration.

Host operating systems

Considerations for both SANtricity System Manager and SANtricity Storage Manager's support of host operating systems (OSes) include OS versions, host bus adapters (HBAs), host processors, multipath drivers, JRE levels, and SANboot.

For information about compatibility of these components with SANtricity Storage Manager, see the *NetApp Interoperability Matrix Tool*.

Storage management software components

Depending on your configuration and data storage requirements, you select different storage management software components.

SANtricity Storage Manager or SANtricity System Manager?

To configure and manage E2700, E5600, or EF560 storage arrays, you use SANtricity Storage Manager's Array Management Window (AMW) and Enterprise Management Window (EMW). If

you have an E2800 storage array, you configure it using the browser-based SANtricity System Manager rather than through SANtricity Storage Manager's AMW. If you have multiple types of storage arrays or more than one E2800 and want to manage your entire environment, you install and use SANtricity Storage Manager's EMW.

SANtricity System Manager is browser-based, so there is no installation required. After you install your E2800 hardware and connect it to the network by assigning appropriate IPs, subnet masks, and the gateway for the controllers, you access SANtricity System Manager by pointing a browser to the E2800's IP address or domain name.

SANtricity Storage Manager components

Client

This package contains both the graphical user interface (GUI) (containing both the EMW and the AMW) and the command line interface (CLI) for managing the storage arrays. This package also contains the Event Monitor that sends alerts when a critical problem exists with the storage array.

Hosts

The host adapters in the hosts that are attached to the storage array are known to the storage management software. However, in most cases the storage management software does not know which host adapters are associated with which hosts.

Event Monitor

During the client installation, you might be asked whether you want to start the Event Monitor.

If you are running an E2800 storage array, the Event Monitor resides on the controller and must be configured for each storage array. Use either SANtricity System Manager or the CLI (*SANtricity 11.30 Command Line Interface and Script Commands Programming Guide*) to complete the configuration task.

If you have an E2700, E5600, or EF560 storage array, start the monitor on only one management station that runs continuously. If you start the monitor on more than one management station, you receive duplicate alert notifications about problems with the storage array. If you install SANtricity components on more than one management station and are not asked about the Event Monitor, verify that the monitor is active on only one of the systems.

> **Note:** To receive critical alert notifications and to access the AutoSupport (ASUP) feature, you must have Event Monitor running on just one management station.

Related information

SANtricity System Manager 11.30 Installing and Configuring for Solaris Express Guide

Installing the SANtricity software on hosts, monitors, and management stations

You can use the following software configuration diagrams and accompanying tables to determine which software packages to install on each machine (host, monitor, or management station):

The following table shows the packages that apply to particular installations.

Adding the storage array to the management domain

Before you add the storage array to the management domain, review the guidelines and complete the preliminary tasks. Then, choose from a list of methods for adding the storage array.

Preparing to add the storage array to the management domain

You must prepare the storage array before adding it to the management domain, which consists of discovering any storage array within the local sub-network so that they display within the EMW.

Completing preliminary tasks for preparing the storage array

You complete some preliminary tasks before you can add the storage array to the management domain.

Make sure you have taken these steps:

- Connected all of the applicable cables.

- Turned on the power to the storage array (powering on the attached drive trays first, and then the controller-drive tray or controller tray).

- Installed the applicable storage management software.

Setting IP addresses

If the express method of having DHCP-assigned IP addresses does not meet the requirements of your configuration, you can use one of the alternate power methods for configuring IP addresses.

By default, E-Series controllers ship with DHCP enabled on both network ports. You can use the default IP addresses or assign static IP addresses.

When the network port is in a "link down" state, that is, disconnected from a LAN, the SANtricity Storage Manager reports its configuration as either static, displaying an IP address of 0.0.0.0 (earlier releases), or DHCP enabled with no IP address reported (later releases). After the network port is in a "link up" state (that is, connected to a LAN), it attempts to obtain an IP address through DHCP.

If the controller is unable to obtain a DHCP address on a given network port, it reverts to a default IP address, which may take up to 3 minutes. The default IP addresses are as follows:

```
Controller 1 (port 1): IP Address: 192.168.128.101
```

```
Controller 1 (port 2): IP Address: 192.168.129.101
```

```
Controller 2 (port 1): IP Address: 192.168.128.102
```

```
Controller 2 (port 2): IP Address: 192.168.129.102
```

When assigning IP addresses:

- Reserve Port 2 on the controllers for Customer Support usage. Do not change the default network settings (DHCP enabled).

- To set static IP addresses, use SANtricity Storage Manager. After a static IP address is configured, it remains set through all link down/up events.

- To use DHCP to assign the IP address of the controller, connect the controller to a network that can process DHCP requests. Use a permanent DHCP lease.

    Note: The default addresses are not persisted across link down events. When a network port on a controller is set to use DHCP, the controller attempts to obtain a DHCP address on every link up event, including cable insertions, reboots, and power cycles. Any time a DHCP attempt fails, the default static IP address for that port is used.

Related concepts

Choosing the method for adding the storage array to the management domain on page 22

Naming the storage array

You have some flexibility and some specific requirements when naming your storage array.

Take note of the following when naming your storage array:

- You can use letters, numbers, and the special characters underscore (_), hyphen (-), and pound sign (#). No other special characters are permitted.

- Limit the name to 30 characters. Any leading and trailing spaces in the name are deleted.

- Use a unique, meaningful name that is easy to understand and to remember. Avoid arbitrary names or names that would quickly lose their meaning in the future. The prefix "Storage Array" is automatically added to the name you assign. The full name is shown in the Logical pane and in the Enterprise Management Window. For example, if you named the storage array "Engineering," it appears as "Storage Array Engineering."

- The storage management software does not check for duplicate names. Check the Enterprise Management Window to make sure that the name you have chosen is not used by another storage array.

- When you first discover a storage array or manually add it, the storage array will have a default name of "unnamed."

Passwords

You can configure each storage array with an Administrator password. If you are using SANtricity Storage Manager, you can also use a Monitor password for each storage array.

Setting an Administrator password for your storage array protects it from being modified by unauthorized users. Modifying commands includes any functions that change the state of the storage array, such as creating volumes and modifying the cache settings. Setting a Monitor password allows users, who are not allowed to modify storage array configurations, to view storage array configurations and to monitor storage array health conditions.

Note that a Monitor password is not supported with SANtricity System Manager.

On SANtricity System Manager, you are asked if you want to set an Administrator password during initial set up.

On SANtricity Storage Manager, you are asked for a password only when you first attempt to change the configuration (such as creating a volume) or when you first perform a destructive operation (such as deleting a volume). You must exit both the Array Management Window and the Enterprise Management Window to be asked for the password again.

Follow these guidelines for setting passwords:

- For increased protection, use a long password with at least 15 alphanumeric characters. The maximum password length is 30 characters.

- Passwords are case sensitive.

- If you no longer want to have the storage array password-protected, enter the current password, and then leave the **New password** text box and the **Confirm password** text box blank.

  Note: Only a user with the Administrator password can set or change the Monitor password. If a user with View-only access (Monitor Password) attempts to launch the Set Password dialog, the system prompts for the Administrator password.

  Note: Both the Administrator storage array password and the Monitor storage array password are different from the pass phrase used for Drive Security.

Note: If you forget your password, you must contact your technical support representative for help to reset it.

Choosing the method for adding the storage array to the management domain

You can choose from several methods for adding the storage array to the management domain. The appropriate method depends on your network configuration and how you initially configured the controllers.
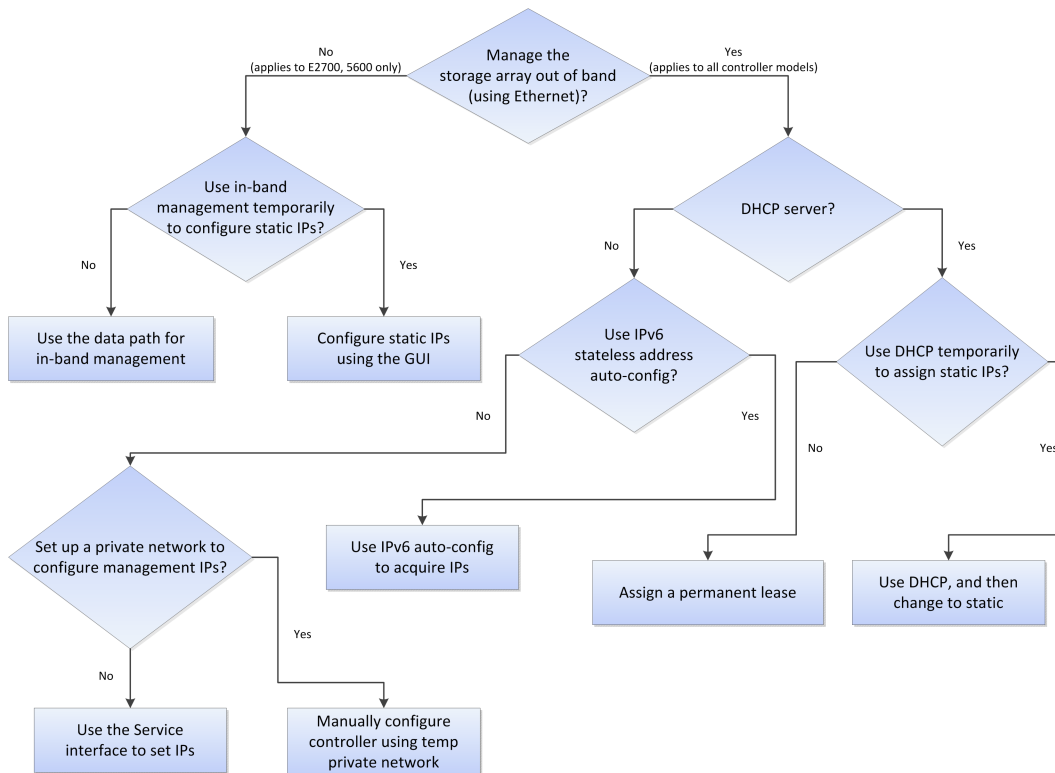
Use one of the following methods to connect your E-Series storage arrays to the management domain:

If you are using...	...do this...
DHCP addressing for initial discovery of the array's management ports, and then want to switch to use static management port addressing	See *Using DHCP and then changing to static addressing* on page 25.

If you are using...	...do this...
Out-of-band management and want to assign a permanent DHCP lease for the array's management ports **Note:** You have used the appropriate *Express Guide* for your operating system and configured the management ports to use the default IP addresses.	See *Configuring DHCP addressing to assign a permanent DHCP lease* on page 24.

If you are using...	...with...	...do this...
Out-of-band management	• DHCP addressing of the management ports • The management station on the same sub-network as the array	See *Using automatic discovery: Out-of-band management* on page 26.
Out-of-band IPv6 stateless address auto-configuration	• **No** DHCP server (IPv6 networks only) • The management station on the same sub-network as the array	
Out-of band management	• **No** DHCP addressing • **No** IPv6 stateless address auto-configuration • The management station on a **different** sub-network from the array	Choose one of the following options: • Use in-band management temporarily to configure the controllers. This option is for FC and SAS environments only. See *Configuring the static IPs for controllers by using the GUI for in-band initially* on page 35. • Temporarily set up a private network to configure the management ports. You will first need to configure the management station so that it resides on the same subnetwork during controller management IP configuration. See *Manually configuring the controllers by setting up a temporary private network* on page 27.

If you are using...	...with...	...do this...
The Service interface through the serial port on the controller	A terminal emulator program on your host management system (required)	See *Using the Service Interface to set IPs* on page 30.
Out-of-band management	SANtricity System Manager	See *Configuring management port using SANtricity System Manager* on page 33.
In-band management		See *Adding the storage array for in-band management* on page 32.

Related information

> *SANtricity Storage Manager 11.30 Installing and Configuring for Solaris Express Guide*
> *SANtricity System Manager 11.30 Installing and Configuring for Solaris Express Guide*

Configuring DHCP addressing to assign a permanent DHCP lease

You change the storage array management ports that you configured using the appropriate *Express Guide* for your operating system from static addressing to DHCP addressing.

About this task

This procedure specifically applies to users with SANtricity Storage Manager configurations. If you have a SANtricity System Manager configuration, refer to the documentation for your DHCP server.

Steps

1. Disconnect the private network you set up using the appropriate *Express Guide* for your operating system, change your management station to connect to your regular network, and prepare the DHCP server.

   a. Make sure your DHCP server is connected to your regular network and that it is configured to assign a permanent (static) DHCP lease.

   b. Connect an Ethernet cable to the management station and to management port 1 on either controller A or B. Wait 3 minutes for the controller's default DHCP setting to time out.

      Note:

      Do not use port 2 on either controller. These ports are reserved for use by NetApp technical personnel.

   c. Change the management station to use DHCP. Refer to your operating system documentation for instructions on how to change the network settings on the management station and how to verify that the address has changed.

2. Open **SANtricity Storage Manager**.

   The **Enterprise Management Window (EMW)** is displayed.

   Note: When you open SANtricity Storage Manager for the first time, the **Select Addition Method** screen prompts you to select whether you want to choose the **Automatic** or **Manual** method to add a new storage array.

3. On the **Select Addition Method** screen, select the **Automatic** radio button, and then select **OK**.

This process finds all of the storage arrays on the local sub-network. Several minutes might lapse to complete the process.

4. In the **EMW Devices** tab, double-click the storage array to open the **Array Management Window (AMW)**.

   When you open the **AMW** for the first time, the **Disk Pool Automatic Configuration** screen is displayed.

5. Select **No** to dismiss the wizard and name the storage array.

6. Name the storage array.

   a. In the **EMW Setup** tab, select **Name/Rename Storage Arrays**.

   b. In the **Select storage array** list, select the storage array you added.

   c. In the **Storage array name** field, type a name for the storage array.

      Storage array names must not exceed 30 characters and cannot contain spaces. Names can contain letters, numbers, underscores (_), hyphens(-), and pound signs (#). Choose a descriptive name for the storage array to make it easier for data center administrators to manage the storage resources over time.

Using DHCP and then changing to static addressing

You can configure the IP addresses for your controllers by using the Dynamic Host Configuration Protocol (DHCP) server. DHCP is a protocol that automates the task of assigning an Internet Protocol (IP) address. Each device that is connected to a TCP/IP network must be assigned a unique IP address. These devices include the controllers in your storage array. When a client needs to start TCP/IP operations, the client broadcasts a request for address information. The DHCP server receives the request, assigns a new address for a specified amount of time called a lease period, and sends the address to the client.

Before you begin

* The management station must be attached to the same subnet as the storage.

* An Ethernet cable must be attached to each controller.

About this task

To ensure that the controllers in your storage array have static IP address, do one of the following:

* If you are using SANtricity System Manager, see the documentation for your DHCP server.

* If you are using SANtricity Storage Manager, use the following procedure.

Steps

1. Open **SANtricity Storage Manager**.

   The **Enterprise Management Window (EMW)** is displayed.

2. On the **Select Addition Method** screen, select the **Automatic** radio button, and then select **OK**.

   This process finds all of the storage arrays on the local sub-network. Several minutes might lapse to complete the process.

3. In the **EMW Devices** tab, double-click the storage array to open the **Array Management Window (AMW)**.

   When you open the **AMW** for the first time, the **Disk Pool Automatic Configuration** screen is displayed.

4. Complete the automatic disk pool configuration, or close the **Disk Pool Automatic Configuration** screen and complete volume group configuration later (see *Deciding whether to use disk pools or volume groups* on page 52).

5. Name the storage array.

   a. In the **EMW Setup** tab, select **Name/Rename Storage Arrays**.

   b. In the **Select storage array** list, select the storage array you added.

   c. In the **Storage array name** field, type a descriptive name for the storage array.

6. Configure the network configuration information of the controllers, using information you obtain from your network administrator.

   a. In the **AMW**, select the **Hardware** tab.

   b. Select **Hardware > Controller > Configure > Management Ports**.

   c. On the **Change Network Configuration** dialog box, select Controller A, Port 1 in the **Ethernet port** drop-down list.

   d. From the **Speed and duplex mode** drop-down list, select **Auto-negotiate**.

      Attention: Possible Connectivity Issues - After you select **Auto-negotiate**, make sure that your Ethernet switch also is set to **Auto-negotiate.**

   e. Depending on the format of your network configuration information, select the **Enable IPv4** check box, the **Enable IPv6** check box, or both check boxes.

   f. Depending on the format you have selected, enter the network configuration information (IP address, subnet mask, and gateway or IP address and routable IP address) in the **IPv4 Settings** tab or the **IPv6 Settings** tab.

      Note: You must obtain the network configuration information from your network administrator.

   g. In the **Ethernet port** list, select Controller B, Port 1, and repeat step d through step f for controller B.

   h. Select **OK**.

7. Return to the **EMW**, select the storage array, and then select **Edit > Remove Storage Array**.

8. On the **EMW Setup** tab, select **Add Storage Arrays**.

9. On the **Select Addition Method** dialog box, select the **Manual** radio button.

10. On the **Add New Storage Array - Manual** screen, make sure that the default **Out-of-band management** radio button is selected.

11. Enter the IP address assigned to controller A, port 1, and controller B, port 1, on the storage array you are adding.

Using automatic discovery: Out-of-band management

You can use automatic discovery to set the controller IP addresses using out-of-band management.

Before you begin

- The management station must be attached to the same subnet as the storage.

- Ethernet cables must be attached to each controller.

- The DHCP server must be configured to assign a permanent (static) DHCP lease.

- If you are using IPv6 stateless address auto configuration without a DHCP server, you must have connected at least one router for sending the IPv6 network address prefix in the form of router advertisements. By default, the controllers automatically obtain their IP addresses by combining the auto-generated link local address and the IPv6 network address prefix after you turn on the power to the controller-drive tray.

About this task

This procedure specifically applies to users with SANtricity Storage Manager configurations. If you have a SANtricity System Manager configuration, refer to *Configuring management port using SANtricity System Manager* on page 33.

Steps

1. Open **SANtricity Storage Manager.**

   The **Enterprise Management Window (EMW)** is displayed.

2. On the **Select Addition Method** screen, select the **Automatic** radio button, and then select **OK**.

   This process finds all of the storage arrays on the local sub-network. Several minutes might lapse to complete the process.

3. In the **EMW Devices** tab, double-click the storage array to open the **Array Management Window (AMW)**.

   When you open the **AMW** for the first time, the **Disk Pool Automatic Configuration** screen is displayed. Select **No** to dismiss the wizard and name the storage array.

4. Name the storage array.

   a. In the **EMW Setup** tab, select **Name/Rename Storage Arrays**.

   b. In the **Select storage array** list, select the storage array you added.

   c. In the **Storage array name** field, type a name for the storage array.

   Storage array names must not exceed 30 characters and cannot contain spaces. Names can contain letters, numbers, underscores (_), hyphens(-), and pound signs (#). Choose a descriptive name for the storage array to make it easier for data center administrators to manage the storage resources over time.

Manually configuring the controllers by setting up a temporary private network

You can manually configure the IP addresses on the controllers by setting up a temporary private network.

Before you begin

- You have connected the management station directly into Ethernet port 1 on each controller.

- You have connected an ethernet cable to the management station and to the management port 1 on either controller (A or B).

   Note: Do not use port 2 on either controller. These ports are reserved for use by NetApp technical personnel.

- You have obtained the network configuration information from your network administrator for the controllers (IP address, subnet mask, and gateway or IP address and routable IP address).

> **Note:** All controller shelves use Auto-MDIX (automatic medium-dependent interface crossover) technology to detect the cable type and configure the connection to the management station accordingly.

Steps

1. Change the IP address on the TCP/IP port on the management station from an automatic assignment to a manual assignment by using the default IP address subnet of the controllers.

   a. Make note of the current IP address of the management station so that you can revert back to it after you have completed the procedure.

      > **Note:** You must set the IP address for the management station to something other than the controller IP addresses (for example, use 192.168.128.100 for an IPv4 network, or use FE80:0000:0000:0000:02A0:B8FF:FE29:1D7C for an IPv6 network).

      > **Note:** In an IPv4 network, the default IP addresses for Ethernet port 1 on controller A and controller B are 192.168.128.101 and 192.168.128.102, respectively.

   b. Change the IP address. Refer to your operating system documentation for instructions on how to change the network settings on the management station and how to verify that the address has changed.

   c. If your network is an IPv4 network, check the subnet mask to verify that it is set to 255.255.255.0, which is the default setting.

   d. From a command prompt, ping the controller IPs to make sure they are accessible.

      Example

      ```
      > ping 192.168.128.102
      ```

      ```
      Reply from 192.168.128.102: bytes = 32 time<1ms TTL = 64
      ```

      ```
      Ping statistics for 192.168.128.102:
      ```

      ```
      Packets: Sent = 4, Received =4, Lost = 0 (0% loss)
      ```

      ```
      Approximate round trip times in milli-seconds:
      ```

      ```
      Minimum = 0ms, Maximum = 0mx, Average = 0 ms
      ```

2. Open the **SANtricity Storage Manager**.

   The **Enterprise Management Window (EMW)** is displayed.

3. On the **Select Addition Method** screen, select the **Automatic** radio button, and then select **OK**.

   This process finds all the storage arrays on the local sub-network. Several minutes might lapse to complete the process.

4. In the **EMW Devices** tab, double-click the storage array to open the **Array Management Window (AMW)**.

   When you open the **AMW** for the first time, the **Disk Pool Automatic Configuration** screen is displayed.

5. Select **No** to dismiss the wizard and finish setting up the management IP addresses.

6. Name the storage array.

   a. In the **EMW Setup** tab, select **Name/Rename Storage Arrays**.

   b. In the **Select storage array** list, select the storage array you added.

   c. In the **Storage array name** field, type a name for the storage array.

      Storage array names must not exceed 30 characters and cannot contain spaces. Names can contain letters, numbers, underscores (_), hyphens(-), and pound signs (#). Choose a descriptive name for the storage array to make it easier for data center administrators to manage the storage resources over time.

   d. Select **OK**.

7. Configure the network configuration information of the controllers, using information you obtain from your network administrator.

   a. In the AMW, select the **Hardware** tab.

   b. Select **Hardware > Controller > Configure > Management Ports**.

   c. On the **Change Network Configuration** dialog box, select Controller A, Port 1 in the **Ethernet port** drop-down list.

   d. From the **Speed and duplex mode** drop-down list, select **Auto-negotiate**.

      Note: Attention Possible Connectivity Issues – After you select **Auto-negotiate**, make sure that your Ethernet switch also is set to **Auto-negotiate.**

   e. Depending on the format of your network configuration information, select the **Enable IPv4** check box, the **Enable IPv6** check box, or both check boxes.

   f. Depending on the format you have selected, enter the network configuration information (IP address, subnet mask, and gateway or IP address and routable IP address) in the **IPv4 Settings** tab or the **IPv6 Settings** tab.

      Note: You must obtain the network configuration information from your network administrator.

   g. In the **Ethernet port** drop-down list, select Controller B, Port 1, and repeat step c through step f for controller B.

   h. Select **OK**.

8. Disconnect the Ethernet cable from your management station, and reconnect the Ethernet cables from the controllers into your regular network.

9. Complete the steps necessary to change the management station's IP address back to what it was initially.

Manually adding a storage array: Out-of-band management

You can manually configure IP addresses on the controllers using out-of-band management.

Before you begin

- If you are using DHCP, the DHCP server is configured to assign a permanent (static) DHCP lease. You must have obtained the IP addresses of the controller management ports from the DHCP server.

- If you are using IPv6 stateless address auto-configuration without a DHCP server, you have connected at least one router for sending the IPv6 network address prefix in the form of router advertisements. You must have obtained the IP addresses of the controllers.

About this task

This procedure specifically applies to users with SANtricity Storage Manager configurations. If you have a SANtricity System Manager configuration, refer to *Configuring management port using SANtricity System Manager* on page 33.

Steps

1. Open **SANtricity Storage Manager**.

   The **Enterprise Management Window (EMW)** is displayed.

2. On the **Select Addition Method** screen, select the **Manual** radio button, and then select **OK**.

3. On the **Add New Storage Array - Manual** screen, make sure that the default **Out-of-band management** radio button is selected.

4. Enter the IP address assigned to controller A, port 1, and controller B, port 1, on the storage array you are adding.

   Note: You can enter the IP addresses in either the IPv4 format or the IPv6 format.

   Note: Alternatively, you can enter the DNS/network name of each controller.

5. Select **Add**.

6. On the **Storage Array Added** screen, select **No** to finish adding storage arrays.

7. In the **EMW Devices** tab, double-click the storage array to open the **Array Management Window (AMW)**.

   When you open the **AMW** for the first time, the **Disk Pool Automatic Configuration** screen is displayed.

8. Select **No** to dismiss the wizard and finish setting up the management IP addresses.

9. Name the storage array.

   a. In the **EMW Setup** tab, select **Name/Rename Storage Arrays**.

   b. In the **Select storage array** list, select the storage array you added.

   c. In the **Storage array name** field, type a name for the storage array.

      Storage array names must not exceed 30 characters and cannot contain spaces. Names can contain letters, numbers, underscores (_), hyphens(-), and pound signs (#). Choose a descriptive name for the storage array to make it easier for data center administrators to manage the storage resources over time.

   d. Select **OK**.

Using the Service Interface to set IPs

The Serial Port Recovery Interface, also known as the Service Interface, allows you to configure controllers manually.

Before you begin

- A terminal emulator program must be installed on the management station.

- You must have a serial cable.

- You must have functional knowledge of the following concepts:

  ◦ Terminal emulator usage

  ◦ Executing break sequences

  ◦ Cycling baud rates

Steps

1. Connect to the controller's serial port.

2. Send a BREAK code.

   The controller's serial port converts to active state.

3. Enter <S> at the following prompt to initiate the Service Interface:

   ```
   Press within 5 seconds: <S> for Service Interface. <BREAK> for baud
   rate
   ```

   Note: The above command prompts must be entered as uppercase.

   A prompt for the Service Interface password is displayed.

4. Enter **SPRIentry** at the following Service Interface password prompt:

   ```
   Enter Password to access Service Interface (60 sec timeout): SPRIentry
   ```

   Note: If a password is not entered within the 60 second interval, the process times out.

   The Service Interface Main Menu displays.

5. Under the Service Interface Main Menu, enter 2 to select Change IP Configuration.

   The Select Ethernet Port menu displays.

6. From the Select Ethernet Port menu, enter 1 to select Ethernet Port 1.

   The Change IP Configuration menu displays.

7. Under the Change IP Configuration menu, enter the following to enable the IPv4 protocol for the port:

   ```
   Enable IPv4? (Y/N):Y
   ```

8. Under Configure using DHCP?, enter the following:

   ```
   Configure using DHCP? (Y/N): N
   ```

   The current fixed IP address, IP subnet mask, and IP address of the default gateway associated with the controller port is displayed under the Current Configuration column within the Change IP Configuration menu.

9. To configure the fixed IP address used for the controller port, enter the appropriate data under the `New Configuration` column for the `IP Address` field.

```
                          Current Configuration  New Configuration
IP Address         if0 : 10.113.160.252          10.113.160.226
```

   Note: You can delete entries under the `New Configuration` column by pressing '.'

10. To configure the IP subnet mask associated with the controller port, enter the appropriate data under the `New Configutation` column for the `Subnet Mask` field.

```
                          Current Configuration  New Configuration
IP Address         if0 : 10.113.160.252          10.113.160.226
Subnet Mask        if0 : 255.255.252.0           255.255.242.0
```

11. To configure the IP address for the default gateway associated with the controller port, enter the appropriate data under the `New Configuration` column for the `Gateway IP Address` field.

```
                          Current Configuration  New Configuration
IP Address         if0 : 10.113.160.252          10.113.160.226
Subnet Mask        if0 : 255.255.252.0           255.255.242.0
Gateway IP Address if0 : 10.113.160.1            10.113.157.1
```

12. Under `Change port configuration (speed & duplex)?`, enter the following:

```
Change port configuration (speed & duplex)? (Y/N): N
```

13. Under `Reboot to have the settings take effect?`, enter the following:

```
Reboot to have the settings take effect? (Y/N): N
```

   Note: Reboot will still be required for changes to take effect.

14. Press ENTER and then ^D.

   All changes made within the `Change IP Configuration` prompt are applied, and the `Service Interface Main Menu` is displayed.

15. Under the `Service Interface Main Menu`, enter q to select `Quit Menu`.

   The Service Interface closes.

Adding the storage array for in-band management

Use the data path to configure IP addresses for a storage array using in-band management.

Before you begin

• The host agent software must be installed on a host attached to the storage array.

• You must know the host name or IP address of this host.

• If you have an E2800 controller shelf, you must use the CLI to perform this task, as it is not supported on SANtricity System Manager.

Steps

1. Open the **SANtricity Storage Manager**.

   The **Enterprise Management Window (EMW)** is displayed.

2. On the **Select Addition Method** screen, select the **Manual** radio button, and then select **OK**.

3. On the **Add New Storage Array - Manual** screen, select the **In-band management** radio button. Enter the host name or IP address of the host that is running the host-agent software, and select **Add**.

   Note: You can enter the IP addresses in either the IPv4 format or the IPv6 format.

4. On the **Storage Array Added** screen, select **No** to finish adding storage arrays.

5. Do one of the following:.

If you have this array....	...do this...
• E2700 • E5600 • EF560	In the **EMW Devices** tab, double-click the storage array to open the **Array Management Window (AMW)**. When you open the **AMW** for the first time, the **Disk Pool Automatic Configuration** screen is displayed. Go to step 6.
E2800	Use the CLI to manage this E2800 in-band storage array, as it is visible from the EMW, but not supported by SANtricity System Manager. Go to step 7.

6. Select **No** to dismiss the wizard and finish setting up the management IP addresses.

7. Name the storage array.

   a. In the **EMW Setup** tab, select **Name/Rename Storage Arrays**.

   b. In the **Select storage array** list, select the storage array you added.

   c. In the **Storage array name** field, type a name for the storage array.

   Storage array names must not exceed 30 characters and cannot contain spaces. Names can contain letters, numbers, underscores (_), hyphens (-), and pound signs (#). Choose a descriptive name for the storage array to make it easier for data center administrators to manage the storage resources over time.

   d. Select **OK**.

Configuring management port using SANtricity System Manager

The controller includes an Ethernet port used for system management. If necessary, you can change its transmission parameters and IP addresses.

About this task

During this procedure, you select port 1 and then determine the speed and port addressing method. Port 1 connects to the network where the management client can access the controller and System Manager.

   Note: Do not use port 2 on either controller. Port 2 is reserved for use by technical support.

Steps

1. Select **Hardware**.

2. If the graphic shows the drives, click **Show back of shelf**.

   The graphic changes to show the controllers instead of the drives.

3. Click the controller with the ports you want to configure.

   The controller's context menu appears.

4. Select **Configure management ports**.
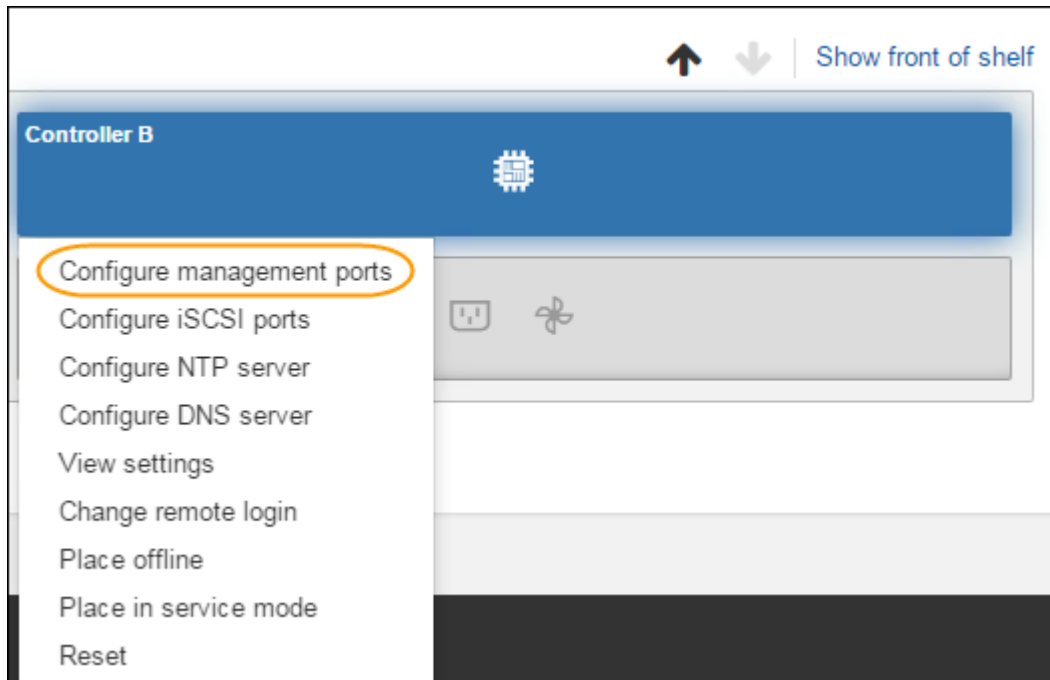
   The Configure Management Ports dialog box opens.

5. Make sure port 1 is displayed, and then click **Next**.

6. Select the configuration port settings, and then click **Next**.

   Field Details

Field	Description
Speed and duplex mode	Keep the **Auto-negotiate** setting if you want System Manager to determine the transmission parameters between the storage array and the network; or if you know the speed and mode of your network, select the parameters from the drop-down list. Only the valid speed and duplex combinations appear in the list.
Enable IPv4 / Enable IPv6	Select one or both options to enable support for IPv4 and IPv6 networks.

   If you select **Enable IPv4**, a dialog box opens for selecting IPv4 settings after you click **Next**. If you select **Enable IPv6**, a dialog box opens for selecting IPv6 settings after you click **Next**. If you select both options, the dialog box for IPv4 settings opens first, and then after you click **Next**, the dialog box for IPv6 settings opens.

7. Configure the IPv4 and/or IPv6 settings, either automatically or manually.

   Field Details

Field	Description
Automatically obtain configuration	Select this option to obtain the configuration automatically.
Manually specify static configuration	Select this option, and then enter the controller's IP address. For IPv4, include the network subnet mask and gateway. For IPv6, include the routable IP address and router IP address.
	Attention: If you change the IP address configuration, you lose the management path to the storage array. Using the SANtricity Storage Manager, you must remove the device from the Enterprise Management Window (EMW). Add it back in to the EMW by selecting **Edit > Add Storage Array**, and then enter the new IP address. For more information, refer to the online help topics in the Enterprise Management Window.

8. Click **Finish**.

Result

The management port configuration is displayed in the controller settings, Management Ports tab.

Configuring the static IPs for controllers by using the GUI for in-band initially

Use in-band management to temporarily configure static IPs through the GUI.

Before you begin

- The host agent software is installed on a host attached to the storage array.

- You know the host name or IP address of this host.

- You have obtained the network configuration information from your network administrator for the controllers (IP address, subnet mask, and gateway or IP address and routable IP address).

- If you have an E2800 controller shelf, you must use the CLI to perform this task, as it is not supported on SANtricity System Manager.

This method does not work if the controller-drive tray uses an iSCSI protocol. When you initially configure an array in this environment, there are no IP addresses set up on the iSCSI ports, required for iSCSI sessions from the host to the storage array and in-band management. If you use iSCSI protocol, see *Manually configuring the controllers by setting up a temporary private network* on page 27.

Steps

1. Open the SANtricity Storage Manager.

The **Enterprise Management Window (EMW)** is displayed.

2. On the **Select Addition Method** screen, select the **Manual** radio button, and then select **OK**.

If no storage arrays have been added to the **EMW**, the **Add New Storage Array - Manual** dialog is displayed. If storage arrays have already been added to the **EMW** and you need to access the dialog, click **Edit > Add Storage Array**.

3. On the **Add New Storage Array - Manual** screen, select the **In-band management** radio button.

4. Enter the host name or IP address of the host that is running the host-agent software, and select **Add**.

   Note: You can enter the IP addresses in either the IPv4 format or the IPv6 format.

5. On the **Storage Array Added** screen, select **No** to finish adding storage arrays.

6. In the **EMW Devices** tab, double-click the storage array to open the **Array Management Window (AMW)**.

   When you open the **AMW** for the first time, the **Disk Pool Automatic Configuration** screen is displayed.

7. Select **No** to dismiss the wizard, and finish setting up the management IP addresses.

8. Name the storage array.

   a. In the **EMW Setup** tab, select **Name/Rename Storage Arrays**.

   b. In the **Select storage array** list, select the storage array you added.

   c. In the **Storage array name** field, type a name for the storage array.

   Storage array names must not exceed 30 characters and cannot contain spaces. Names can contain letters, numbers, underscores (_), hyphens (-), and pound signs (#). Choose a descriptive name for the storage array to make it easier for data center administrators to manage the storage resources over time.

   d. Select **OK**.

9. Configure the network configuration information of the controllers, using information you obtain from your network administrator.

   a. In the AMW, select the **Hardware** tab.

   b. Select **Hardware > Controller > Configure > Management Ports**.

   c. On the **Change Network Configuration** dialog box, select Controller A, Port 1 in the **Ethernet port** drop-down list.

   d. From the **Speed and duplex mode** drop-down list, select **Auto-negotiate**.

   Attention: Possible Connectivity Issues – After you select **Auto-negotiate**, make sure that your Ethernet switch also is set to **Auto-negotiate.**

   e. Depending on the format of your network configuration information, select the **Enable IPv4** check box, the **Enable IPv6** check box, or both check boxes.

   f. Depending on the format you have selected, enter the network configuration information (IP address, subnet mask, and gateway or IP address and routable IP address) in the **IPv4 Settings** tab or the **IPv6 Settings** tab.

   Note: You must obtain the network configuration information from your network administrator.

   g. In the **Ethernet port** drop-down list, select Controller B, Port 1, and repeat step c through step f for controller B.

   h. Select **OK**.

10. Return to the **EMW**, select the storage array, and then select **Edit > Remove > Storage Array**.

11. On the **EMW Setup** tab, select **Add Storage Arrays**.

12. On the **Select Addition Method** dialog box, select the **Manual** radio button.

13. On the **Add New Storage Array - Manual** screen, make sure that the default **Out-of-band management** radio button is selected. Enter the IP address assigned to controller A, port 1, and controller B, port 1, on the storage array you are adding.

Configuring multipath

If the express method for configuring the multipath driver does not meet the requirements of your configuration, you can consider alternate power methods.

Related concepts

Related information

SANtricity Storage Manager 11.30 Installing and Configuring for Solaris Express Guide
SANtricity System Manager 11.30 Installing and Configuring for Solaris Express Guide

Overview of multipath drivers

Multipath drivers help the hosts continue to operate without interruption when a physical path fails.

Multipath drivers provide a redundant path for the data cables connecting the storage array's controllers to the host bus adapters. For example, you can connect two host bus adapters to the redundant controller pair in a storage array, with different data cables for each controller. If one host bus adapter, one data cable, or one controller fails, the multipath driver automatically reroutes input/ output (I/O) to the good path.

Multipath drivers provide these functions:

- They automatically identify redundant I/O paths.

- They automatically reroute I/O to an alternate controller when a controller fails or all of the data paths to a controller fail (failover).

- They check the state of known paths to the storage array.

- They provide status information on the controller and the bus.

- They check to see if Service mode is enabled on a controller and if the asymmetric logical unit access (ALUA) mode of operation has changed.

- They provide load balancing between available paths.

Multipath driver setup considerations

Most storage arrays contain two controllers that are set up as redundant controllers. If one controller fails, the other controller in the pair takes over the functions of the failed controller, and the storage array continues to process data. You can then replace the failed controller and resume normal operation. You do not need to shut down the storage array to perform this task.

The redundant controller feature is managed by the multipath driver software, which controls data flow to the controller pairs. This software tracks the current status of the connections and can perform the switch-over.

Whether your storage arrays have the redundant controller feature depends on a number of items:

- Whether the hardware supports it. Check to see whether you have duplex or simplex controllers in your configuration.

- Whether your OS supports certain multipath drivers. Refer to the installation and support guide for your operating system to determine whether your operating system supports redundant controllers.

- How the storage arrays are connected.

With the ALUA (I/O Shipping) feature, a storage array can service I/O requests through either controller in a duplex configuration; however, I/O shipping alone does not guarantee that I/O is routed to the optimized path.

Supported multipath drivers

E-Series storage arrays support multipath drivers specific to your operating system and a recommended host type.

The information in this topic provides general guidelines. Refer to the *Interoperability Matrix Tool* for compatibility information for specific HBA, multipath driver, OS level, and controller-drive tray support.

Operating system	Multipath driver	Recommended host type
Solaris	MPxIO (non-TPGS)	Solaris Version 10 or earlier
	MPxIO (TPGS/ALUA)	Solaris Version 11 or later

When you select either the **Typical (Full Installation)** option or the **Custom** installation option through the SMagent package, the host context agent is installed with SANtricity Storage Manager.

The preferred multipath driver is provided "in-box" with the operating system.

After the host context agent (SMagent) is installed, and the storage is attached to the host, the host context agent sends the host topology to the storage controllers through the I/O path. Based on the host topology, the storage controllers automatically define the host and the associated host ports, and set the host type. The host context agent sends the host topology to the storage controllers only once, and any subsequent changes made in SANtricity Storage Manager is persisted. For more information about where the host context agent resides in the install packaging, refer to *Storage management software components* on page 17.

If the host context agent does not select the recommended host type, you must manually set the host type in SANtricity.

- To manually set the host type, from the Array Management Window, select the **Host Mappings** tab, select the host, and then select **Host Mappings** >**Host** >**Change Host Operating System**.

- If you are using SANtricity Storage Manager but not using partitions (for example, no Hosts defined), set the appropriate host type for the Default Group by selecting **Host Mappings** > **Default Group** > **Change Default Host Operating System**.

- If you are using SANtricity System Manager, use the "Create host manually" procedure in the System Storage Manager online help.

Related information

NetApp Interoperability Matrix Tool

Failover drivers for the Solaris operating system

MPxIO (using TPGS for Solaris 11) is the supported failover driver for the Solaris operating system.

The Automatic Load Balancing feature is not supported on the Solaris MPxIO failover driver. Volumes mapped to hosts with the MPxIO failover driver cannot participate in automatic load balancing, although if other hosts that have failover drivers that support Automatic Load Balancing

are connected to the same storage array, volumes mapped to those hosts will be moved to balance the workload as much as possible.

> **Note:** With minor exceptions, host types that do not support Automatic Load Balancing continue to operate normally whether or not the feature is enabled. One exception is that if a system has a failover, storage arrays move unmapped or unassigned volumes back to the owning controller when the data path returns. Any volumes that are mapped or assigned to non-Automatic Load Balancing hosts are not moved.

Solaris OS restrictions

SANtricity Storage Manager no longer supports or includes RDAC for the following Solaris operating systems:

- Solaris 10

- Solaris 11

MPxIO load balancing policy

The load-balancing policy that you can choose for the Solaris MPxIO multi-path driver is the Round Robin with subset policy.

The round robin with subset I/O load-balancing policy routes I/O requests, in rotation, to each available data path to the controller that owns the volumes. This policy treats all paths to the controller that owns the volume equally for I/O activity. Paths to the secondary controller are ignored until ownership changes. The basic assumption for the round robin with subset I/O policy is that the data paths are equal. With mixed host support, the data paths might have different bandwidths or different data transfer speeds.

Multipath configuration diagrams

You can configure multipath in several ways. Each configuration has its own advantages and disadvantages.

This section describes the following configurations:

- Single-host configuration

- Direct connect and fabric connect configurations

This section also describes how the storage management software supports redundant controllers.

Single-Host configuration

In a single-host configuration, the host system contains two host bus adapters (HBAs), with a port on each HBA connected to different controllers in the storage array. The storage management software is installed on the host. The two connections are required for maximum failover support for redundant controllers.

Although you can have a single controller in a storage array or a host that has only one HBA port, you do not have complete failover data path protection with either of those configurations. The cable and the HBA become a single point of failure, and any data path failure could result in unpredictable effects on the host system. For the greatest level of I/O protection, provide each controller in a storage array with its own connection to a separate HBA in the host system.
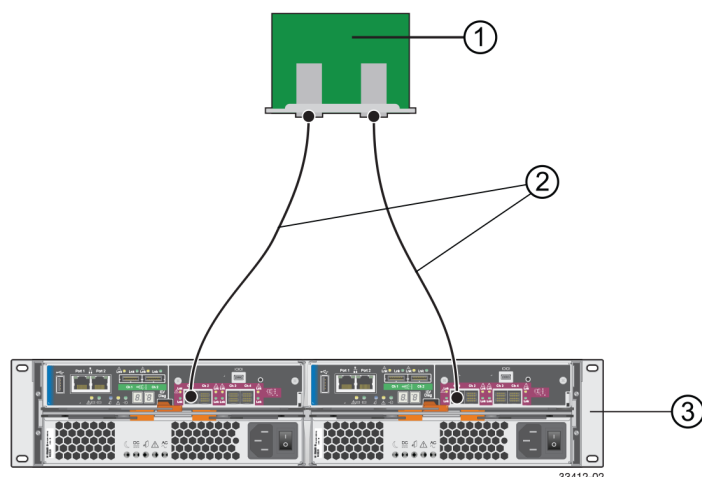
1. Host System with Two SAS, Fibre Channel, iSCSI, or InfiniBand Host Bus Adapters

2. SAS, Fibre Channel, iSCSI, or InfiniBand Connection – The Network Protocol Connection Might Contain One or More Switches

3. Storage Array with Two Controllers

Direct connect and fabric connect configurations

In a direct connect or fabric connect configuration, two host systems are each connected by two connections to both of the controllers in a storage array. SANtricity Storage Manager, including multipath driver support, is installed on each host.

Not every operating system supports this configuration. Consult the restrictions in the installation and support guide specific to your operating system for more information. Also, the host systems must be able to handle the multi-host configuration. Refer to the applicable hardware documentation.

In either a direct connect or fabric connect configuration, each host has visibility to both controllers, all data connections, and all configured volumes in a storage array.

The following conditions apply to these both direct connect and fabric connect configurations:

• Both hosts must have the same operating system version installed.

• The multipath driver configuration might require tuning.

• A host system might have a specified volume or volume group reserved, which means that only that host system can perform operations on the reserved volume or volume group.

33415-02
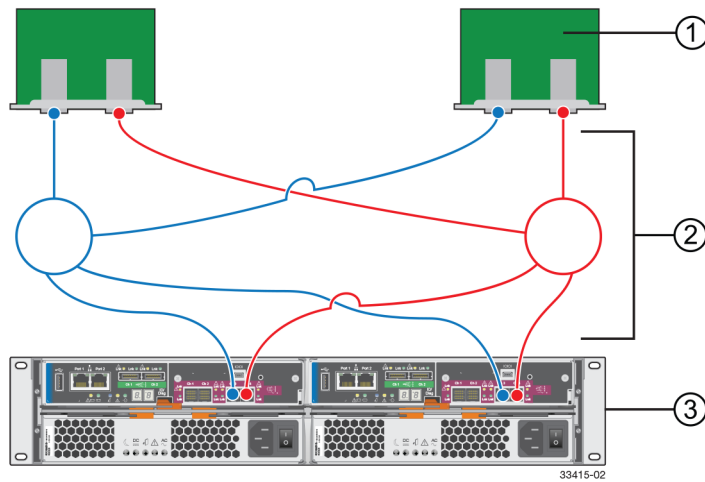
1. Two Host Systems, Each with Two Host Bus Adapters

2. Connections with Two Switches (Might Contain Different Switch Configurations)

3. Storage Array with Two Controllers

Supporting redundant controllers

The following figure shows how multipath drivers provide redundancy when the host application generates a request for I/O to controller A, but controller A fails. Use the numbered information to trace the I/O data path.

33256-01
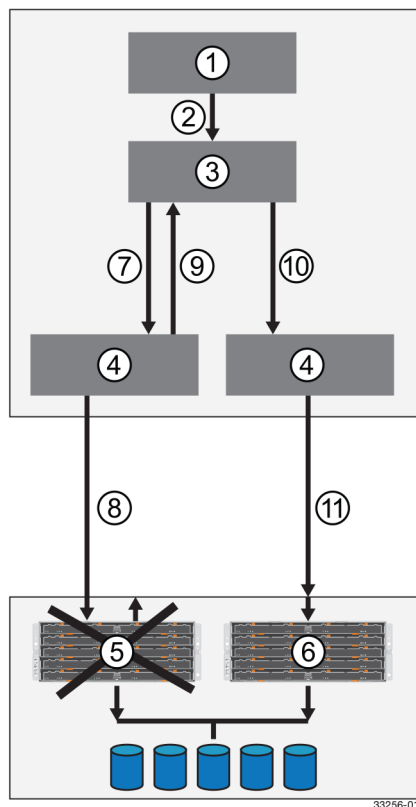
1. Host Application

2. I/O Request

3. Multipath Driver

4. Host Bus Adapters

5. Controller A Failure

6. Controller B

7. Initial Request to the HBA

8. Initial Request to the Controller Failed

9. Request Returns to the Multipath Driver

10. Failover Occurs and I/O Transfers to Another Controller

11. I/O Request Re-sent to Controller B

How a multipath driver responds to a data path failure

One of the primary functions of the multipath driver is to provide path management. Multipath drivers monitor the data path for devices that are not working correctly or for multiple link errors.

If a multipath driver detects either of these conditions, the failover driver automatically performs the following steps:

- The multipath driver checks for the redundant controller.

- The multipath driver performs a path failure if alternate paths to the same controller are available. If all of the paths to a controller are marked offline, the multipath driver performs a controller failure. The failover driver provides notification of an error through the OS error log facility.

- For multipath drivers that are not using ALUA drivers, the multipath driver transfers volume ownership to the other controller and routes all I/O to the remaining active controller.

- For ALUA-based multipath drivers, controller B redirects I/O to the surviving controller (controller B). Then, if controller A is still active, controller B ships the I/O to controller A (SAN path loss case). If controller A has failed, controller B triggers a forced ownership transfer from the failed controller to itself (controller B).

User responses to a data path failure

You can use the Major Event Log (MEL) to troubleshoot a data path failure.

The information in the MEL provides the answers to these questions:

- What is the source of the error?

- What is required to fix the error, such as replacement parts or diagnostics?

When troubleshooting, follow these guidelines:

- Under most circumstances, contact technical support any time a path fails and the storage array notifies you of the failure.

- Use the MEL to diagnose and fix the problem, if possible.

- If your controller has failed and your storage array has customer-replaceable controllers, replace the failed controller. Follow the instructions provided with the controller.

Related information

NetApp E-Series and EF-Series Systems Documentation Center

Power methods for configuring multipath

Depending on your requirements, such as dividing I/O activity between RAID controllers or handling compatibility and migration, you can use the power methods for configuring multipath drivers.

Dividing I/O activity between two RAID controllers

For the best performance of a redundant controller system, use the storage management software to divide I/O activity between the two RAID controllers in the storage array. You can use a graphical user interface (GUI) or the command line interface (CLI).

Step

1. To use the GUI to divide I/O activity between two RAID controllers, perform one of these steps, using the appropriate interface:

If you are using	Do this ....
SANtricity Storage Manager,	From the Array Management Window: a. **Specify the owner of the preferred controller of an existing volume** – Select **Volume > Change > Ownership/Preferred Path**. **Note:** You also can use this method to change the preferred path and ownership of all volumes in a volume group at the same time. b. **Specify the owner of the preferred controller of a volume when you are creating the volume** – Select **Volume > Create**.

SANtricity System Manager,	**Specify the owner of the preferred controller of an existing volume**
	
	a. Select **Storage > Volumes**.
	
	b. Select any volume and then select **More > Change ownership**.
	
	  The **Change Volume Ownership** dialog box appears.
	
	  All volumes on the storage array appear in this dialog box.
	
	c. Use the **Preferred Owner** drop-down list to change the preferred controller for each volume that you want to change, and confirm that you want to perform the operation.

CLI	Go to the "Create RAID Volume (Free Extent Based Select)" online help topic for the command syntax and description.

Note: The volume might not use the new I/O path until the multipath driver reconfigures to recognize the new path. This action usually takes less than five minutes.

Enabling MPxIO on the Solaris 10 and 11 OS

MPxIO is included in the Solaris 10 and 11 OS. Therefore, you do not need to install MPxIO. You only need to enable it.

About this task

MPxIO for the x86 architecture is, by default, enabled for the Fibre Channel (FC) protocol.

Steps

1. To enable MPxIO for FC drives, run the following command:

```
stmsboot -D fp -e
```

2. Reboot the system.

3. To prepare for either enabling or disabling MPxIO on a specific drive port, specify `ls -l /dev/cfg/` on the command line.

   From the output returned, select the port you would like to either enable or disable.

4. Add the port you want to either enable or disable to the `/kernel/drv/fp.conf` Fibre Channel port driver configuration file by specifying a line similar to the following examples:

   Enable

```
name="fp" parent="/pci@8,600000/SUNW,qlc@2" port=0 mpxio-disable="no";
```

   Disable

```
name="fp" parent="/pci@8,600000/SUNW,qlc@2" port=0 mpxio-
disable="yes";
```

5. To globally enable or disable MPxIO, run one of the following commands:

   Enable

```
# stmsboot -e
```

   Disable

```
# stmsboot -d
```

Editing the sd.conf file and the ssd.conf file for TPGS support in Solaris 10

To ensure the accuracy of the failover process using TPGS support with Solaris 10, you can edit either the sd.conf file or the ssd.conf file.

About this task

If you update your system frequently with patches as they become available, you do not need to perform this task.

Steps

1. Depending on your configuration file, edit one of the following configuration files:

   - If your system uses the SPARC architecture, access the `/kernal/drv/ssd.conf` file, and edit the file so it contains the following:

```
ssd-config-list="NETAPP  INF-01-00 ", "cache-nonvolatile:true,
disksort:false, physical-block-size:4096,
retries-busy:30, retries-reset:30, retries-notready:300, retries-
timeout:10, throttle-max:64, throttle-min:8";
```

     Note: There must be two spaces separating the VID (`NETAPP`) from the PID (INF-01-00).

- If your system uses the x86 architecture, access the `/kernal/drv/sd.conf` file, and edit the file so it contains the following:

```
sd-config-list="NETAPP  INF-01-00 ", "cache-nonvolatile:true,
disksort:false, physical-block-size:4096,
retries-busy:30, retries-reset:30, retries-notready:300, retries-
timeout:10, throttle-max:64, throttle-min:8";
```

> **Note:** There must be two spaces separating the VID (`NETAPP`) from the PID (INF-01-00).

2. Reboot for these changes to take effect.

Frequently asked questions about Solaris multipath drivers

Frequently asked questions include questions related to Solaris multipath drivers.

Question	Answer
Where can I find the .conf files that are used by MPxIO?	You can find MPxIO-related files in this directory: `/kernel/drv`
Where can I find SANtricity data files?	You can find SANtricity data files in this directory: `/var/opt/SM`
Where can I find the command line interface (CLI) files?	You can find CLI files in this directory: `/usr/sbin`
Where can I find the bin files?	You can find the bin files in the `/usr/sbin` directory.

Where can I find device files?	You can find device files in these directories:
	`/dev/rdsk`
	`/dev/dsk`

How can I confirm that MPxIO is enabled?	Check the `format` command output to ensure that the devices have logical paths beginning with `/scsi_vhci/`.

Where can I find the SANtricity Storage Manager files?	You can find the SANtricity Storage Manager files in these directories:
	`/opt/SMgr`
	`/opt/StorageManager`

Where can I get a list of storage arrays, their volumes, LUNs, WWPNs, preferred paths, and owning controller?	Use the `SMdevices` utility, which is located in the `/usr/bin` directory. You can run the `SMdevices` utility from any command prompt.
How can I see whether volumes have been added?	Use the `devfsadm` utility to scan the system. Then run either the `SMdevices` utility or the `mpathadm list lu` command to list all volumes and their paths. If you still cannot see any new volumes, reboot the host and then run either the `mpathadm list lu` command again, or the `SMdevices` utility. The `mpathadm list lu` command works only if MPxIO is enabled. As an alternative, list this information by entering either the `luxadm probe` command or the `format` command.

Question	Answer
How do I find which failover module manages a volume in Solaris?	Check the host log messages (applies to Solaris 11 only) for the volume. Storage arrays with asymmetric logical unit access (ALUA) are managed by the `f_tpgs` module. Storage arrays with an earlier version of the SANtricity OS software (controller software) are managed by the `f_asym_lsi` module.
	As an alternative, list this information by selecting one of the devices or LUNs you would like to check, and then enter the following command: `# mpathadm show lu <disk>` and check the access state.
	The system response resembles:
	<pre> - Active optimzed/Active not optimized for ALUA/TPGS targets - Active/Standby for non ALUA/TPGS targets</pre>
How can I determine the multipath support for my device?	Use the following command to list the vendor identification (VID).
	`# mpathadm show mpath-support libmpscsi_vhci.so.`
	If the VID is not displayed with the command shown above, then `f_tpgs` will be used (if the target supports TPGS).
Where can I find the backup of the `.conf` files after enabling the MPxIO multipath driver?	All files are saved in `/etc/mpxio/` in a file name formed by concatenating the original file name, the timestamp, and an indication of whether the file was enabled or disabled as shown in the example below:
	`fp.conf.enable.20140509_1328`

Configuring virtualization and clustering

For load balancing, availability, and security concerns, virtualization and clustering are essential considerations for your storage configuration.

Related information

SANtricity Storage Manager 11.30 Installing and Configuring for Solaris Express Guide
SANtricity System Manager 11.30 Installing and Configuring for Solaris Express Guide

Virtualization considerations

For the purpose of storage, virtualization refers to the act of creating a virtual machine (VM) within a parent operating system. Virtualization isolates applications, and allows for virtual desktop deployments that can provide security not available on the physical operating system. In addition, virtualization can ensure high availability while reducing hardware costs across an enterprise. There are many virtualization technologies built onto operating systems, as well as operating systems whose main purpose is to provide virtualization.

Virtualization offers a wide range of capabilities to an organization:

- **Server consolidation**: Many servers can be replaced by one large physical server, so hardware is consolidated, and guest operating systems are converted to virtual machines. This consolidation provides the ability to run legacy software on new hardware.

- **Isolation**: A guest operating system can be fully isolated from the host running it. If the virtual machine is corrupted, the host system is not harmed.

- **Migration**: A process to move a running virtual machine to another physical machine. Live migration is an extended feature that allows this move without disconnection of the client or the application.

- **Disaster recovery**: Virtualized guest systems are less dependent on the hardware.

For virtualization deployments on NetApp E-Series products, storage volume layout and host mappings should be considered. Additionally, host multipathing and connection Pass-Thru may be required.

Storage volume layout

When planning your volume layout, the following general guidelines apply:

- The larger the deployment, the higher the disk count.
  If volume groups or disk pools are not large enough, latency problems can cause a series of timeouts.

- As the volumes used by virtual machines increases within a volume group, the IO workload moves from mostly sequential to mostly random in pattern.
  For example, one VMs workload will look sequential, but if you provide a series of VMs, the expanded workload will look random over time.

Volume Mapping & Pass Through

Volumes are typically mapped to the parent directory. Unless there are multiple RAID groups, NetApp recommends using one large disk for VMs. The large disk can later be divided into smaller segments for virtualization.

If copy services backup individual VMs, then volumes need to be mapped for each VM to the parent operating system. Some virtual environments allow storage to be managed by the virtual machine directly. This management requires you to define an additional host and host-type on the storage array to be configured.

Volumes mapped to this host are not visible to the parent operating system.

Multipathing and virtualization

Virtualization must account for multipathing software. In a typical virtualized environment, the parent operating system performs any failover scenarios required. If the VM is a pass thru, any pathing considerations need to be handled through failover within the VM.

Virtualization needs to account for multipathing software. In a typical virtualized environment, the parent os performs any failover scenarios required. If the VM is a pass thru, any pathing considerations need to be handled through failover within the VM.

When planning your installation, consider the following methods:

- **Single Root I/O Virtualization (SR-IOV)** is a specification that allows a single Peripheral Component Interconnect Express (PCIe) physical device under a single root port to appear to be multiple separate physical devices to the hypervisor or the guest operating system.

Host clustering support

Host clustering provides a way to load balance and make highly available applications. Generally, a cluster solution is one or more servers that work together and can be viewed as a single system. Cluster solutions improve performance and availability over a single computer, while being more cost-effective.

The following terms are common to a discussion of Host clustering:

Nodes

The underlying clients running the cluster application that make up the cluster. Traditionally, nodes pertained to physical servers, but some clustering packages allow virtual machines to also play the role of a node. In most cases, all nodes in a cluster use the same hardware and the same operating system.

Services

An entity shared by cluster nodes, Services are the high-level, tangible entities that depend on everything below them in the clustering hierarchy. Network shares and applications are examples of Services.

Services are monitored for accessibility and stability by the cluster application.

Resources

An entity shared by cluster notes, Resources are a lower-level entity than Services. Resources include entities like disks, and IP addresses.

Resources are exposed through services and monitored for accessibility and stability by the cluster application.

Cluster accessibility

Managing accessibility is critical for all cluster notes. The best methods for managing accessibility involve using a "heartbeat" for node-to-node communication, using "fencing" to control access to a cluster, and using a "quorum to control the size of a cluster.

- **heartbeat**: All cluster nodes communicate with each other through a heartbeat. The most obvious communication method is through the network. If possible, the heartbeat should be on a separate

network. Clusters can also use serial cables or shared disks for communications. The heartbeat is so vital, that in some clusters a single dropped packet can result in a fenced node.

- **fencing**: The process nodes use to kick other nodes from a cluster. This process varies among cluster packages and can happen for a variety of reasons. Clusters usually have multiple types of fencing devices (ways to remove nodes from a cluster) including APC Power and SCSI Reservations.

- **quorum**: Some clusters adopt the idea of a quorum: a cluster is not be established until enough nodes have joined and agree that a cluster can be started. If enough nodes leave and there is no longer a quorum, the cluster can dissolve. Quorums can be established from the network or from shared disks (where a disk is called the quorum disk). Normally, quorum disks are more tolerant to node failures as network quorum requires a node majority (N/2+1).

Most clusters also have the concept of a failover domain. The failover domain determines which node will own the service at which time and can usually prioritize service migrations for load balancing.

Other clusters claim a "master node" in cases of failure. This method is not widely used because if the master node fails, the cluster can become 'split brain'. Split brain occurs when nodes are still claimed as active but do not have communications to other nodes who also claim to be active. The consequences can be devastating as similar services acting on the same resource can overwrite one another.

Cluster topology

Cluster connections consist of a public network, a private, cluster management network, and a storage network.
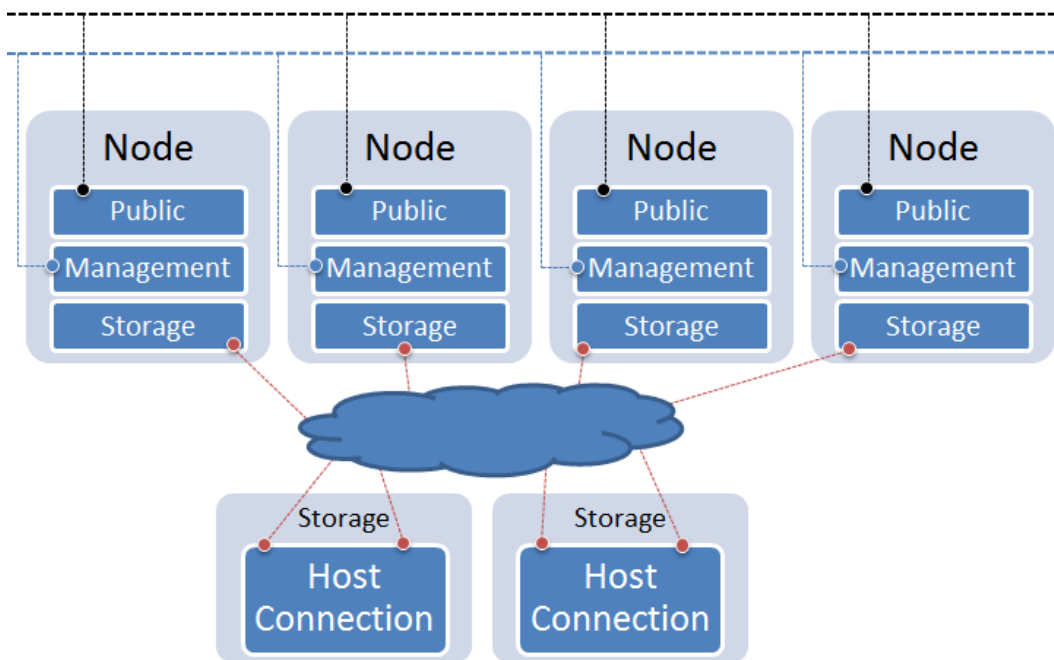
- **Public Network**: this network provides access to the outside world or LAN.

- **Private Network**: It is recommended to isolate a network specifically for cluster management. Some clustering software allow different management types (serial, network, etc).

- **Storage Network**: Traditional connections to storage. This can be a variety of protocols.

Cluster shared storage in SANtricity

Allowing multiple hosts to share the same storage is critical in many clusters.

About this task

Shared storage can be used in couple of ways by the cluster.

- **Shared Disk File System**: Some file systems are distributed aware. These file systems typically deploy a rigorous concurrency model to keep incoming data requests serialized.

- **General Parallel File System (GPFS)**: A high-performance clustered file system that can be deployed in either shared-disk or shared-nothing distributed parallel modes. GPFS provides higher I/O performance by striping blocks of data from individual files over multiple disks, and reading and writing these blocks in parallel.

- **Quorum Disk**: Shared storage can provide a disk to the cluster designed to keep the cluster operational. If a node cannot access the quorum disk, then the node understands that it is no longer part of the cluster until access become available. Nodes communicate through the quorum disk to relay state information. This disk can be used in place of a heartbeat and can be the trigger for fencing behavior within the cluster.

To create shared storage in both SANtricity Storage Manager and SANtricity System Manager (if your storage array has an E2800 controller shelf), use the following general procedure, supplemented with online help topics:

Steps

1. Create all of the individual hosts that will share access to a set of volumes.

2. Do one of the following:

    - If you have an E2700, E5600, or EF560 controller shelf, create a host group.

    - If you have an E2800 controller shelf, create a host cluster.

3. Add all of the individual hosts to the host cluster or the host group.

4. Map all volumes into the host group or assign all volumes to the host cluster that you want to share.

    When complete, all hosts can see the volume.

What are SCSI reservations?

SCSI reservations allow a node to lock volume access to other nodes. .

- SCSI-2 reservations provide two commands: `SCSI Reserve` and `SCSI Release`. A bus reset clears the LUN reservation. SCSI-2 reservations have been deprecated in recent standards, but are still available on various clusters.

Deciding whether to use disk pools or volume groups

You can create volumes using either a disk pool or a volume group. The best selection depends primarily on your key storage requirements, such as expected I/O workload, performance requirements, and data protection requirements.

If you have a highly sequential workload and need maximum system bandwidth and the ability to tune storage settings, choose a volume group.

If you have a highly random workload and need faster drive rebuilds, simplified storage administration, and thin provisioning, choose a Dynamic Disk Pool (DDP).

Use case	Volume group	Dynamic disk pool
Workload - random	Good	Better
Workload - sequential	Better	Good
Drive rebuild times	Slower	Faster
Performance (optimal mode)	Good Best for large-block, sequential workloads	Good Best for small-block, random workloads
Performance (drive rebuild mode)	Degraded. Up to 40% drop in performance	Better
Multiple drive failure	Less data protection Slow rebuilds, greater risk of data loss	Greater data protection Faster, prioritized rebuilds
Adding drives	Slower Requires Dynamic Capacity Expansion operation	Faster Add to disk pool on the fly
Thin provisioning support	No	Yes
SSDs	Yes	Yes
Simplified administration	No Allocate global hot spares, configure RAID	Yes No hot spare or RAID settings to configure
Tunable performance	Yes	No

Storage partitions

A storage partition is a logical entity that consists of one or more volumes that can be accessed by a single host or can be shared among hosts that are part of a host group. A host group is a group (cluster) of two or more hosts that share access, in a storage partition, to specific volumes on the storage array. You can create an optional logical entity in the storage management software. You must create a host group only if you will use storage partitions.

Note: If you have an E2800 controller shelf, storage partitioning is neither available nor needed on your system.

Note: If you must define a host group, you can define it through the Define Hosts Wizard described in the AMW online help.

- You can think of a storage partition as a virtual storage array. That is, take the physical storage array and divide it up into multiple virtual storage arrays that you can then restrict to be accessible only by certain hosts.

- You do not create storage partitions in this step, but you must understand them to define your hosts.

- Even if you do not use storage partitions, you must select the Host Operating System type for the Default Group.

- You *do not* need to create storage partitions if these conditions exist:

  ◦ You have only one attached host that accesses all of the volumes on the storage array.

  ◦ You plan to have all of the attached hosts share access to all of the volumes in the storage array.

  Note: When you have multiple hosts accessing the volumes in a storage partition, you must have some type of clustering software on the hosts to manage volume sharing and accessibility.

The following displays an example of no additional storage partitions required:
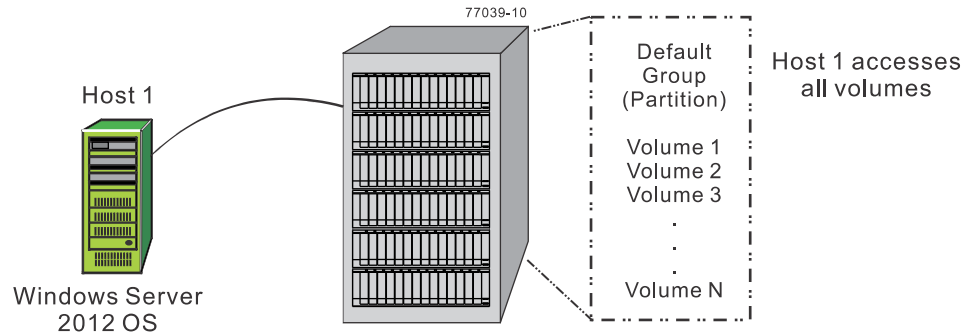
A single host accesses **all** volumes;
no additional storage partitions are needed.
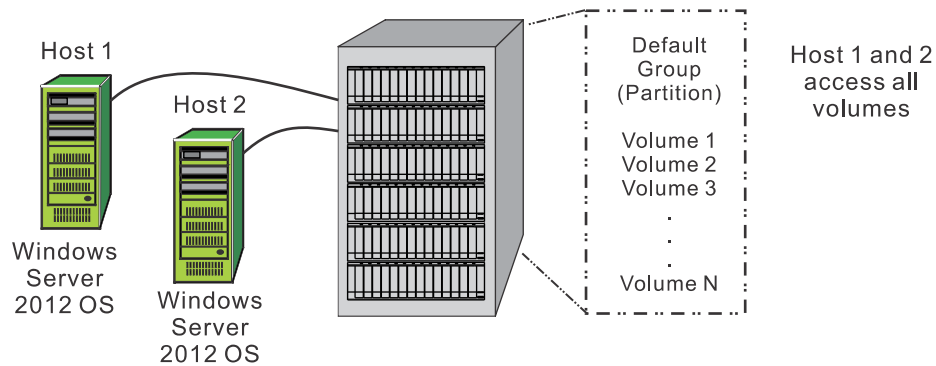
Multiple homogeneous hosts share access to **all** volumes;
no additional storage partitions are needed and
no specific host group is needed.

- You *do* need to create storage partitions if these conditions exist:

  ◦ You want certain hosts to access only certain volumes.

The following displays an example of additional storage partitions required (homogeneous host):
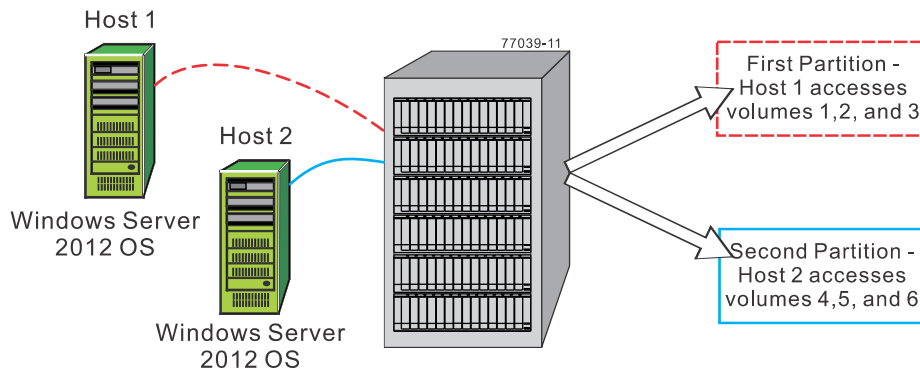
- Each host needs access to specific volumes.
- Both hosts use the same operating system (homogeneous).
- Storage divided into two logical storage partitions.
- A Default Group (partition) is not used.

◦ You have hosts with different operating systems (heterogeneous) attached in the same storage array. You must create a storage partition for each type of host.

The following displays an example of additional storage partitions required (heterogeneous host):
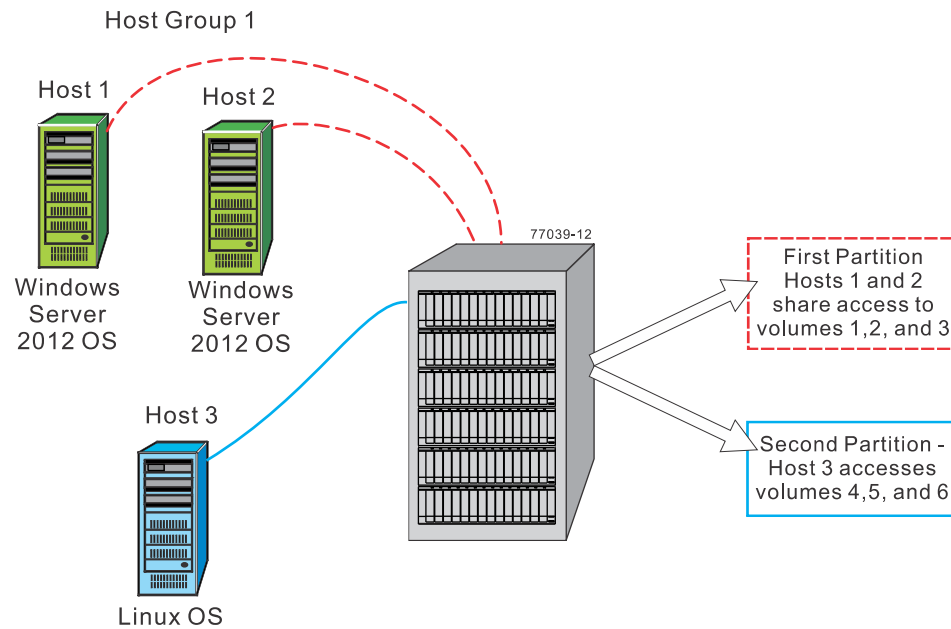
- Host 1 and host 2 (Windows Server 2012 OS) share access to specific volumes through host group 1.

- Two heterogeneous hosts (Linux OS and Windows Server 2012 OS) exist.

- Host 3 (Linux) accesses specific volumes.

- Storage is divided into two logical storage partitions.

- A Default Group (partition) is not used.

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