Smart Business Architecture
Data Center for Midsize Organizations

NetApp Storage Deployment Guide

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This document is for people who:

- Would like to easily scale available disk capacity for application servers
- Would like to more easily and efficiently manage their overall investment in storage capacity
- Are interested in shared storage access to facilitate deployment of server virtualization
- Want to gain a general understanding of NetApp® storage systems
- Are expanding their existing storage network to address additional business requirements
- Are interested in guidance and best practices for initial configuration and management of a NetApp storage system
- Are responsible for selection or implementation of disk storage resources for organizations with 100–1000 connected network users, and 15–250 physical or virtualized servers
- Have read the Smart Business Architecture Foundation and Data Center for Midsize Organizations deployment guides

Who Should Read This Guide

This guide should be of interest to anyone in a midsize organization that wants to understand why they might want to utilize NetApp Storage Systems to provide centralized disk resources for servers.

The audience also includes technology resellers who want to understand more about NetApp Storage Systems, and understand the basic best practices for system setup.

Using This Storage Deployment Guide

This guide is a concise reference on NetApp Storage System deployment and is broken up into a few sections.

The **Introduction** and **Business Overview** sections outline the issues the NetApp Storage Systems can solve within your organization and the capabilities they bring to bear to solve them.

The **Design Overview, System Configuration,** and **Storage Provisioning** sections provide information on how the NetApp Storage Systems can be integrated into your network, along with basic procedures and best practices for initial system configuration.

The remaining sections of the document provide additional information on advanced features available on NetApp Storage Systems, and how they might be utilized by your organization.

In the **Conclusion,** information is also provided to point you to the correct resource to order NetApp Storage Systems for your organization.

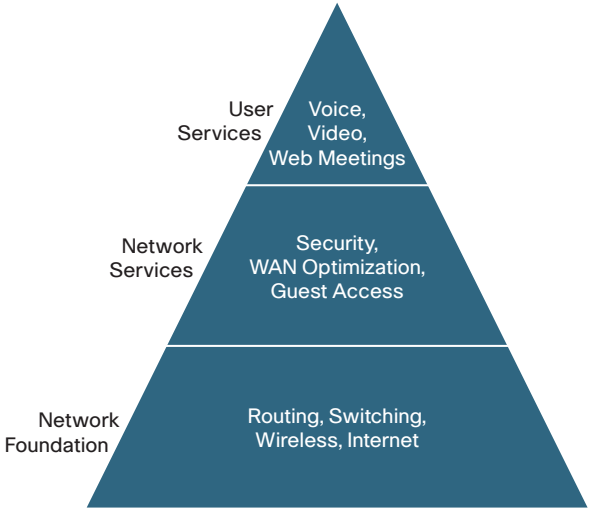
Additional Information

This guide is a companion document to the Smart Business Architecture for Midsize Organizations Design Guide and Deployment Guide.

The Cisco Smart Business Architecture for Midsize Organizations is a prescriptive architecture that delivers an easy-to-use, flexible, and scalable network with wired, wireless, security, WAN optimization, and unified communication components. It eliminates the challenges of integrating the various network components by using a standardized design that is reliable with comprehensive support offerings.

The Cisco Smart Business Architecture for Midsize Organizations is designed to address the common requirements of organizations with 100 to 1000 employees. Each organization is unique however and so are its requirements so we ensured that the Cisco Smart Business Architecture was built so that additional capabilities could be added on without redesigning the network.

Figure 1. Smart Business Architecture Model



One way the Cisco Smart Business Architecture accomplishes this extensibility is by breaking down the architecture into three primary layers, **Network Foundation, Network Services,** and **User Services**, as illustrated in Figure 1 above.

This guide focuses on best practices for integration of NetApp storage systems into networks built upon the Smart Business Architecture. Components of the entire storage solution are present in all three layers of the Smart Business Architecture. The Cisco Ethernet or Fibre Channel switching infrastructure forms the Network Foundation for access to storage, along with providing additional Network Services such as security. The NetApp storage systems themselves are end nodes to the network, but provide additional security services and multiprotocol storage access as a User Service, using either block-based access methods such as iSCSI and Fibre Channel or network-attached storage (NAS) protocols.

To learn more about Cisco Smart Business Architecture, visit http://www.cisco.com/go/smartarchitecture or http://www.cisco.com/go/partner/smartarchitecture

Introduction

This guide is an overview of NetApp storage solutions and the value they offer businesses of all sizes. It includes simple instructions for how to set up and configure a basic NetApp storage system. It also discusses advanced NetApp features that can deliver exceptional storage efficiency and functionality for backup, restoration, and disaster recovery.

Business Overview

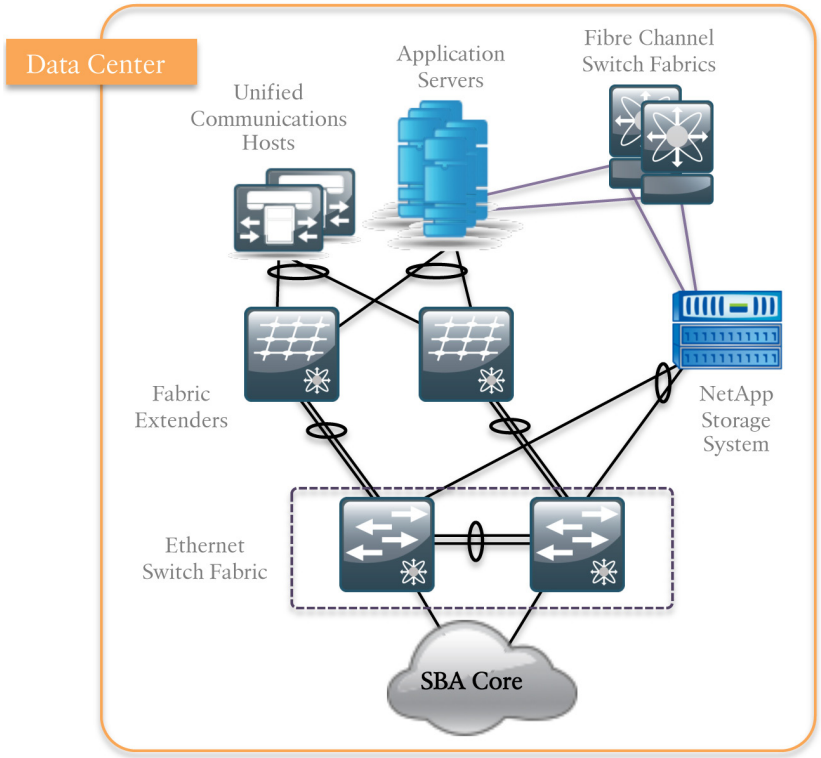
The Need for Centralized Storage

As the value and amount of electronic data increase, deploying the right storage strategy becomes even more critical. A centralized storage strategy offers the best solution to store, protect, and retain your valuable data. Today's solutions address technology trends around managed scalability, server virtualization, and networking by offering advanced features with simplified management for organizations with limited IT staff.

Trying to keep up with data growth can be a challenge, especially when using direct-attached storage (DAS). Selecting the amount of storage needed for a given application is not an exact science. You must estimate how much data you need to store over time and then choose a server with enough drive bays to accommodate the expected data growth. When the drive bays have all been filled, you can directly attach an external disk shelf or JBOD via SCSI or SAS, but that is an expensive solution if you expect to use only a portion of the capacity of the shelf. A directly attached storage shelf typically cannot be used by more than one server at a time.

One of the most compelling technology trends today is server virtualization. Server virtualization offers the ability to increase the utilization of excess CPU processing capacity available with today's high-performing multicore CPUs. Hosting many virtual servers on a physical server CPU allows better utilization of this untapped processing capacity. Once a server is virtualized from the physical hardware, it can be moved from one physical server to another to support load balancing, hardware servicing or failover, and site-to-site mobility. These advanced virtualization features are available only in shared networked storage environments.

Server virtualization is also driving the need for more robust data networks. The ratio of virtual servers to physical servers is typically 10:1 or greater, resulting in much higher I/O loads per physical server. Ethernet is emerging as an increasingly robust and capable storage network that offers flexibility, simplicity, and performance for organizations of all sizes. The ability to share a common network technology for data traffic, voice, video, and storage offers tremendous value over alternative dedicated solutions. The skill sets for Ethernet management are common in the industry. And the penetration of this technology into every home and business drives economies of scale to keep costs low.



NetApp and Cisco Partnership

With a shared vision of a virtual dynamic data center and a partnership that extends back to 2003, NetApp and Cisco are developing technologies that deliver the value and performance to meet your IT requirements. We are partnering with industry leaders to provide reference architectures and proven configurations to enable organizations of all sizes to meet the IT and business needs of today and tomorrow.

NetApp Differentiators

NetApp storage solutions are built on a single platform that scales from small deployments of a few terabytes to large deployments beyond a petabyte, all with a common set of features and management tools. Each NetApp FAS storage system is capable of running multiple block- and file-based protocols at the same time, including NFS, CIFS, FC, and iSCSI. NetApp unified storage simplifies data management by offering the ability to scale your storage environment as

your business grows, without the need for staff retraining or forklift equipment upgrades. And NetApp V-Series storage systems can extend the life of your existing FC storage investments by extending many of the same advanced features as the FAS storage systems to the management of legacy installed-base storage systems from third-party manufacturers.

NetApp leads the industry in storage efficiency and innovation. With features such as thin provisioning, deduplication, high-performing and space-efficient Snapshot™ copies, and advanced disaster recovery capabilities, NetApp offers solutions to help you achieve your business goals.

Smart Business Architecture and NetApp

The growth of data is not unique to larger enterprises. Businesses of all sizes face the challenges of acquiring, storing, and retaining large amounts of data. In response to these challenges, solutions that were once considered overly complicated and expensive for smaller businesses have been made simpler to procure, deploy, and manage. Advanced functionality once reserved for costly solutions is now common in lower-priced solutions, offering midsize organizations the ability to more easily address data growth and retention. The NetApp Storage Deployment Guide for SBA offers an overview of these features and also provides practical suggestions and deployment best practices for NetApp storage.

Design Overview

Storage Networking

A network infrastructure that uses Fibre Channel or Ethernet should have no single point of failure. A highly available solution includes two or more Fibre Channel or Ethernet network switches, two or more host bus adapters (HBAs) or network interface cards (NICs) per server, and two or more target Fibre Channel ports or Ethernet NICs per storage controller. In addition, when using Fibre Channel, two fabrics are required to have a truly redundant architecture. For information about designing and deploying a networked storage iSCSI solution, refer to the Cisco Smart Business Architecture Data Center Deployment Guides and to the NetApp Fibre Channel and iSCSI Configuration Guide on NOW™ (NetApp on the Web) for your version of NetApp Data ONTAP®.

NetApp unified storage solutions enable powerful thin provisioning, simplified data management, and scalable and consistent I/O performance for all protocols across NAS (NFS, CIFS) and SAN (Fibre Channel, FCoE, and iSCSI) in a single pool of storage. Key benefits and features include:

- Supports SAN (Fibre Channel, FCoE, and iSCSI) or NAS
- Scales non-disruptively from a few Terabytes to over 1 Petabyte
- Easily installed, configured, managed, and maintained
- Rapid backup and recovery with zero-penalty Snapshot copies
- Simple, cost-effective replication for disaster recovery
- Instant space-efficient data clones for provisioning and testing
- Dynamically expand and contract storage volumes as needed
- Data deduplication to reduce capacity requirements

NetApp storage solutions offer these powerful data management and data protection capabilities, which enable you to lower costs while meeting capacity, utilization, and performance requirements.

Data Protection

A byproduct of any consolidation effort is increased risk if the consolidation platform fails. As physical servers are converted to virtual machines and multiple VMs are consolidated onto a single physical platform, the impact of a failure to the single platform can be catastrophic. Fortunately, hypervisors provide multiple technologies that enhance the availability of a virtual data center. These technologies include physical server clustering, application load balancing, and the ability to non-disruptively move running VMs and data sets between physical servers.

When focusing on storage availability, many levels of redundancy are available for deployments, including purchasing physical servers with multiple storage interconnects or HBAs, deploying redundant storage networking and network paths, and leveraging storage arrays with redundant controllers. A deployed storage design that meets all of these criteria can be considered to have eliminated all single points of failure.

The reality is that data protection requirements in a virtual infrastructure are greater than those in a traditional physical server infrastructure. Data protection is a paramount feature of shared storage devices. NetApp RAID-DP® is an advanced RAID technology that is provided as the default RAID level on all NetApp FAS systems. RAID-DP protects against the simultaneous loss of two drives in a single RAID group. It is very economical to deploy; the overhead with default RAID groups is a mere 12.5%. This level of resiliency and storage efficiency makes data residing on RAID-DP safer than data stored on RAID 5 and more cost-effective than RAID 10.

System Configuration

NetApp System Manager is a feature-rich yet easy to use storage management tool for basic configuration and management of NetApp storage systems. System Manager is ideal for initial setup and configuration of one system at a time. As your environment grows, NetApp offers a suite of storage management tools. These advanced management tools are discussed further in "Advanced Features," later in this guide.

This guide uses System Manager to demonstrate how to easily configure a NetApp storage system. Version 1.1 is supported on all NetApp FAS2000, FAS3000, FAS3100, and FAS6000 systems, and on the corresponding V-Series systems.

NetApp System Manager is supported on the following host systems:

- Windows XP 32-bit, SP2 and later (also supported in a VMware 32-bit guest OS)
- Windows Vista Enterprise 32-bit and 64-bit
- Windows Server 2003 SP1
- Windows Server 2008 Enterprise 64-bit

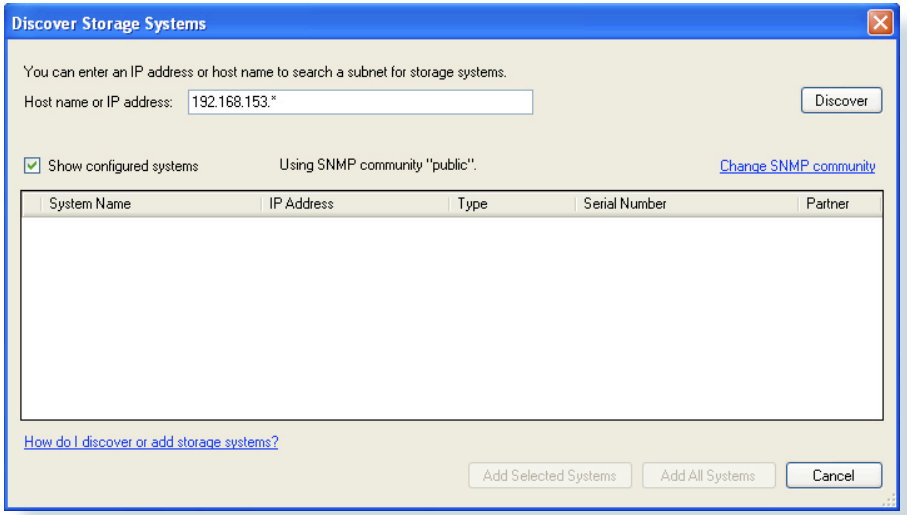
Initial System Setup

Connect the management interface of the storage system or array on a network with DHCP enabled and working.

NOTE: Smart Business Architecture designs do not generally illustrate DHCP services to be active and available in a Server Farm or Data Center environment. If a source of DHCP services is not available to provide initial configuration, the console port on the NetApp system provides an alternate command-line approach to set the IP address of the management port.

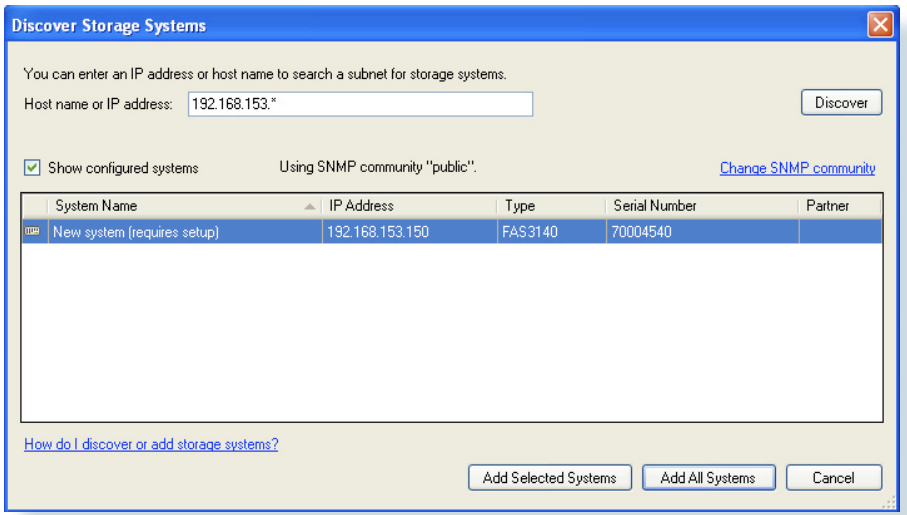
Step 1: Install NetApp Storage Manager from the software CD and launch System Manager.

Step 2: When you launch System Manager for the first time, you are prompted to either add individual systems or to discover all systems on a network, so that you can select the controllers you want to manage. To search for your controller, enter an IP address in the subnet that contains your controller in the Host Name or IP Address field and then click **Discover**.

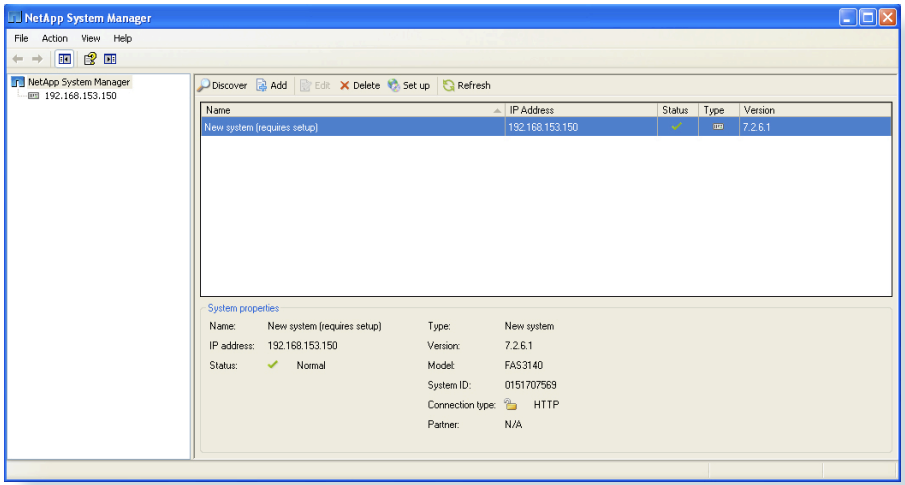


System Manager uses DHCP and SNMP to discover storage controllers. New controllers are represented as "New system (requires setup)."

Step 3: Select the new system and click Add Selected Systems.

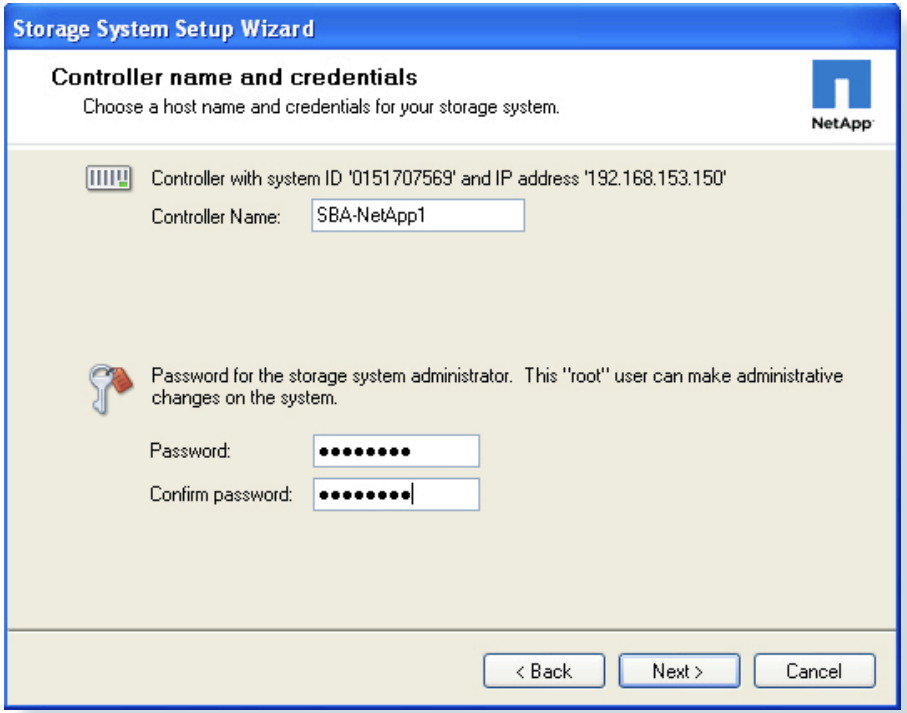


In the window that opens, the left pane shows the new controller with the IP address acquired by the controller from DHCP.

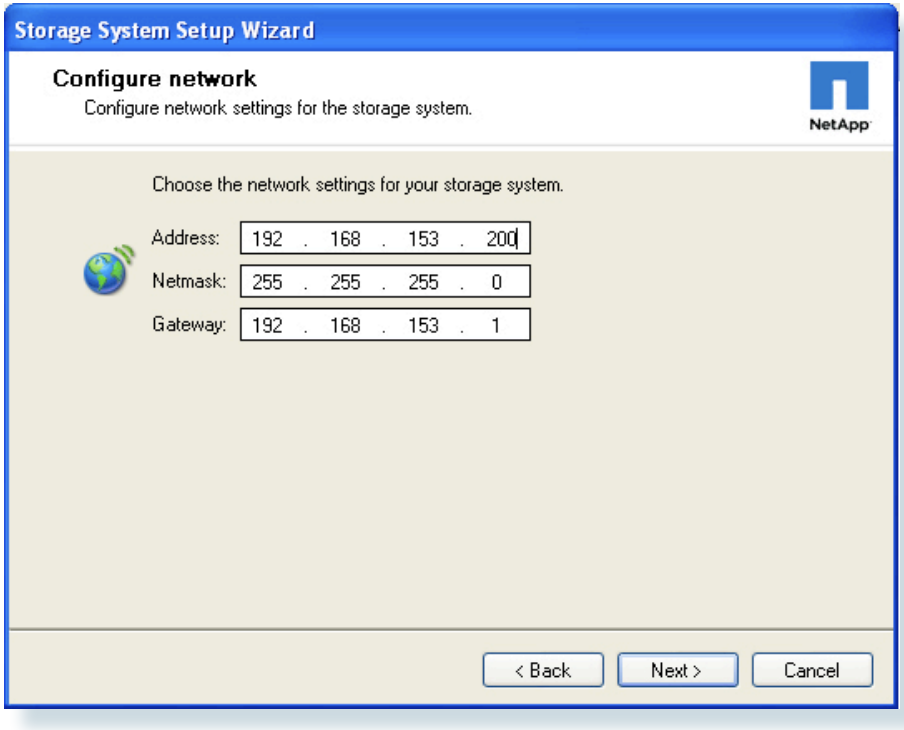


Step 4: Select the new controller IP address. A message appears in the right pane: "This new storage system requires setup." To set up the new storage system, click the **Set Up Storage System** link, which launches the Storage System Setup Wizard.

The wizard prompts you for the controller name and credentials.

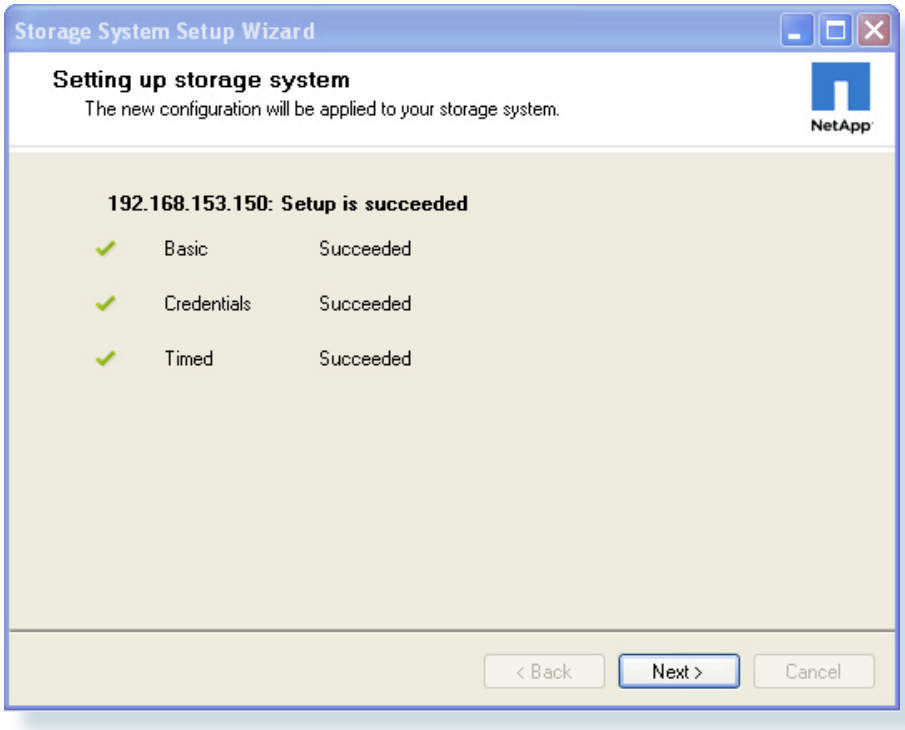


Step 5: System Manager displays the IP address that the controller has acquired from DHCP. This is the final step to configure your storage on the network. Change this IP address to a static IP address assigned to you by the network administrator.



Click **Next** to display a summary of the configuration.

Step 6: Click **Next** again to complete the configuration.



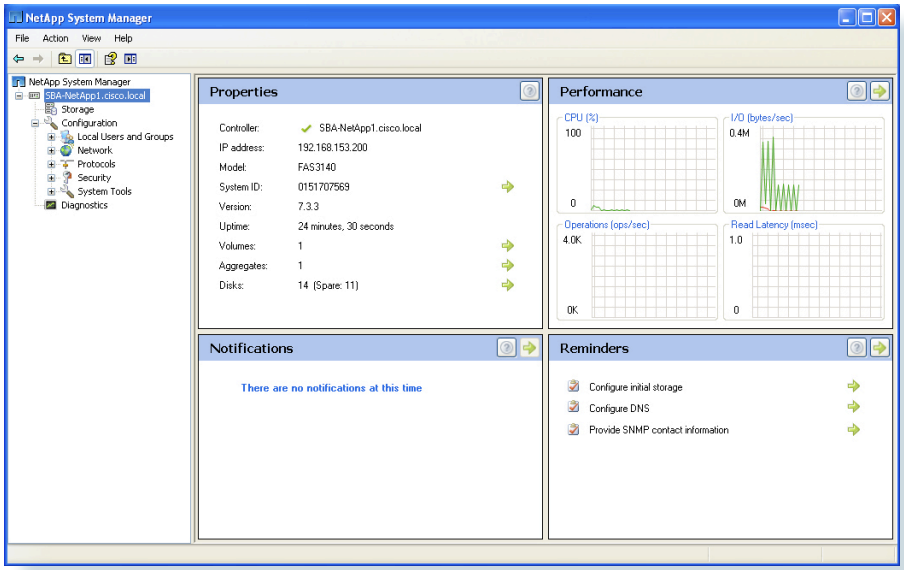
The setup is complete with the basic configuration such as hostname, IP address, subnet, credentials, management interface, and system default IP gateway. It also sets up the time and date along with CIFS in workgroup mode.

NOTE: System Manager provides the ability to set up basic SSL to establish a secure link between the host and controller for management. These settings can be configured by clicking on the **Storage** > **Security** tab in the left pane.

Basic NetApp Array Management

To view details, click the controller name in the left pane. The dashboard view that opens displays system properties such as name, IP address, model, system ID, Data ONTAP version, system uptime, and number of volumes, aggregates, and disks. To manage these items, click the green arrows to their right.

System Manager also provides basic performance graphs for CPU utilization, total I/O, combined operations of all protocols, and latency for all protocols.



System Manager also offers Notifications and Reminders roll-ups. The Notifications area shows the current event list by scanning through the syslog. The Reminders area shows reminders or a to-do list. To go directly to the source of the reminder, click the green arrow next to it.

Your NetApp storage system is configured and ready to use. You can now perform storage management (manage disks, aggregates, volumes, qtrees, LUNs), protocol management (CIFS, NFS, iSCSI, FCP, FCoE), and system configuration (network, licenses, SNMP, users, groups).

Storage Provisioning

Storage provisioning on NetApp storage is easy, involving only a few steps to provision a LUN or file share. Aggregates form the foundation storage layer from which flexible volumes and then LUNs are stored. The layers of storage virtualization offer a number of advantages to manage and optimize the storage, protection, and retention of your data.

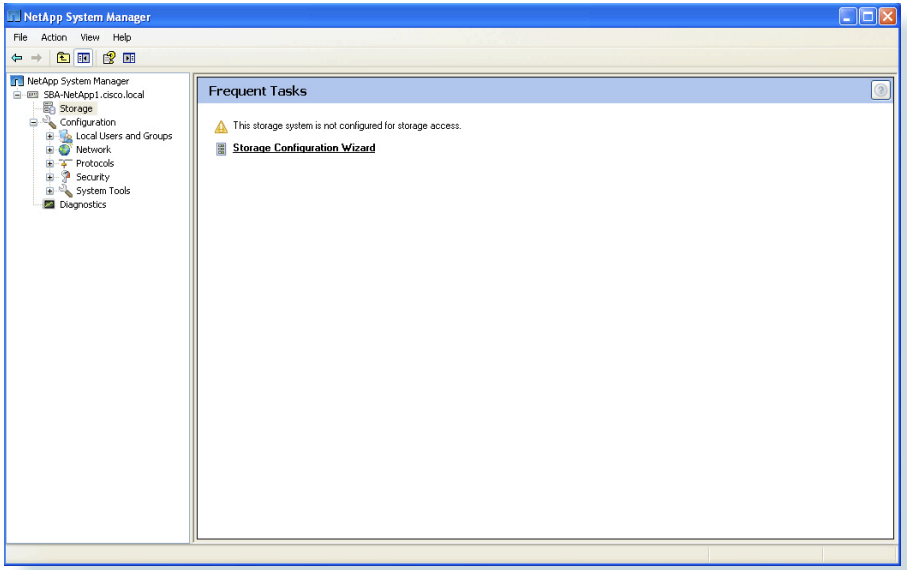
Aggregates

An aggregate is NetApp's virtualization layer, which abstracts physical disks on a storage device from logical data sets that are referred to as flexible volumes. Aggregates are the means by which the total IOPS (input/output operations per second) available from all of the individual physical disks are pooled as a resource. Aggregates are well suited to meet users' differing security, backup, performance, and data-sharing needs, as well as the most unpredictable and mixed workloads.

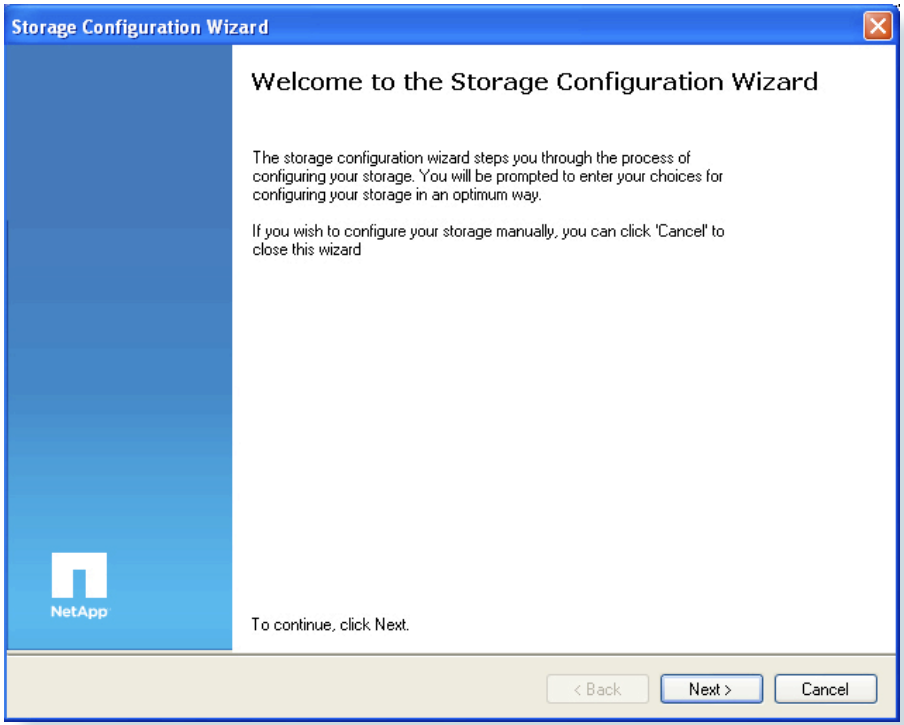
NetApp recommends that whenever possible, a separate small aggregate with RAID-DP should be used to host the root volume. This aggregate stores the files required to run and provide GUI management tools for the NetApp storage system. The remaining storage should be placed into a small number of large aggregates. This provides optimal performance because of the ability of a large number of physical spindles to service I/O requests. On smaller arrays, it might not be practical to have more than a single aggregate, due to the restricted number of disk drives on the system. In these cases, it is acceptable to have only a single aggregate.

Creating an Aggregate

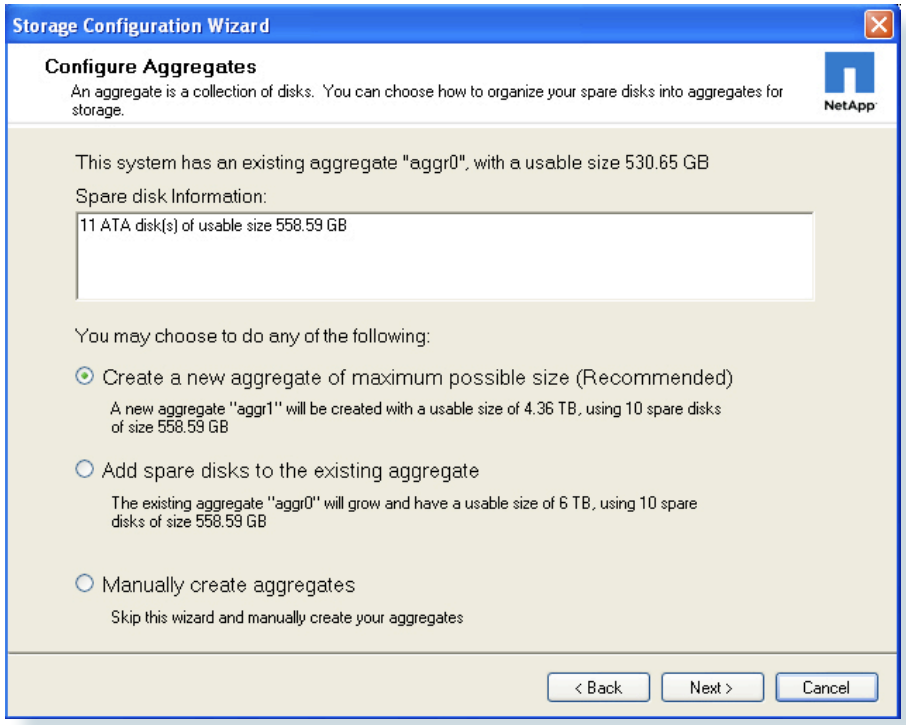
Step 1: Select Storage in the left pane, then click on the Storage Configuration Wizard link in the right pane to launch.



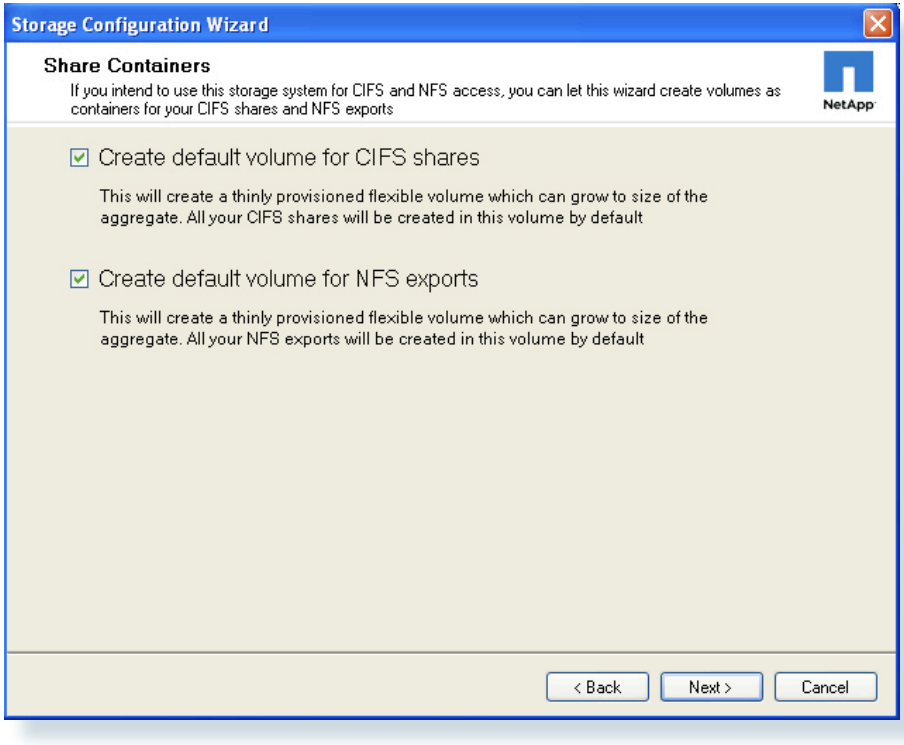
Step 2: Click **Next** to proceed with initial storage configuration of the new system.



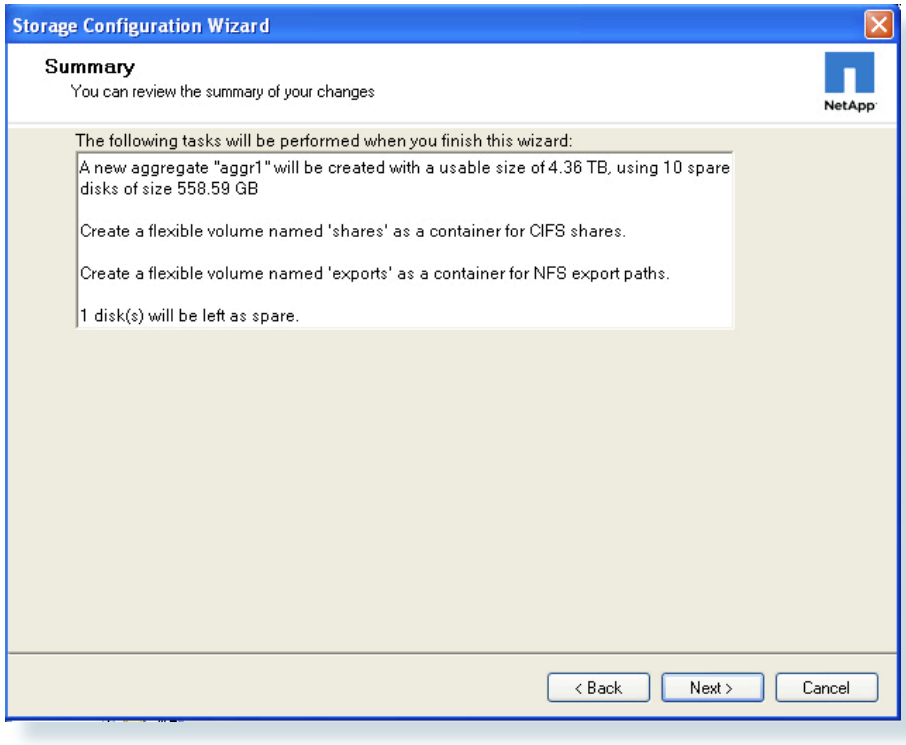
Step 3: Choose the appropriate radio button for your desired configuration of aggregates. For this example, we will choose the recommended item. Create a new aggregate of maximum possible size.



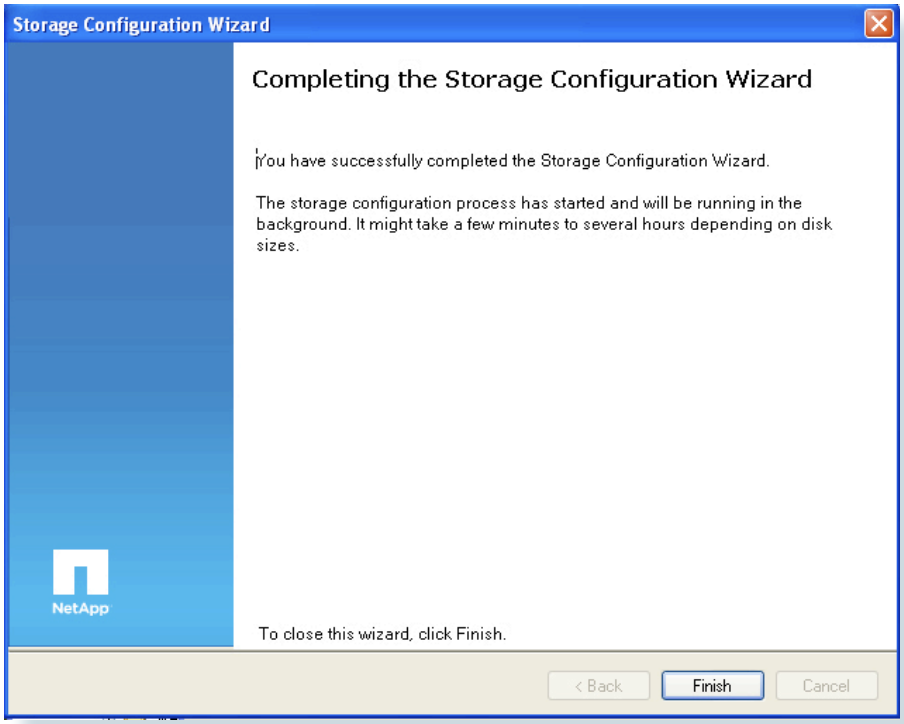
Step 4: In the following step, check boxes are provided to create default CIFS shares and NFS exports if required in your configuration. Choose the desired options and click **Next** to continue.



Step 5: Verify the summary of settings being performed by the Storage Configuration Wizard displayed in the window. Then click Next to create the aggregate.



Step 6: The creation of an aggregate takes place in the background, allowing you to begin storing data immediately. Click **Finish** to close the wizard.

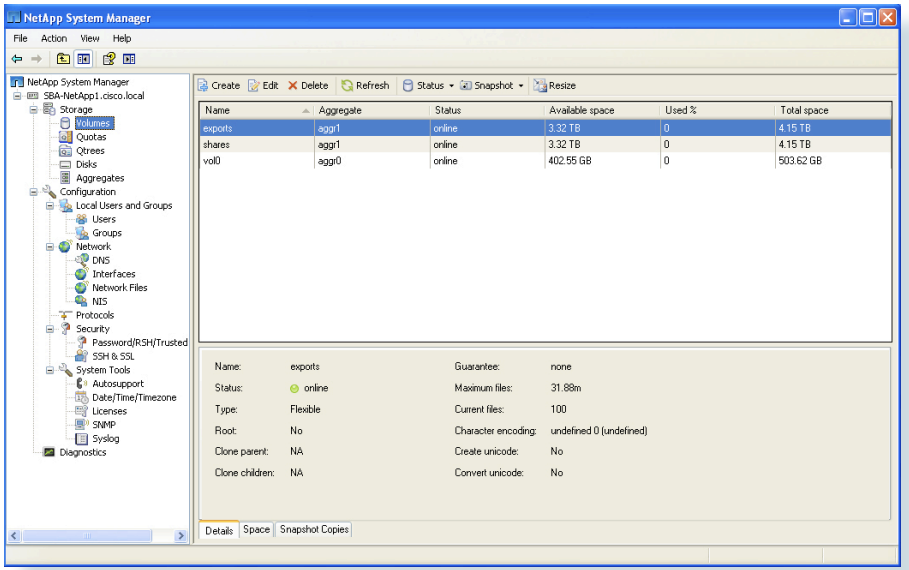


For details on manually configuring an aggregate, see "Configure an Aggregate" in section 3.6.1 of the Data ONTAP Storage Management Guide.

Flexible Volumes

FlexVol® volumes (flexible volumes) are thin storage containers that can contain LUNs and/or file shares that are accessed by servers over Fibre Channel (FC), Fibre Channel over Ethernet (FCoE), iSCSI, NFS, or CIFS. A FlexVol volume is a virtual volume that you can manage and move independently from physical storage. It can be created and resized, larger or smaller, as your application needs change.

Step 1: Select **Storage > Volumes** and then click **Create** to create a volume.

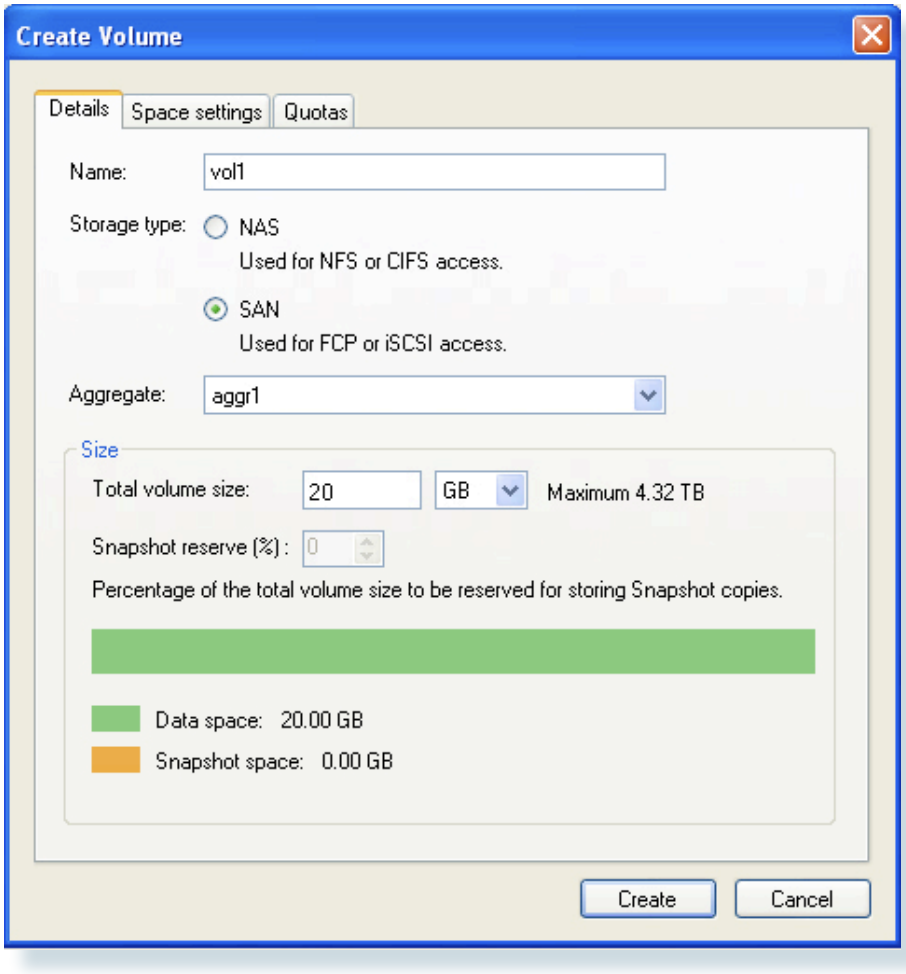


Step 2: To create a volume, you must define the following properties:

- **Volume name**
- **Storage type:** NAS (file properties) or SAN (block properties)
- **Aggregate:** Specify an aggregate for the LUN
- **Volume size:** The LUN capacity
- **Snapshot reserve:** The amount of the LUN to be reserved for Snapshot data

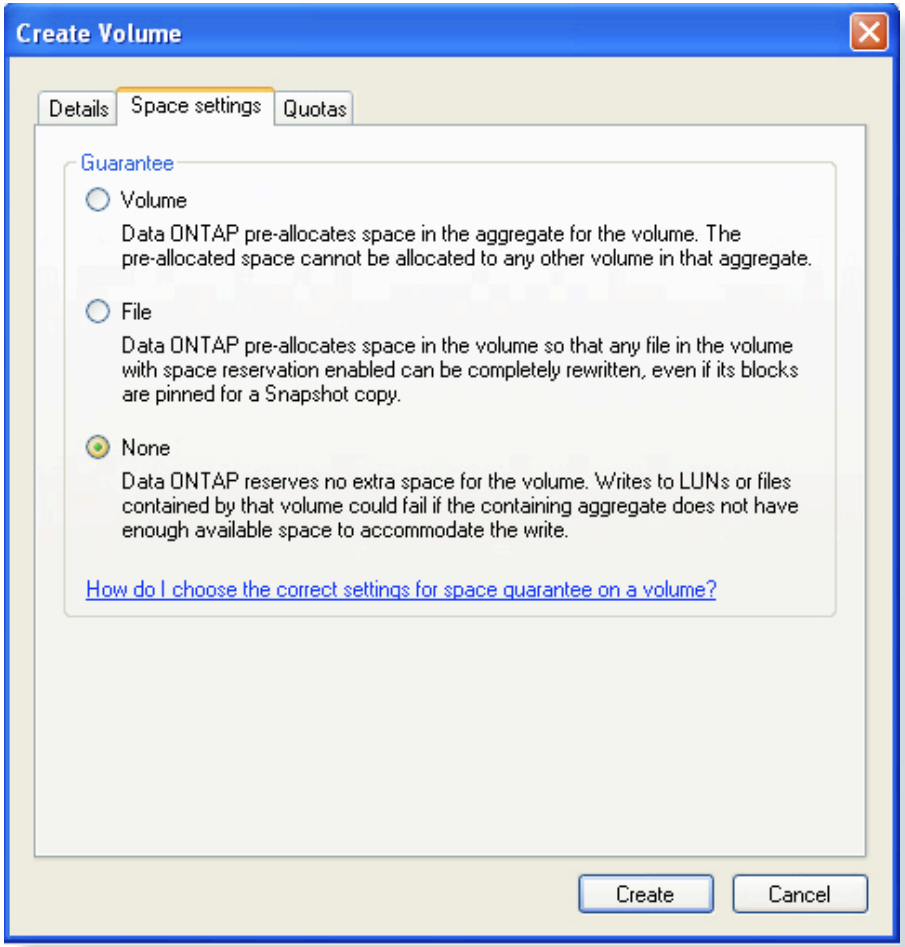
Volume name: NetApp suggests using a combination of the hostname, physical disk, and replication policy. Example: HostB_Disk1_4hmirror.

Snapshot reserve: This dedicates space in the LUN for Snapshot data. The default setting is 20%, which means that 20% of the LUN is not available for other data storage. You can choose a higher value or as little as 0%, depending on your requirements. NetApp recommends configuring all volumes with 0% and disabling the default Snapshot schedule.



Step 3: The Space Settings tab is used to reserve space on disk for the volume. You can reserve space for the whole volume or for a file with reservation properties. Additionally, you can select **None** to create a thinly provisioned volume that consumes space on disk only as data is written. For a description of thin provisioning see "Thin Provisioning" in the "Advanced Features" section in this document.

Step 4: Click **Create** to create the volume.

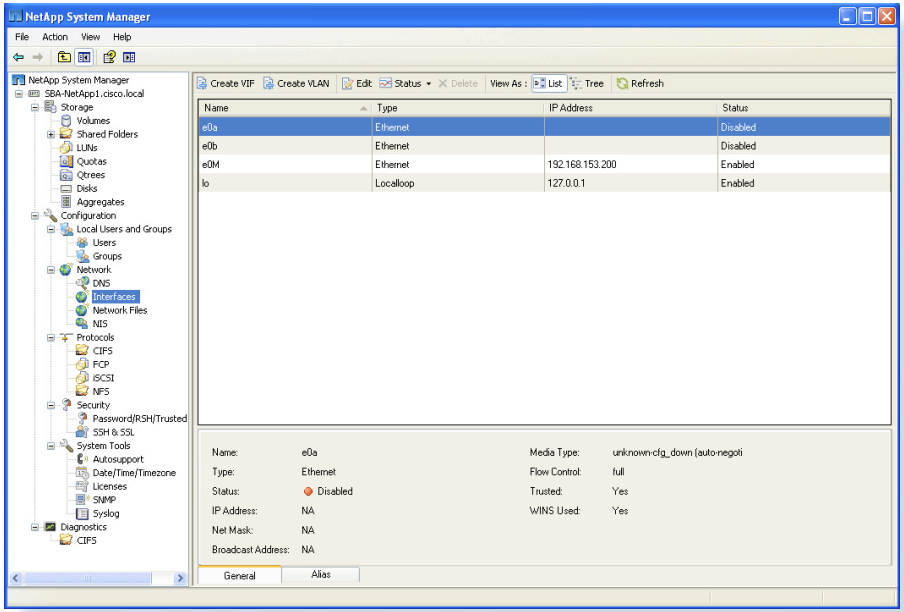


NOTE: Because out-of-space errors are not expected in a CIFS environment, do not set the space guarantee to **None** for volumes accessed by using CIFS.

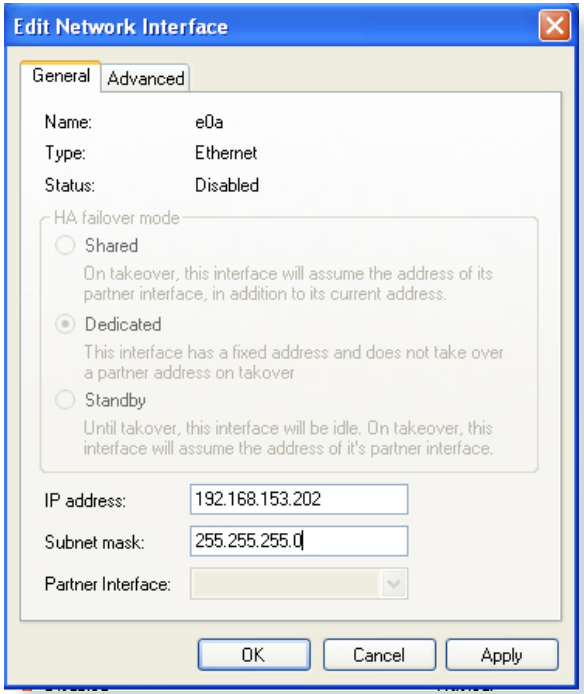
NOTE: Space guarantees are honored only for online volumes. If you take a volume offline, any committed but unused space for that volume becomes available for other volumes in that aggregate.

Enabling an Ethernet Storage Interface

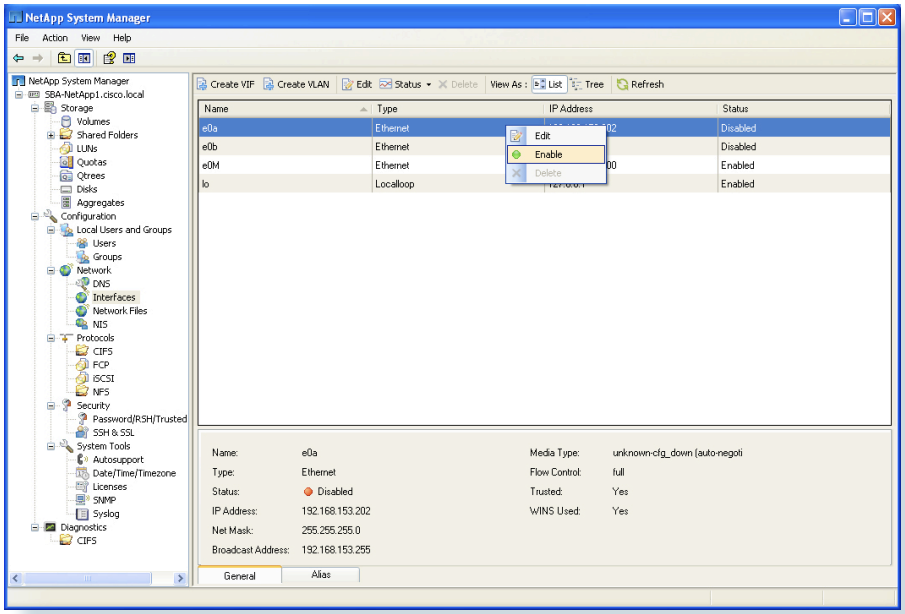
On a system that will support Ethernet-based access to storage, it is desirable to dedicate the e0M for system management traffic, and use one or more separate physical Ethernet interface for iSCSI initiators or NAS clients to access storage. To enable an additional Ethernet interface, choose **Configuration** > **Network** > **Interfaces** from the left pane, and highlight an available Ethernet interface in the right pane. Choose the **Edit** button to edit the interface settings.



Configure the IP address and subnet mask information on the **General** tab of the **Edit Network Interface** window, and click **OK**.



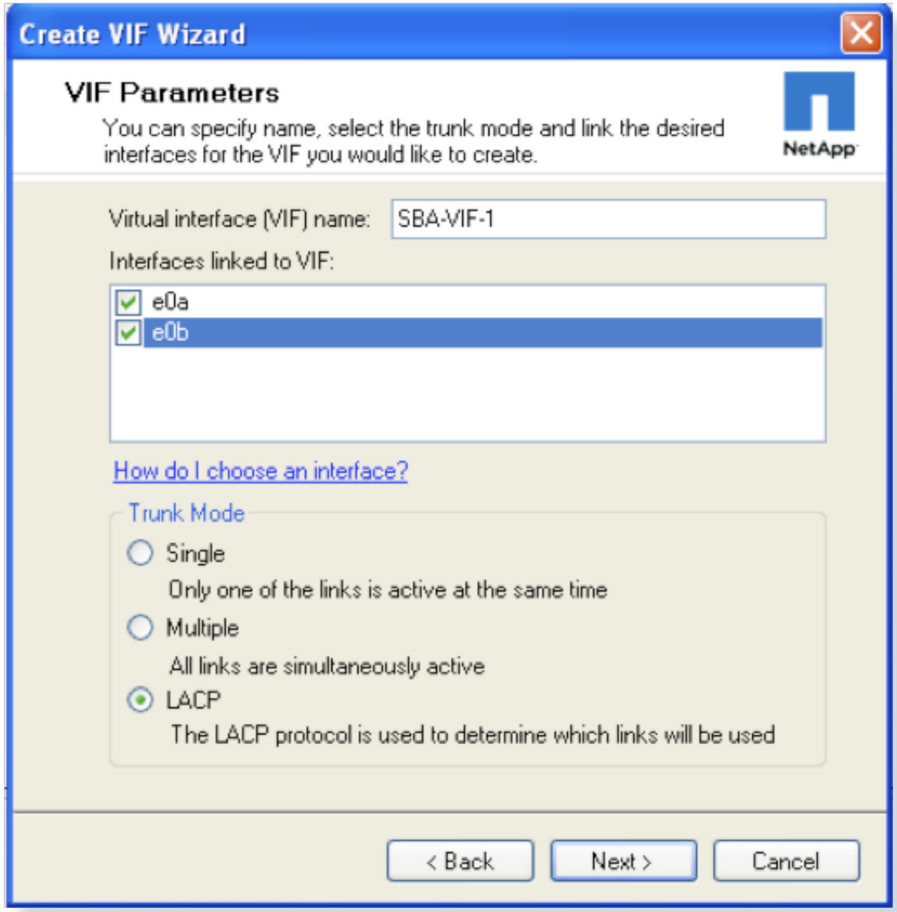
Once the interface has an IP address, right-click the configured interface and choose **Enable** from the pop-up menu.



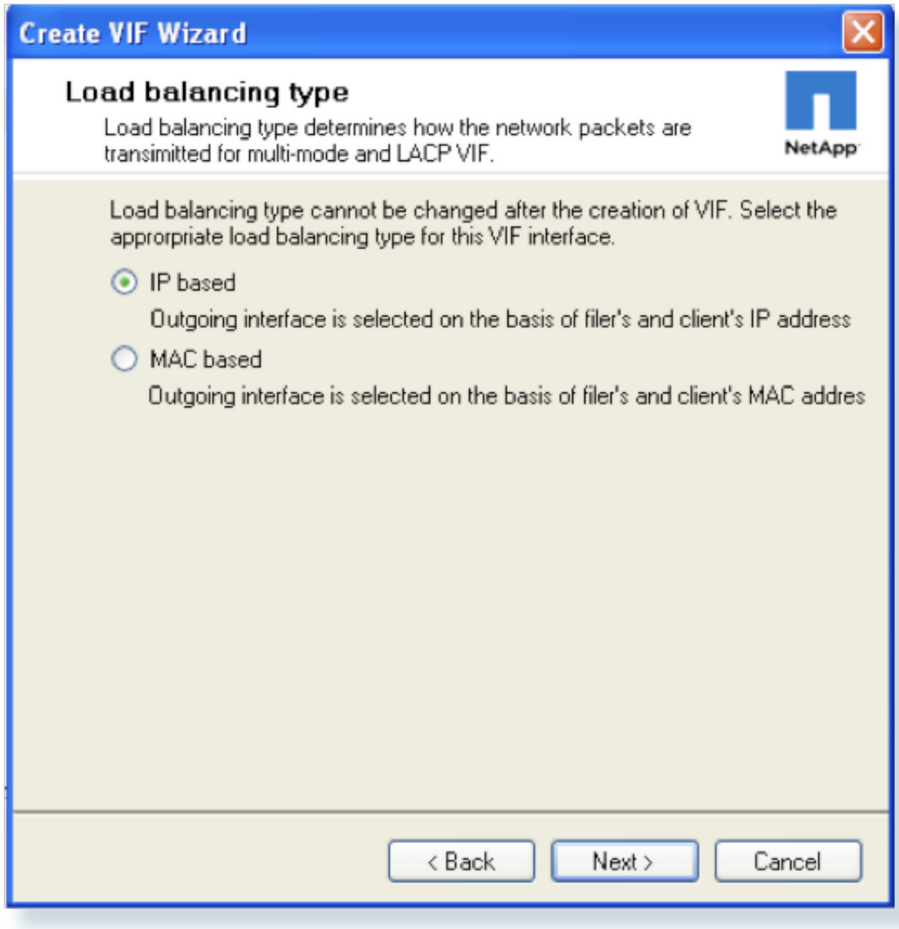
The address configured on the new interface should be used as the target IP address for iSCSI initiators. This configuration allows management traffic to be isolated on a separate interface from production storage traffic, and provide separate management access in the case the Ethernet storage interface ever needs to be reset or changed.

The Cisco SBA Data Center for Midsize Organizations design illustrates the storage system dual-attached to the Ethernet switching fabric using a port-channel connection. This type of a connection on a NetApp system is referred to as a virtual interface, or VIF. With a VIF configuration the dual interfaces provide system resiliency, and when configured as a port-channel using Link Aggregation Control Protocol (LACP), both links can actively carry storage traffic.

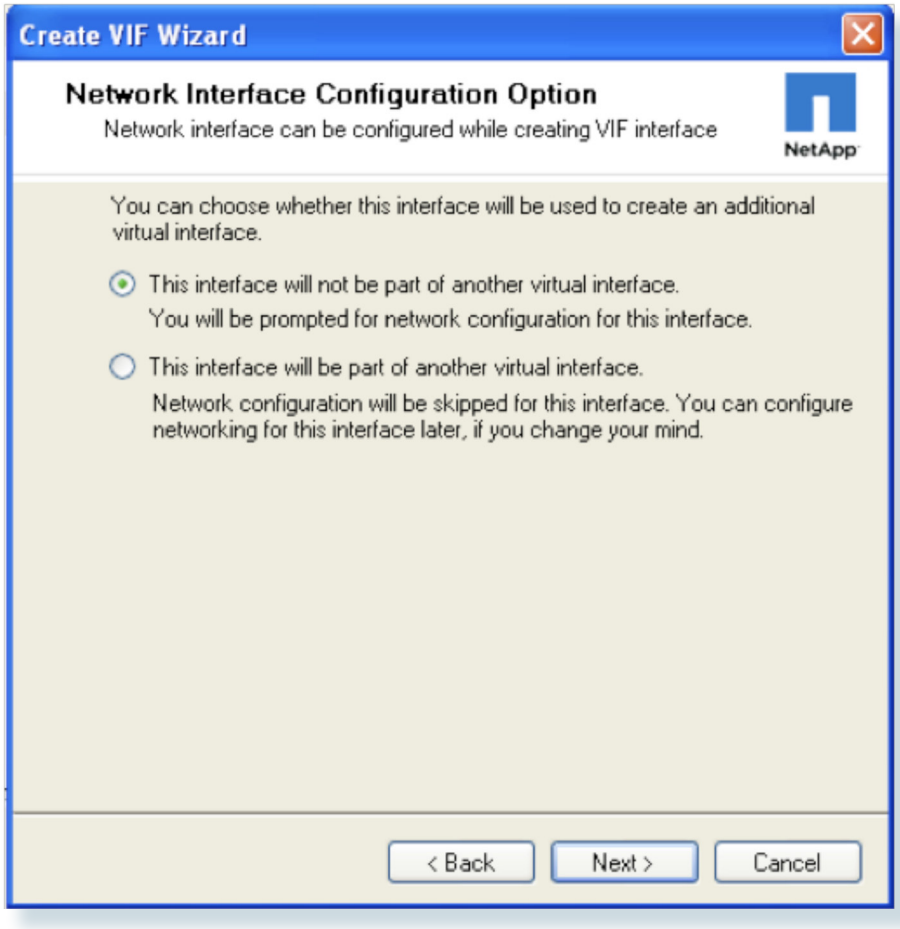
To enable the Ethernet Storage interface as a VIF, choose "Create VIF" from the Network Interfaces screen. Choose the two interfaces that will be part of the VIF, and select LACP as the trunk mode to connect to an Ethernet switch fabric configured for an LACP port-channel connection.



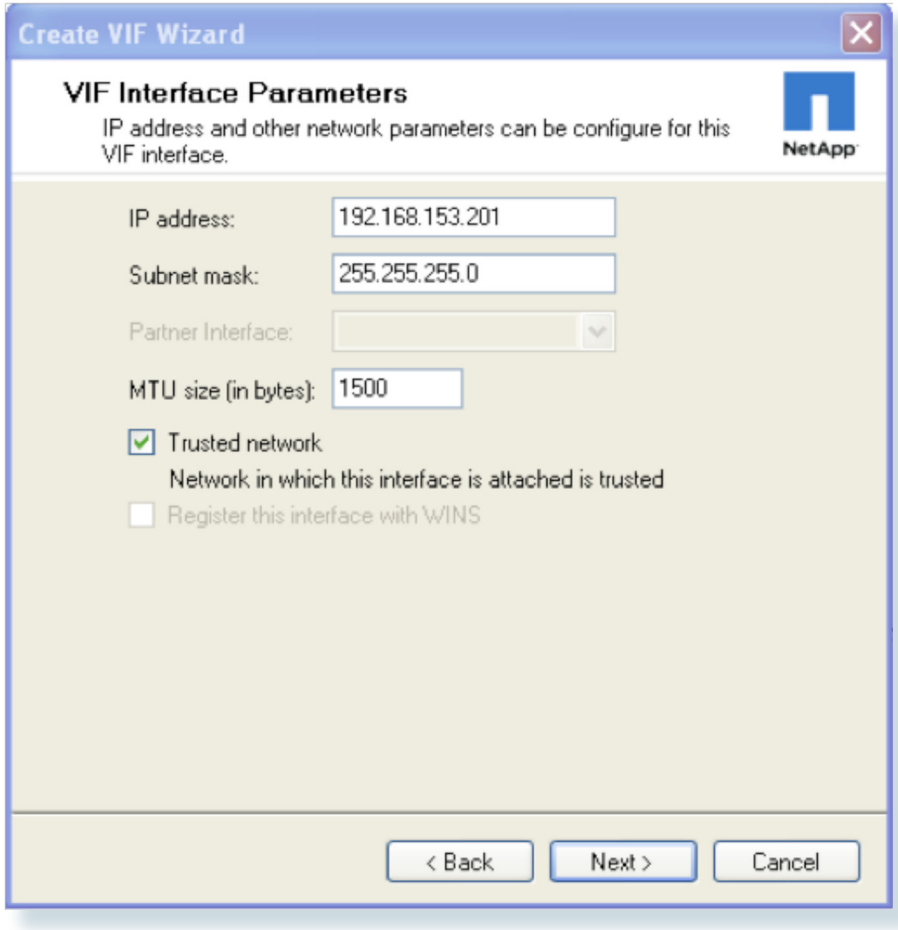
Click **Next** to continue, then choose the load balancing type on the following screen. IP-based balancing is the default and recommended type.



Click **Next** to continue, then on the Network Interface Configuration Option screen, choose the "This interface will not be part of another virtual interface" radio button.



Click **Next** to continue. Finally, assign an IP Address to the VIF. If you are converting a single interface configuration to a VIF, any existing IP Addressing will automatically be removed from the physical interfaces as they are placed into the VIF. So the same interface address previously used on a single interface may be reapplied to the VIF.



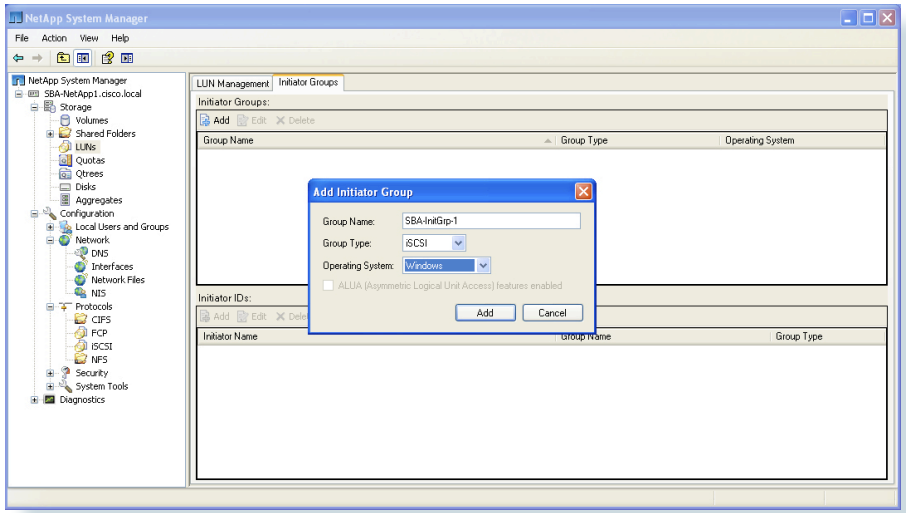
Leave the other choices on the screen at default and choose **Next** to continue and create the VIF. Once the VIF is created, the port status may be monitored on the Network Interfaces screen. When LACP negotiation is completed with the Ethernet switching fabric, the port status will be shown as "Enabled."

NOTE: You may require configuration of the management and Ethernet storage interfaces on different subnets. In that case it would be necessary to send traffic to different default gateways through separate specific interfaces. For more information on this type of configuration, consult the NetApp online Knowledgebase (see https://now.netapp.com/Knowledgebase/solutionarea.asp?id=kb27012). The NetApp Knowledgebase requires a login, which is available free of charge.

Creating an Initiator Group

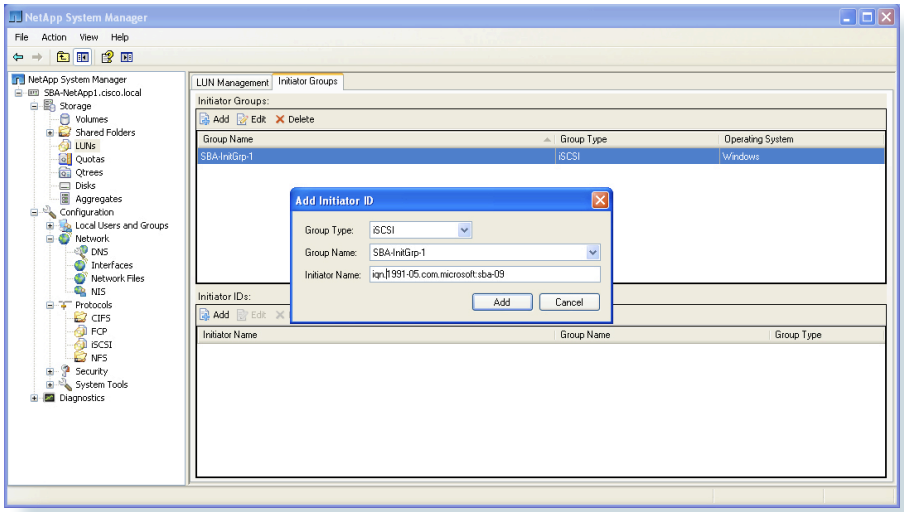
An iSCSI Initiator Group may be associated to a LUN for iSCSI access, and holds one or more Initiator IDs. Initiator IDs are text identifiers configured on the host systems that need to access storage. **Initiator Groups are also commonly referred to as *igroups, access control lists* or *LUN masking lists*.** When creating a LUN for iSCSI access, it is helpful if the appropriate iSCSI initiator group already exists so that it can be associated to the LUN directly within the LUN creation wizard.

To add an iSCSI initiator group to the system, choose **Storage > LUNs** in the left pane of System Manager, and select the **Initiator Groups** tab. Click the **Add** button, and enter a name for the initiator group. Select **iSCSI** as the group type, and select the appropriate Operating System for the host that will be accessing this group. Click the **Add** button in the **Add Initiator Group** window to create the group.



NOTE: To create an initiator group for a Fibre Channel host, use the Group Type pull-down box to change the type to FCP.

Once the group has been created, highlight the group name in the upper half of the right pane, and click the **Add** button in the lower half of the right pane to add an initiator ID to the group. The Initiator Name must match the name identified in the iSCSI configuration of the host machine that will be accessing storage.



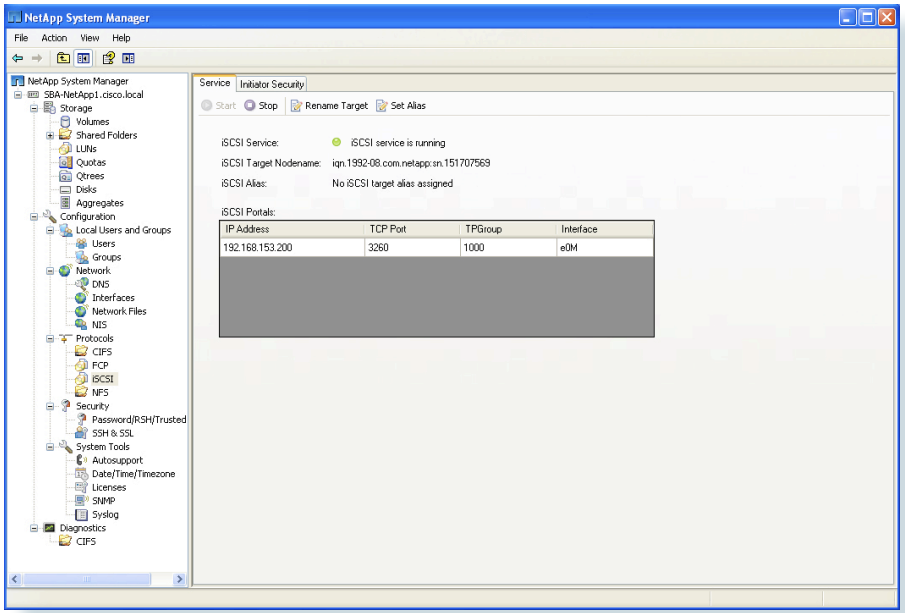
Click the **Add** button in the **Add Initiator ID** window to complete the addition of the new ID. With the initiator Group and ID created, you are now ready to proceed with adding a LUN to the system to be accessed via iSCSI.

NOTE: To add an initiator ID for a Fibre Channel host, choose FCP in the Group Type pull-down box, and enter the appropriate WWN in the Initiator Name field.

Creating a LUN for iSCSI or Fibre Channel

LUNs are logical units of storage provisioned from a NetApp storage system directly to servers. Hosts can access the LUNs as physical disks using FC, FCoE, or iSCSI protocol.

The following example shows how to configure an iSCSI LUN. Before configuring the LUN, you must start the iSCSI service on the storage system. Select **Configuration > Protocols > iSCSI** and then click **Start**.



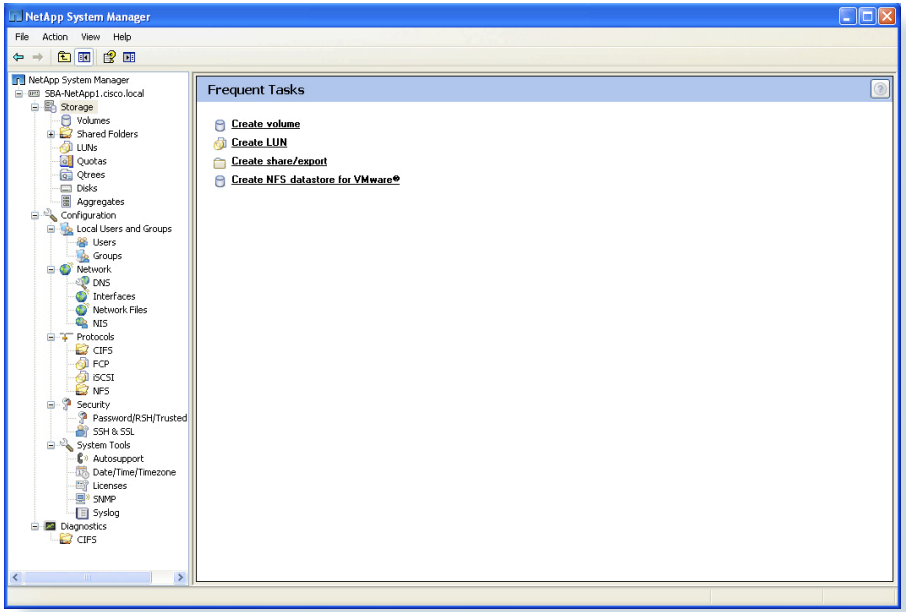
You can create four different types of storage objects on the same storage system. Click the storage icon to list the four available options:

- Create volume
- Create LUN
- Create share/export
- Create NFS datastore for VMware

LUNs and file shares/exports are objects within a volume. Creating a LUN automatically creates a default volume as part of the process. If you want to configure a volume with properties other than the defaults, you can do so separately. Also, you can create an NFS data object optimized for VMware applications.

The next section describes how to create a LUN mapped to an iSCSI initiator. The process of configuring an FC LUN or file share/export is essentially the same, the protocol used for access to the LUN is determined by the type of initiator group created earlier.

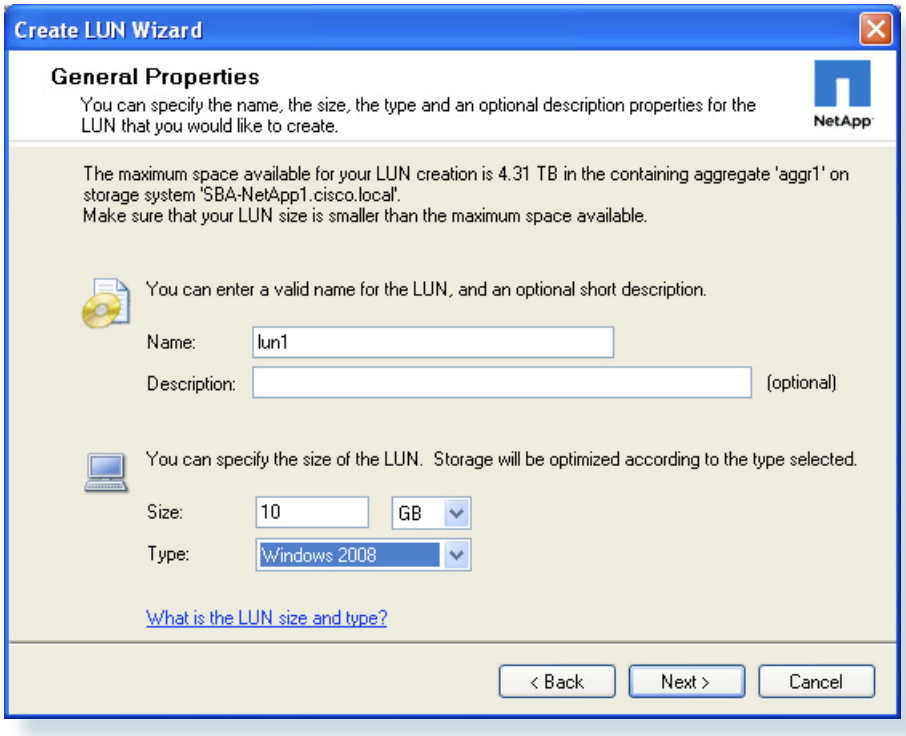
Step 1: With **Storage** selected in the left pane, click **Create LUN** to launch the Create LUN Wizard.



Step 2: Click **Next** to begin creating a LUN.

Step 3: Define the following properties for your LUN:

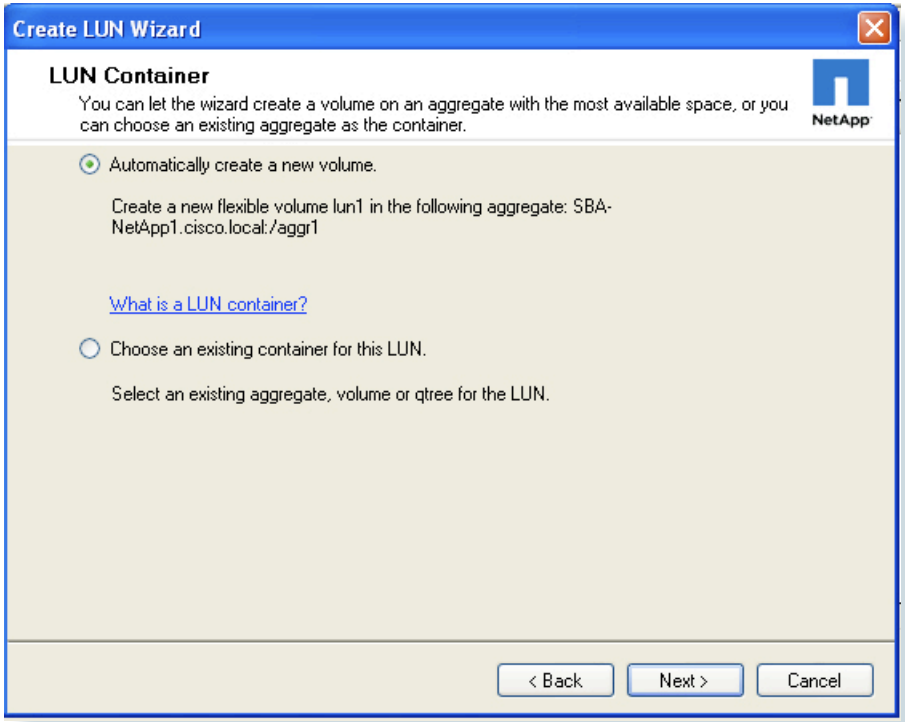
- LUN name
- Description (optional)
- LUN size
- Operating system type



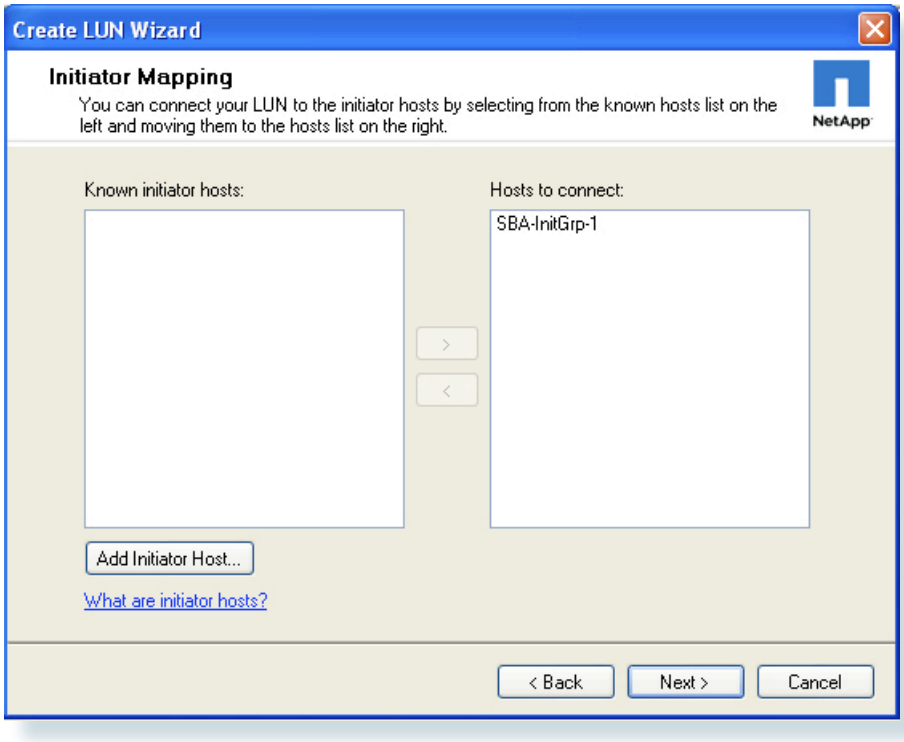
Each operating system maps data to LUNs slightly differently. The OS Type parameter determines the on-disk layout of the LUN. It is important to specify the correct OS type to make sure that the LUN is properly aligned with the file system on it. The underlying reason is that optimal performance with the storage system requires that I/O be aligned to a 4096-byte boundary. Unaligned I/O can cause an increase in per-operation latency. Unaligned I/O requires the storage system to read from or write to more blocks than necessary to perform logical I/O. This issue is not unique to NetApp storage. Any storage vendor or host platform can exhibit this problem. Once the LUN is created, you cannot modify the LUN host operating system type.

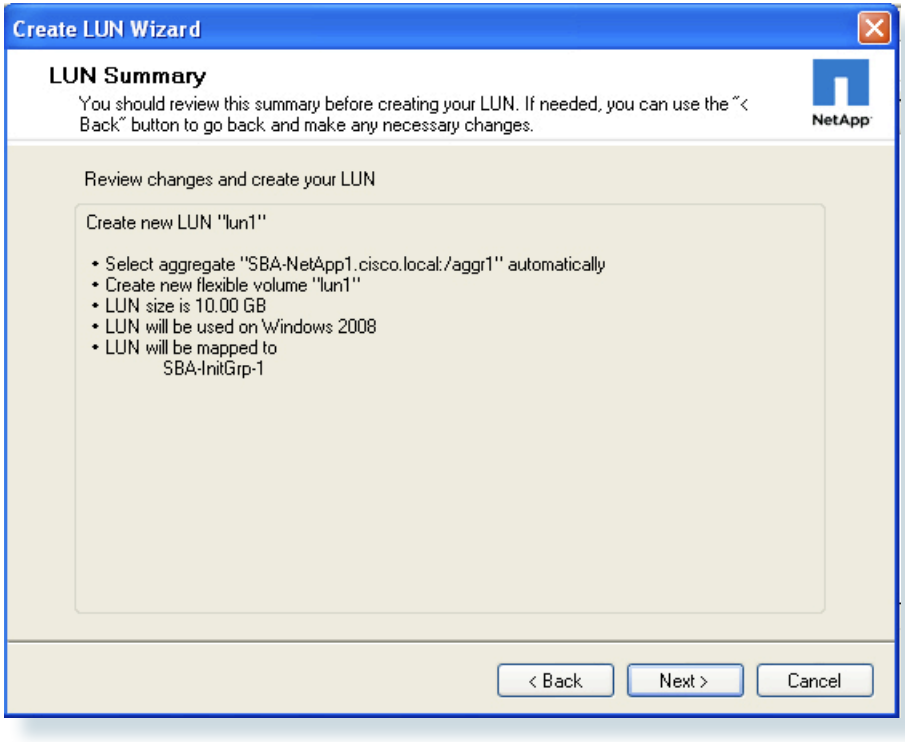
NOTE: If you have selected the incorrect OS type and then created the LUN, the LUN at the storage array will be misaligned. To properly align the LUN, you must create a new LUN then select the correct OS type.

Step 4: Specify whether you want to automatically create a new volume or select an existing volume. If you created a separate volume before creating a LUN, the option exists to choose an existing volume.



Step 5: Use the Initiator Mapping window to map the LUN to the initiator group (host) that was previously created. Select the group name in the left side of the window, and click the right arrow to move the selected name into the Hosts to connect list.





Step 6: Click the **Next** button to proceed, and verify the changes that will be applied to the system listed in the LUN Summary window. Click **Next** in the LUN Summary window to complete creation of the LUN.

Once the LUN has been created, it will be accessible to the iSCSI host that was identified in the initiator mapping.

Advanced Features: Increasing Storage Efficiency and Flexibility

Thin Provisioning

Traditional storage provisioning and preallocation of storage on disk is a method that storage administrators understand well. It is a common practice for server administrators to overprovision storage to avoid running out of storage and the associated application downtime when expanding the provisioned storage.

Although no system can be run at 100% storage utilization, there are methods of storage virtualization that allow administrators to address and oversubscribe storage in the same manner as with server resources (such as CPU, memory, networking, and so on). This form of storage virtualization is referred to as thin provisioning.

Traditional provisioning preallocates storage; thin provisioning provides storage on demand. The value of thin-provisioned storage is that storage is treated as a shared resource pool and is consumed only as each individual application requires it. This sharing increases the total utilization rate of storage by eliminating the unused but provisioned areas of storage that are associated with traditional storage. The drawback to thin provisioning and oversubscribing storage is that (without the addition of physical storage) if every application requires its maximum possible storage at the same time, there will not be enough storage to satisfy the requests.

NetApp FlexVol uses thin provisioning to allow LUNs that are presented as physical disks to be provisioned to their total capacity, yet consume only as much physical storage as is required to store data. LUNs connected as pass-through disks can also be thin provisioned. Thin provisioning applies equally to file shares.

NetApp Deduplication

With NetApp deduplication, server deployments can eliminate the duplicate data in their environment, enabling greater storage utilization. Deduplication can be seamlessly introduced into the server environment without having to make any changes to server administration, practices, or tasks. Deduplication runs on the NetApp storage system at scheduled intervals and does not consume any CPU cycles on the server.

Deduplication can be extremely helpful for virtual server scenarios such as fixed-size virtual hard drives, frequent creation and deletion of virtual disk files on the SAN LUNs, and data in the child VM.

Deduplication is enabled on the NetApp volume, and the amount of data deduplication realized is based on the commonality of the data stored in a deduplication-enabled volume.

NetApp Snapshot

A NetApp Snapshot copy is a locally retained, frozen, space-efficient read-only view of a volume or an aggregate. Its improved stability, scalability, recoverability, and performance make it more efficient than other storage snapshot technologies.

Snapshot copies facilitate frequent low-impact, user-recoverable online backup of files, directory hierarchies, LUNs, and application data. They offer a secure and simple method of restoring data so that users can directly access the Snapshot copies and recover from accidental file deletion, data corruption, or modification. The SnapManager® suite of products, which are available for various enterprise applications, uses the features of Snapshot copies and delivers an enterprise-class data protection solution.

NetApp FlexClone

NetApp FlexClone® technology creates true cloned volumes—instantly replicated data sets, files, LUNs, and volumes that use no additional storage space at the time of creation. A FlexClone volume is a writable point-in-time copy generated from the Snapshot copy of a FlexVol volume. It has all the features of a FlexVol volume, including growing, shrinking, and being the base for a Snapshot copy or even another FlexClone volume.

FlexClone volumes deployed in a virtualized environment offer significant savings in dollars, space, and energy. Additionally, the performance of a FlexClone volume or file is identical to the performance of any other FlexVol volume or individual file.

Backup, Disaster Recovery, and High Availability

Backup and recovery is the most critical component of the data protection plan. If data is changed unexpectedly, a system is compromised, or a site is lost, a backup is crucial to protect and recover business information assets.

NetApp backup and recovery solutions equip users to increase the reliability of data protection while minimizing management overhead and cost. These solutions fit into any strategy, enabling users to meet their service-level requirements.

Backup and Recovery Concepts

Data protection plans for a virtualized environment become more critical as consolidation brings all crucial data into one place and any form of failure results in a massive impact on the business applications.

Backup tasks running in the server virtualized infrastructure are often resource (CPU, memory, disk I/O, and network) intensive and can result in bottlenecks that adversely affect the performance of the other business-critical applications that share the environment. Backup schedules must be closely coordinated with the applications that are running on the available resources.

Disaster Recovery

Business operations depend heavily on information systems and the related IT infrastructure. A minor application outage can cause a significant impact, and the effect of data loss is even more critical. There are various metrics that are commonly used in designing a business continuity plan. Two of the most frequently used metrics are recovery point objective (RPO) and recovery time objective (RTO). RPO, measured in minutes and hours, describes how far the recovered data are out of sync with the production data at the time of disaster. RTO, measured in minutes, describes how fast the operations can be restored.

Several approaches have been developed to increase data availability and business continuity in case of disaster occurring at the hardware or software level, and even site failures. Backup methods primarily provide a way to recover from data loss from an archived medium—a high-level data protection method.

Redundant hardware setups can provide second-level protection to mitigate damage caused by hardware failures. Data mirroring is another mechanism to increase data availability and minimize downtime.

NetApp offers the SnapMirror® solution, which empowers IT infrastructures with a fast, flexible data replication mechanism over Ethernet and Fibre Channel networks. It is a key component to be considered when designing and deploying enterprise data protection plans. SnapMirror is an efficient data replication solution that takes advantage of underlying NetApp technologies such as Snapshot, FlexClone, deduplication, and so on. Disaster recovery is its primary objective, and SnapMirror can also assist in other critical application areas such as DR testing, application testing, load sharing, remote tape archiving, and remote data access.

Business Continuance Concepts

Disaster can occur in any IT infrastructure, and a data protection plan is even more critical for environments that are consolidated by using server virtualization. This is true because consolidation adds complexity by sharing reduced physical hardware resources for the applications and the business-critical data that are running. The infrastructure must be designed with special attention to the following challenges that can crop up in a virtualized environment.

- Less time (or even no time) is available to schedule downtime windows to perform cold backup on virtual machines.
- Performing hot backup of virtual machines can result in inconsistent backup copies, which are of no use during recovery.
- Infrastructure contains various OS instances, making it difficult to identify a consistent state for backup.
- Replicating data over LAN or WAN can consume twice as much of the available resources.
- Planning for identical resources at the DR site results in increased TCO and unused infrastructure.

NetApp offers solutions that complement the server virtualization solutions and help to mitigate these challenges. Solutions such as NetApp Snapshot, FlexClone, deduplication, and so on enable an architect to design a complete data protection solution and to make efficient use of the available resources.

NetApp SnapMirror

NetApp SnapMirror software is a simple, flexible, cost-effective disaster recovery and data distribution solution that is deployed for more of the enterprise application infrastructure. Data is replicated across LAN or WAN, offering high availability and faster disaster recovery for business-critical applications. Continuous data mirroring and mirror updates across multiple NetApp storage systems facilitate the mirrored data for multiple purposes. Businesses in different geographical locations can take advantage of SnapMirror and make local copies of mirrored data available to all locations, enhancing efficiency and productivity.

NetApp SnapVault

NetApp SnapVault® leverages disk-based backup and block-level incrementals for reliable, low-overhead backup and recovery of NetApp storage suitable for any environment.

With SnapVault, data protection occurs at the block level–copying only the data blocks that have changed since the last backup, not entire files. This enables backups to run more frequently and to use less capacity, because no redundant data is moved or stored.

For distributed organizations, this not only makes disk-based backup cost-effective, it offers the option of backing up directly from remote facilities to a core data center, centralizing management and minimizing investment needs at the edge.

Monitoring and Management

Storage monitoring and management are critical to the success of the server environment. NetApp offers tools to monitor the health of storage systems, provide alerts, generate reports, and manage storage growth.

NetApp SnapManager

NetApp SnapManager management tools integrate with the leading business applications to automate and simplify the complex, manual, and time-consuming processes associated with the backup, restoration, recovery, and cloning of the leading business applications, including Oracle, Microsoft Exchange, SQL Server, SharePoint, SAP, and server virtualization.

Leverage the NetApp technology stack to create near-instant and space-efficient Snapshot copies and clones of your applications. Integrate with native application technologies and achieve complete automation of data management.

Use policies to simplify, standardize, and automate data protection. Increase backup frequency—without affecting performance—for better data protection. Recover and restore a failed database to full production in minutes, regardless of size.

Create complete data clones in seconds on primary storage or directly to your development and test environment. Use clones to engage in parallel QA, development, testing, and other processes, and deploy applications faster than ever before.

NetApp Operations Manager

NetApp Operations Manager monitors, manages, and generates reports on all of the NetApp storage systems in an organization. When you are using NetApp thin provisioning, NetApp recommends deploying Operations Manager and setting up email and pager notifications to the appropriate administrators. With thin-provisioned storage, it is very important to monitor the free space available in the aggregates. Proper notification of the available free space means that additional storage can be made available before the aggregate becomes completely full. For information about setting up notifications in Operations Manager, see the Configuring Alarms and Managing Aggregate Capacity within the Operations Manager Administration Guide on NOW.

NetApp Protection Manager

Automate your data protection operations with Protection Manager's policy-based management, global monitoring, and reporting.

Managing data protection can be complicated and time consuming. Most tools fail to give you a comprehensive and easy-to-understand view of your data protection environment. What's more, they make it difficult to efficiently provision and use storage resources.

Protection Manager can simplify common data protection tasks and automate management across Snapshot, SnapMirror, SnapManager, SnapVault, and Open Systems SnapVault operations. It automates storage provisioning and provides global policy-based management, monitoring, and alerting.

Protection Manager makes it easy to define, apply, and update data protection policies across the enterprise. It minimizes effort, cuts administrative overhead, and helps to meet best practices and service-level agreements globally.

A simple dashboard shows comprehensive data protection information, including unprotected data, alerts, and utilization, at a glance.

Protection Manager automation combines with thin provisioning, deduplication, NetApp Snapshot, and block incremental technology to shrink the storage footprint and increase management efficiency.

NetApp Provisioning Manager

Provisioning Manager can speed the creation of new NetApp storage resources and help improve capacity management of existing storage resources. Storage administrators can use Provisioning Manager's policy-based automation to create repeatable, automated provisioning processes to improve the availability of data and enable provisioned storage to comply with policies. These processes are faster than manually provisioning storage, are easier to maintain than scripts, and help to minimize the risk of data loss due to misconfigured storage.

Provisioning Manager applies user-defined policies to consistently select the appropriate resources for each provisioning activity. This frees administrators from the headache of searching for available space to provision and allows more time for strategic issues. A centralized management console allows administrators to monitor the status of their provisioned storage resources.

Provisioning Manager can help improve your business agility and capacity utilization, shrink provisioning time, and improve administrator productivity. By leveraging Provisioning Manager's thin provisioning and deduplication capabilities, you can get a high level of storage efficiency from your NetApp storage investment. This allows you to store more data, more efficiently, and help improve your business agility.

Conclusion

The requirements of midsized organizations increasingly reflect those of larger enterprises, although generally on a smaller scale. However, with limited IT skill sets, midsized organizations must rely on partners and vendors that can deliver effective solutions in a simplified manner. Cisco's Smart Business Architecture solutions address these needs.

NetApp storage solutions offer the performance and functionality to unlock the value of your business regardless of size. The NetApp family of storage solutions offers class-leading storage efficiency and performance that scale with your organization. Whether you deploy a NetApp FAS system or choose to extend the life of your existing FC storage with a NetApp V-Series system, NetApp storage solutions offer a common storage platform that is designed to maximize the efficiency of your data storage. Capable of data-in-place upgrades to more powerful FAS or V-Series systems, running the same Data ONTAP operating system and using the same management tools and feature sets, NetApp systems grow with your organization and are ideal for midsized organizations as well as large enterprises.

Contacting NetApp

For more information on NetApp products, services, and solutions, NetApp sales representatives and reseller partners are ready to answer your questions and provide you with the pricing and configuration information you need to make your purchasing decision.

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