Technical Report

Deploying Veritas NetBackup with NetApp E-Series Storage

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Abstract

This document describes deployment of Veritas NetBackup on NetApp® E-Series storage.

NetApp®

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1 Introduction

The modern data landscape is vast and varied, and it is growing by the day. As data becomes ubiquitous, so do the challenges that businesses face in managing, storing, and accessing that data around the clock. Businesses have data on bare-metal servers, virtualized servers, and in the cloud, which adds another layer of complexity to an already huge undertaking. Powerful, unified data protection solutions are necessary to safeguard this asset; if an unexpected outage renders data unavailable for even a short time, the cost to the organization can be immense. By maintaining backups of data, both on and off site, businesses can make sure that their operations keep moving because they can simply switch to the machines with the duplicate data.

NetApp and Veritas together offer a powerful, comprehensive backup solution to help businesses meet recovery time objectives (RTOs) and recovery point objectives (RPOs), minimize downtime, and simplify administration of backups and restores.

NetApp E-Series and EF-Series storage systems provides simple, reliable SAN storage that integrates seamlessly with most application environments. Its modular design decreases operating expenses while offering many options for connectivity, capacity, and performance that easily scale to meet the demands of a growing backup environment.

Veritas NetBackup 8.1 is a software solution that unifies data protection whether data is in the cloud, on virtual servers, or on bare-metal servers. NetBackup eliminates complexity and offers:

- Unified data protection on a converged platform
- World-class scalability and performance
- As-a-service experience
- Foundation for enterprise data management

With single-click recovery orchestration when your business depends on it, Veritas NetBackup with NetApp E-Series offers a robust backup solution.

1.1 About NetApp

NetApp creates innovative products and solutions that help customers around the world store, manage, protect, and retain one of their most precious corporate assets: their data. NetApp is recognized throughout the industry for continually pushing the limits of technology so that customers don't have to choose between saving money and acquiring the capabilities that they need to be successful.

NetApp finds ways to enable customers to do things that they couldn't do before and at a speed that they never thought possible. NetApp partners with industry leaders to create efficient and cost-effective solutions that are optimized for customers' IT needs and to deliver to and support these customers. Leading organizations worldwide count on NetApp for software, systems, and services to manage and store their data. Customers value our teamwork, expertise, and passion for helping them succeed now and into the future. To learn more, visit the NetApp website.

1.2 About Veritas Technologies

Veritas Technologies empowers businesses of all sizes to discover the truth in information—their most important digital asset. Using the Veritas platform, customers can accelerate their digital transformation and solve pressing IT and business challenges including multi-cloud data management, data protection, storage optimization, compliance readiness, and workload portability—with no cloud vendor lock-in. Information about Veritas is available on the Veritas website. Veritas corporate headquarters is located in Mountain View, CA.

2   Reference Architecture Overview

This section details reference architectures that cover simple, advanced, and distributed deployment scenarios.
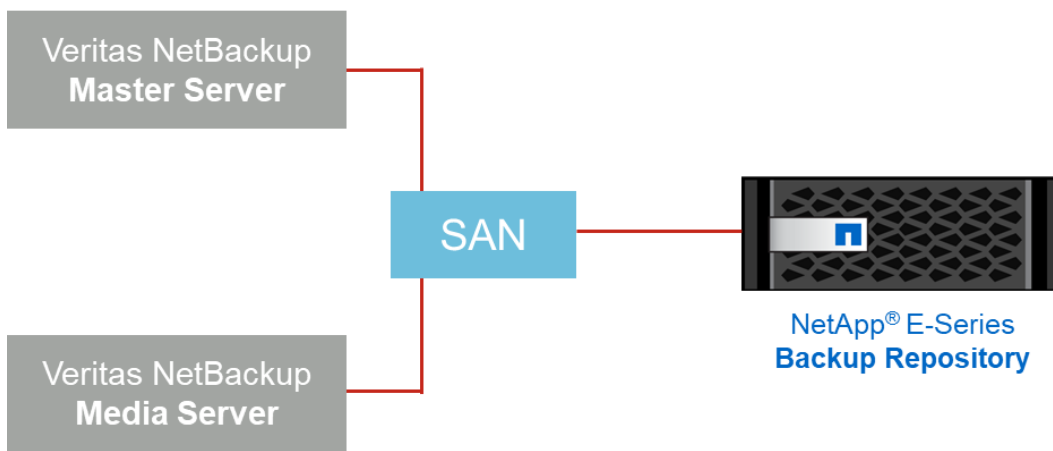
2.1   Deployment Scenarios

Veritas NetBackup deployment scenarios include simple, advanced, and distributed deployments.

Simple Deployment: Single Master Server and Media Server

In this deployment scenario, one master server is installed, one media server is connected to a backup repository through a SAN, and then one or more clients is connected to the SAN. This deployment is the simplest, which makes it ideal for evaluating NetBackup. It has enough I/O and capacity to support a large organization; however, it lacks redundancy and is not recommended for a production environment. Figure 1 shows a single-master, single-media, single site-deployment.

Figure 1) Simple deployment scenario.

Advanced Deployment: Multiple Master Servers and Multiple Media Servers

In this deployment scenario, two or more master servers are connected, two or more media servers are connected to a backup repository through SAN, and then one or more clients is connected to the SAN.

This scalable redundant backup scenario performs well in a large business or enterprise. Failure at a media server can be overcome by using a different media server. Also, the additional media servers offer flexibility to run recovery jobs even while backups are being performed. The master servers can replicate media data such as policies, logs, and the backup catalog.

If a master or media server fails, continuous protection and recovery are still possible, and a straightforward path exists to replace the failed server. This fully scalable solution grows with your needs, protects your data, ensures availability to a single site, and is ideal for a single-site business of any size. Figure 2 shows a multimaster, multimedia,and single-site deployment.

Note: A single-site deployment does not protect against a single-site catastrophic event such as a flood or fire.

Figure 2) Advanced deployment scenario.

Multimaster, Multimedia, Single Site
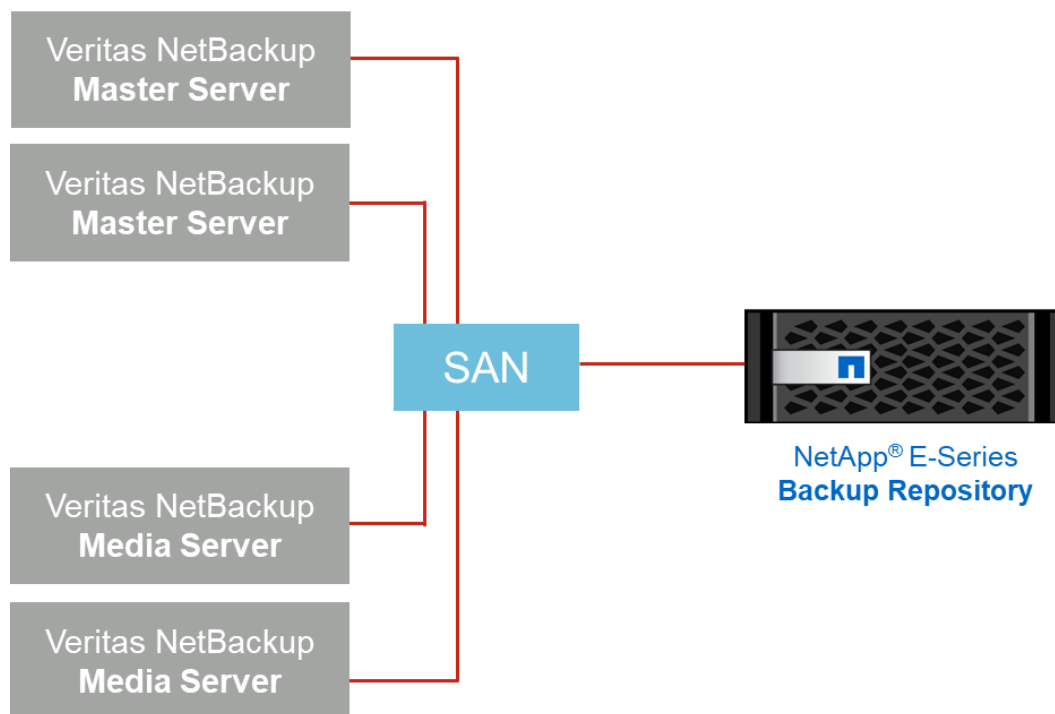
Distributed Deployment: Multiple Master Server and Multiple Media Servers with AIR Replication

In this deployment scenario, the scale and redundancy of the advanced deployment are taken, and the deployment is duplicated in a hot or warm secondary remote site to increase availability and geographic redundancy.

With this second site, NetBackup can replicate all media data and backup images so that data protected on site A can be restored to site B. Further, if site A has a catastrophic outage, all data and virtual machines (VMs) can be recovered to site B. In this scenario, NetApp maximizes the scale, redundancy, and availability of NetBackup. This deployment scenario is ideal for the large enterprise. Figure 3 shows a multimaster, multimedia, and multisite deployment.

Figure 3) Distributed deployment scenario.

Multimaster, Multimedia, Multisite
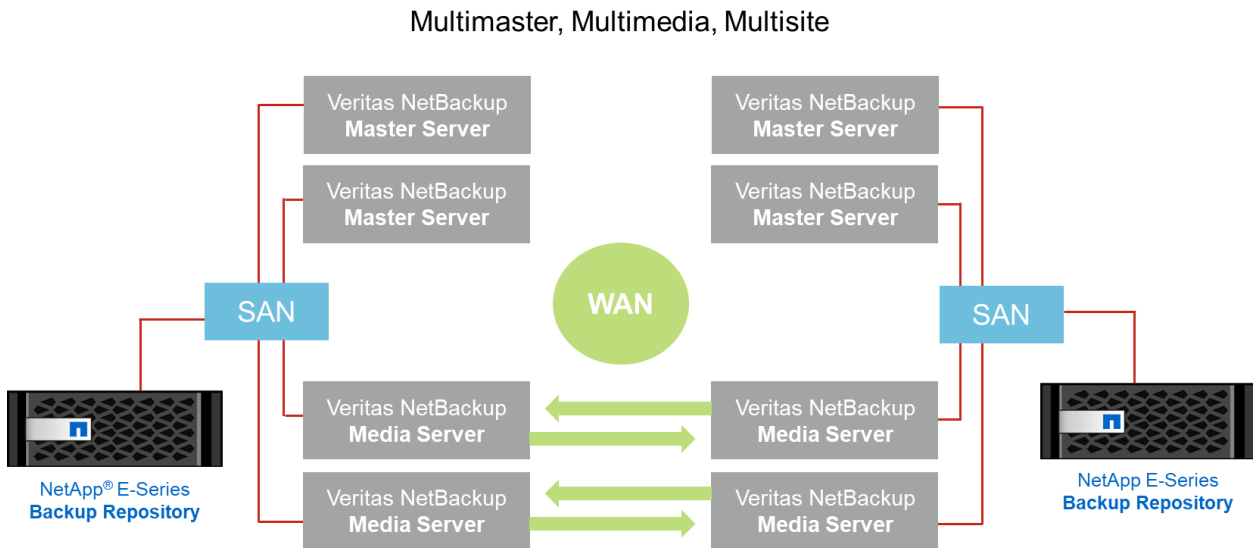
3 NetApp E-Series Hardware and Software Specifications

3.1 NetApp E-Series Hardware

The NetApp E-Series hardware portfolio contains three categories: entry-level, midrange, and all-flash storage systems.

Entry-Level E-Series Storage Systems

NetApp E-Series E2800 and EF280 Storage Systems

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

- Support for all-flash and hybrid-drive configurations; NetApp offers its entry-level, all-flash solution with the EF280

  For more information, see [TR-4685: Introduction to NetApp EF-Series EF280 All Flash Array](#) (NetApp login required).
- Modular host interface flexibility (SAS, FC, and iSCSI)
- High reliability (99.999%)
- Intuitive management: Simple administration for IT generalists and detailed drill-down for storage specialists

The new entry-level E2800 is a 12Gb SAS 3 system with NetApp SANtricity® 11.30 software. The E2800 introduces new embedded management, including the browser-based SANtricity System Manager 11.30, which features the following new capabilities:

- Embedded web services
- The easy-to-use GUI of SANtricity System Manager
- The ability to store and present up to 30 days of performance data, including I/O latency, IOPS, CPU utilization, and throughput

- The ability to perform application and workload tagging
- Easier alert management, including an embedded SNMP agent and MIB
- Embedded NetApp AutoSupport® functionality

Together, these features create an entry-level storage system with the flexibility and performance capabilities to support enterprise workloads without sacrificing simplicity or efficiency. In addition, the E2800 storage system's fully redundant I/O paths, advanced protection features, and extensive diagnostic capabilities deliver high levels of availability, data integrity, and security.

The E2812 and E2824 shelf options support one or two controller canisters, and the E2860 supports only two controller canisters. All shelves support dual power supplies and dual fan units for redundancy (the shelves have an integrated power fan canister). The shelves are sized to hold 12, 24, or 60 drives, as shown in Figure 4.

Figure 4) Hardware overview for the E2800.
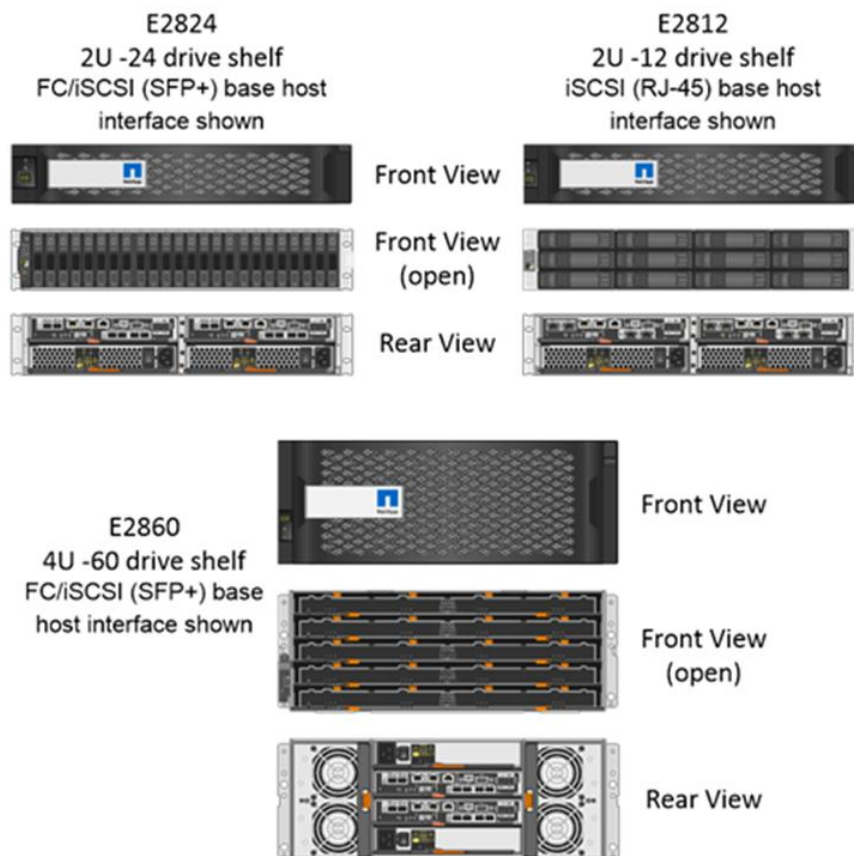
Note: For detailed information about the E2800 system, see TR-4538: Introduction to NetApp E-Series E2800.

Midrange E-Series Storage Systems

The midrange portfolio currently includes the E5700 and E5600 controller pair.

NetApp E-Series E5700 Storage System

NetApp E-Series E5700 hybrid arrays running SANtricity operating system 11.40 have a new modern look, leverage the new 12Gbps DE460C and DE224C drive shelves, support a more secure UI, and deliver significantly higher performance than their predecessor E-Series arrays.

For backup and recovery applications and other high-capacity workloads, the E5760 hybrid array dramatically increases the maximum supported capacity per array footprint from 384 drives to 480 drives, or eight total 4RU (rack unit) shelves. Currently that's up to 4.8PB of ultradense raw capacity in 32RU of rack space, or 150TB/RU, using 10TB NL-SAS drives. This storage density continues to grow every 6 to 12 months as larger-capacity drives are qualified for E-Series systems.

As a result, a strategy of purchasing multishelf systems up front with minimum initial drive counts allows you to continue to increase the footprint density of your E-Series investment over time. You can achieve greater density by adding sets of higher-capacity drives as you need them to satisfy future storage growth. You can accomplish this goal without changing the footprint or planning new power and, most importantly, without a service disruption.

In fact, growing by drive packs makes the process of growing over time extremely easy and cost effective. Simply order a new RAID group's or pool's worth of drives as a capacity building block when you need it. Then install the drives without disruption to live systems, map the new capacity to new requirements, or grow existing capacity while maintaining optimal system resiliency and performance over the life of your storage system. This approach drives down your total long-term cost and offers a low-risk and built-in grow-on-demand strategy that your organization can easily execute in quarter-driven budget cycles.

Figure 5 shows the E5760 array front and rear views. The front view shows how easy it is to open a drive drawer to install new drives.

Note: The front bezel should be installed during normal operating conditions.

Figure 5) The new E5760 hybrid storage array with the front bezel off.

E5760 front bezel

E5760 front view with drawer 5 open

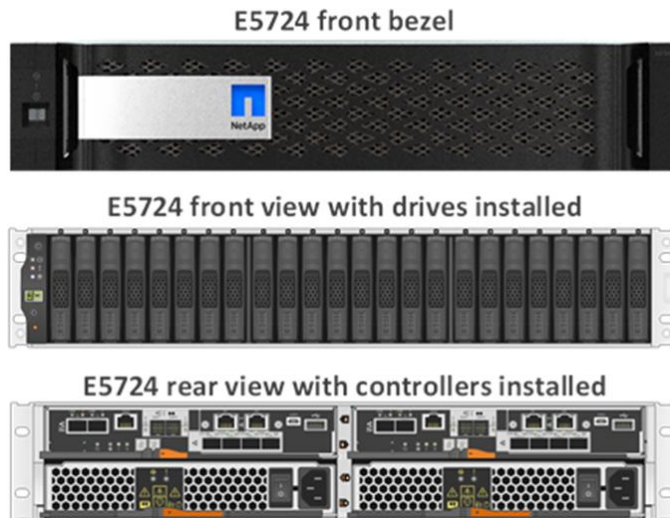**E5760 rear view with controllers installed**

For workloads that require fast storage such as Splunk and other analytics applications, high-performance databases, and specialty applications that require ultralow latency storage, E-Series E5724 hybrid arrays support up to 192 drives, with a base set of 10KRPM SAS drives for the HDD tier (see Figure 6). You can add more 10K SAS drives or up to 120 solid-state drives (SSDs) to build a fast tier in the same array. The E5724 also supports 15.3TB SSDs to build a large-capacity fast tier (~1.8 PB of fast, raw capacity). For extreme flexibility, you can add a DE460C expansion drive shelf that supports both SSDs and NL-SAS drives.

Note: The DE460C shelf does not support 15.3TB SSDs. It does support 800GB, 1.6TB, and 3.2TB SSDs.

The system can deliver consistent submillisecond latency response times for small random workloads, up to 21GBps for large sequential read workloads, and about 8GBps for large sequential write workloads.

Figure 6) The E5724 storage array with the front bezel off.

E5724 front bezel

E5724 front view with drives installed

E5724 rear view with controllers installed

Note: E5700 controllers are not offered in the 12-drive DE212C shelf. Only the E-Series E2800 controllers are offered in the 12-drive configuration (that is, E2812).

Each E5700 controller provides two Ethernet management ports for out-of-band management and has two 12Gbps (x4 lanes) wide-port SAS drive expansion ports for redundant drive expansion paths to the drives.

The E5700 controllers (Figure 7) also include two built-in host ports, either two 16Gb FC or two 10Gb iSCSI, and your choice of the following optional host interface cards (HICs):

- Four-port 12Gb SAS (mini-SAS 3 connector)
- Four-port 32Gb FC (OM4 fiber required)
- Four-port 25Gb iSCSI (OM4 fiber required)
- Two-port 100Gb InfiniBand ([IB] requires 100Gb-capable cables and host channel adapters [HCAs])

   Note: A software feature pack can be applied in the field to change the host protocol of the optical baseboard ports from FC to iSCSI or from iSCSI to FC. In addition, the IB protocol can be changed to one of three choices: iSCSI Extensions for RDMA (iSER); SCSI RDMA Protocol (SRP); or NVMe over Fabrics, which is abbreviated NVMe-oF (IB). Only one IB protocol can be active on an E5700 array.

Figure 7) The E5700 controller with ports identified.
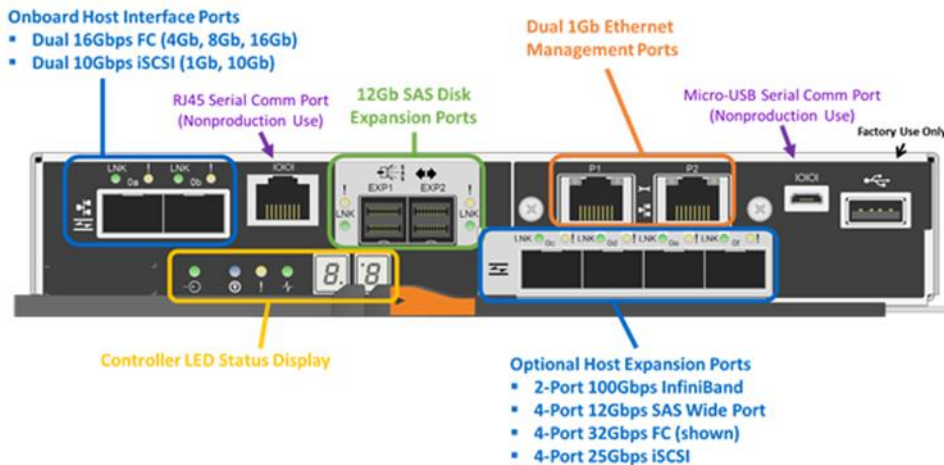
Note: For more information about the E5700 system, see TR-4627: Introduction to NetApp E5700 Arrays.

NetApp E-Series E5600 Storage System

For detailed information about the E5600 system, see TR-4544: Introduction to NetApp E-Series E5600.

All-Flash EF-Series Storage Systems

The all-flash portfolio currently includes the EF570 and EF560 controller pair.

NetApp E-Series EF570 Storage System

NetApp EF570 arrays (Figure 8) have a new modern look, leverage the new 12Gbps DE224C drive shelves, support a more secure user interface, and deliver stunning performance for both mixed random workloads and large sequential workloads in one powerful all-flash array package.

Figure 8) New NetApp EF570 all-flash array with bezel on and off.
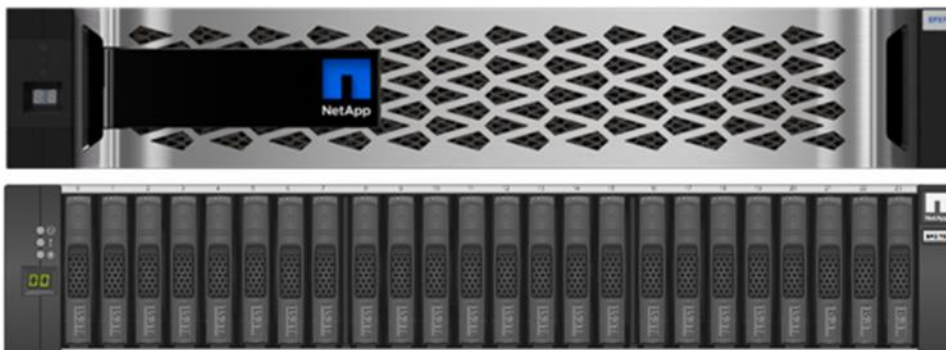
The EF570 can deliver consistent submillisecond latency response times for up to 1,000,000 4KB random read IOPS with as few as 24 SSDs. Alternatively, the same configuration can deliver up to 16GBps large sequential read throughput or about 9GBps cache mirrored large sequential write throughput. If you add an expansion drive shelf and 12 additional SSDs, the EF570 array delivers up to 21GBps throughput for large sequential read workloads and up to 12GBps for full stripe write workloads.

Note: For more information about the EF560 system, see TR-4637: Introduction to NetApp E-Series EF570 Arrays.

NetApp E-Series EF560 Storage System

Note: For detailed information about the EF560 system, see TR-4546: Introduction to NetApp EF560 Flash Array.

3.2 Key NetApp E-Series and EF-Series Features

Here are some of the important features of NetApp E-Series storage systems:

- NetApp E-Series and EF-Series systems provide highly scalable capacity and performance.
- Maximum density promotes optimal space utilization and reduced power and cooling requirements.
- NetApp Dynamic Disk Pool (DDP) technology enables dynamic rebalancing of drive count changes to easily expand storage capacity as backup needs grow while providing added data protection with faster rebuild times if a drive fails.
- You can easily integrate E-Series systems through multiple host interfaces, drive technologies, and disk shelf options for flexible deployment.
- Full disk encryption offers data security throughout the drive's lifecycle. Both native key management and KMIP-compliant external key management are supported.
- Tighter economics provide:
    - A better price per gigabyte
    - A lower TCO
    - Supportability and reliability, availability, and serviceability to minimize the cost of support calls

3.3 Enterprise Reliability and Availability

Field-proven technology protects your valuable data.

- E-Series is the right choice for peace of mind because it:
    - Leverages knowledge from one million systems
    - Is backed by a worldwide support organization
- E-Series is architected for the highest reliability and availability and includes:
    - A fully redundant I/O path with automated failover
    - Online configuration, expansion, and maintenance
    - Advanced monitoring and diagnostic features that enable fast problem resolution
    - Proactive tracking of SSD wear life and sending of alert messages
- E-Series provides enterprise data protection, including:
    - Robust disaster recovery (sync and async)
    - Local protection with high-efficiency NetApp Snapshot™ copies

3.4 SANtricity OS 11.40: New Features

E5700 and EF570 arrays are new with the NetApp SANtricity OS 11.40 release, but there are also significant software enhancements in the release that apply to all the new-generation E-Series arrays, including the E5700, EF570, and entry-level E2800 arrays. An onboard web-based GUI, SANtricity System Manager, manages these arrays.

New features in SANtricity OS 11.40 include:

- Support for directory services that use Lightweight Directory Access Protocol (LDAP)
- Support for role-based access control (RBAC): five standard roles defined with varying permission levels
- Support for certification authority (CA) and Secure Sockets Layer (SSL) certificates

- Secure CLI implementation: secure when the certificates are installed
- Added support for an external encryption key manager in addition to the legacy E-Series drive security onboard encryption key manager
- Security enhancements that extend to the onboard web services API, where user account passwords are now required

    Note: If you want to run in the previous security mode with a single administrative password and still use symbols to communicate by using the API, the new security features can be disabled by the admin user when the storage system is initially set up.

In addition to LDAP and RBAC, there are also enhancements to the most-used host multipath functionality that were released in previous SANtricity OS maintenance releases and are now part of the SANtricity OS 11.40 general availability (GA) release.

Note: For details about SANtricity OS 11.40, see TR-4627: Introduction to NetApp E5700 Arrays.

3.5 SANtricity System Manager Versus Storage Manager

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

There are two versions of the storage management software:

- SANtricity System Manager is used to manage individual E2800 storage arrays.
- SANtricity Storage Manager, with its Enterprise Management Window (EMW), provides an aggregated view of all E-Series arrays. The Array Management Window (AMW) of SANtricity Storage Manager is used to manage the E2700, E5600, EF560, and all earlier storage arrays.

When you choose to manage a storage array from the EMW, the EMW opens the appropriate software (AMW or System Manager), depending on what controller the storage array contains.

The key features of System Manager include:

- Runs on box: You don't have to install any storage management software unless you need an aggregated view or use a mirroring feature.
- Is displayed in a browser and is mobile ready.
- Has a modern look and feel, with a tile-based GUI and an easy-to-use online help system.
- Uses simplified workflows and simplified terminologies.
- Includes new functionality, such as application and workload tagging, enhanced performance data, an embedded monitor, and a graphical view of thin volume usage.
- Includes an embedded RESTful API that can be used for management.

If you have purchased an E2800-based storage array, your decisions about what components to install depend on how you answer the questions in Figure 9.

Figure 9) Decision tree to determine which management components to install.
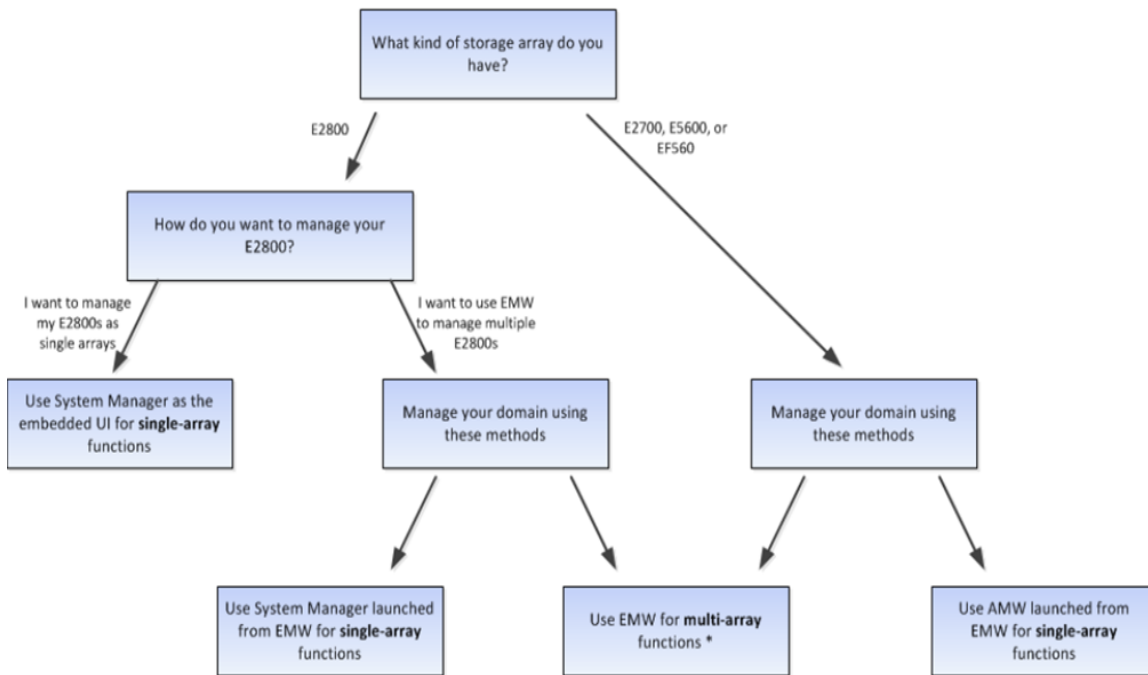
For more information about SANtricity System Manager, see section 3 of TR-4538: Introduction to NetApp E-Series E2800. For more information about Storage Manager, see section 2 of TR-4544: Introduction to NetApp E-Series E5600.

4 Veritas NetBackup 8.1

4.1 Overview

NetBackup is sometimes referred to as a three-tiered architecture, made up of master server, media server, and backup clients. Figure 10 illustrates the three-tiered nature of NetBackup.

- The first tier, the master server, manages, controls, and reports how, when, and where backups are executed. The master server is where backup policies are defined, and where and how media is administered. It serves as your one-stop shop for job reporting and logging. The master server gathers metadata and is responsible for keeping a media catalog of all backup data. It provides a single pane of glass view for NetBackup.

- The second tier, the media server, is responsible for performing the backup work. Media servers typically have more resources than the other tiers. Resources such as CPU, memory, and network/storage I/O are required to move large amounts of data from production compute nodes to backup repositories, such as the NetApp E5700 storage array. Once data is protected in a repository, a copy can be replicated to another array or public cloud provider.

- The third tier is the client tier, with the systems that contain the data you want to protect, or the source of the backup data. These can be servers of any kind; for example, bare-metal OS, virtualized, or hyper converged systems.

Figure 10) The three-tiered architecture of NetBackup.
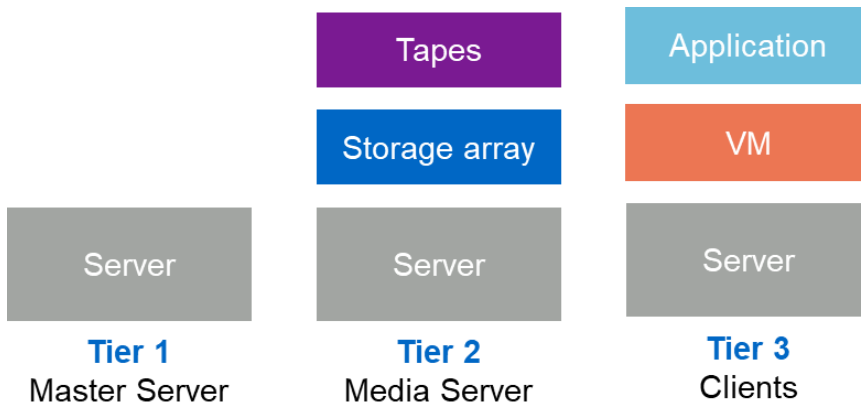
4.2 Solution Architecture

The following solution architecture components were used in the testing environment:

- One master server.
- One media server.
- Four Dell EMC PowerEdge R730 servers as VMware ESXi servers to host the VMs.
- Two Brocade G620 FC switches as Fabric A and Fabric B.
- An all-flash NetApp E-Series storage array was attached to the fabric and used as the production storage; this is where the data to be protected was located. A NetApp E5700 storage array was also attached to each fabric to use as a backup repository; this is where the protected data would reside.
- Four Dell EMC PowerEdge R730 servers attached to the fabric and to a 10Gbps TOR Ethernet switch (see Figure 11).

Figure 11) Solution architecture used in the testing environment.

Dell EMC S4048-ON

A B
Source Storage
NetApp® EF-Series
96 x 800GB SSD

Dell EMC PowerEdge R730

Compute 1
Compute 2
Compute 3
Compute 4

x4 **Fabric A**
Brocade G620

x4

x4 **Fabric B**
Brocade G620

x4

NBU Master Server
NBU Media Server

A B
Backup Target
NetApp EF-Series
60 x 8TB HDD

——— 32Gbps FC   ——— 16Gbps FC   ——— 10Gbps FC
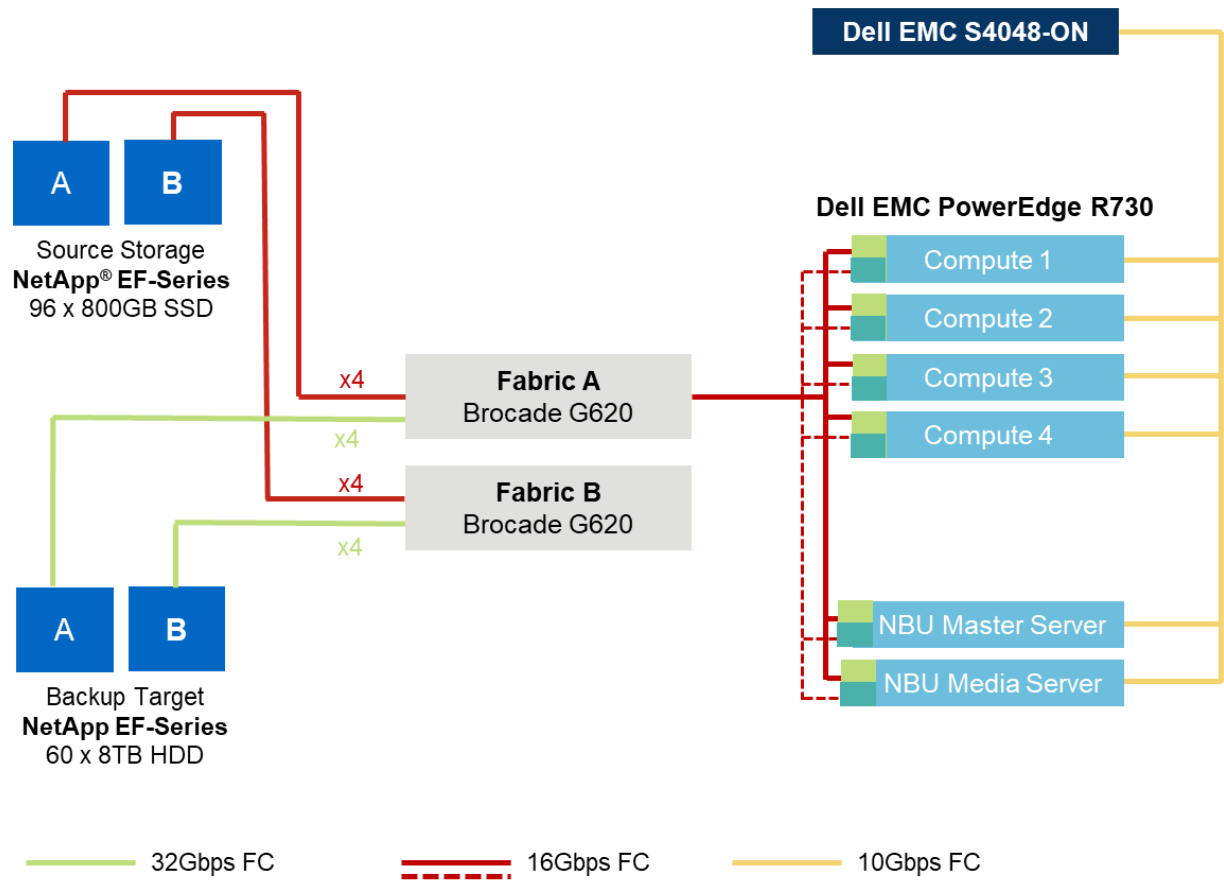
5   Veritas NetBackup 8.1 Requirements

This section describes NetBackup 8.1 requirements for the master and media servers.

5.1   Master Server

Table 1) NetBackup 8.1 requirements for a master server.

Specification	Requirement
CPU	• The NetBackup media server requires a minimum of four cores. Refer to the NetBackup 8.1 Release Notes for minimum system requirements.
Memory	• Master servers in a production environment with several database agents enabled should have a minimum of 16GB of memory. • For additional information about memory requirements, refer to the *NetBackup Backup Planning and Performance Tuning Guide* included in the documentation bundle for the appropriate NetBackup version.

Disk space	• Veritas recommends that you have a minimum available disk space of 5% in any Disk Storage Unit volume or file system.
	• For UNIX and Linux systems, master servers must have a minimum soft limit of 8,000 file descriptors per process for NetBackup to run correctly.
	• For information about the effects of an insufficient number of file descriptors, refer to the tech note on the Veritas Support website.
	• NetBackup catalogs contain information about your backups that become larger as you use the product. The disk space that the catalogs require depends primarily on the following aspects of your backup configuration:
	  – The number of files that are backed up
	  – The frequency of backups
	  – The amount of time that you set to retain the backup data

Network	• OS-compatible network adapter; 1Gbps networking required, 10Gbps recommended. • Refer to the Veritas NetBackup Network Ports Reference Guide for TCP ports specific to the NetBackup master server processes.
OS	• Veritas NetBackup 8.1 supports a wide variety of UNIX, Linux, and Windows operating systems for hosting master servers. For a complete list of compatible operating systems, refer to the Veritas NetBackup Software Compatibility List.

5.2   Media Server

Table 2) NetBackup 8.1 requirements for a media server.

Specification	Requirement
CPU	• A minimum of four cores is recommended for the NetBackup media server.
Memory	• Media servers in a production environment with several database agents enabled should have a minimum of 4GB of memory each. • For additional information about memory requirements, refer to the NetBackup Backup Planning and Performance Tuning Guide.

Disk space	• For Linux and UNIX systems, media servers must have a minimum soft limit of 8,000 file descriptors per process for NetBackup to run correctly. • For information about the effects of an insufficient number of file descriptors, refer to the [tech note](#) on the Veritas Support website.
Network	• OS-compatible network adapter; 1Gbps networking required, 10Gbps recommended. • For TCP ports specific to the NetBackup media server processes, see the [Veritas NetBackup Network Ports Reference Guide](#).
OS	• Veritas NetBackup 8.1 supports a wide variety of UNIX, Linux, and Windows operating systems for hosting the media server. For a complete list of compatible operating systems, refer to the [Veritas NetBackup Software Compatibility List](#).

6   Veritas NetBackup 8.1 Design Considerations

Veritas NetBackup offers different ways to protect your data when using VMware; you can design your backups to run over the SAN, LAN, HotAdd, or NBDSSL. This document focuses on SAN for both backup and restore.

6.1   SAN Transport: VMware vStorage APIs for Data Protection

In this mode, vStorage APIs gather inventory from a VMware vCenter server about the compute hosts, VMs, and storage, and then read Virtual Machine Disk (VMDK) data directly from the SAN. With the API there is no need for agents, because the backup processing happens on the host, not on the VM itself.

The SAN transport mode requires the VMware Backup Host to reside on a physical machine with access to FC or iSCSI SAN containing the virtual disks to be accessed. This is an efficient data path because no data needs to be transferred through the production ESX/ESXi host.

Changed Block Tracking (CBT) is a VMware vStorage API for the Data Protection (VADP) feature that allows the ESXi hosts to track blocks of data that have changed. This is useful when executing incremental backup when you want to capture only the new data blocks.

6.2   SAN Transport Considerations

Review the following SAN transport considerations:

• Make sure that the VM datastores volumes are accessible to the VMware Backup Host.

• Make sure that forward and reverse lookup on DNS is working correctly and that VM names are identical to DNS entries.

• Make sure that the volumes are online in Windows Disk Manager, but do not assign a drive letter. For more information, see section 10, NetBackup VMware VM Recovery Process.

6.3   SAN Transport Limitations

Review the following SAN transport limitations:

• You cannot take advantage of VADP in the following scenarios:
  – VMs with independent disks
  – VMs on VMWare Virtual Volumes
  – VMs on a VMWare VSAN

  Note: Consider using LAN network block device (NBD) instead.

- VMware APIs cannot perform simultaneous writes to the same datastore. For best performance, run only one restore job at a time to the same datastore.
- VMware limits the APIs in the VMware Virtual Disk Development Kit (VDDK), so the write performance during restore does not use the maximum bandwidth of the underlying hardware.

6.4 Veritas NetBackup SAN Transport Backup (VADP) Overview

Figure 12 shows the first step of the SAN transport backup. The backup host (media server) tells the hypervisor (by means of vCenter Server) to take a Snapshot copy and quiesce the VMDK of the VM to be backed up.

Figure 12) Step one of SAN transport backup.
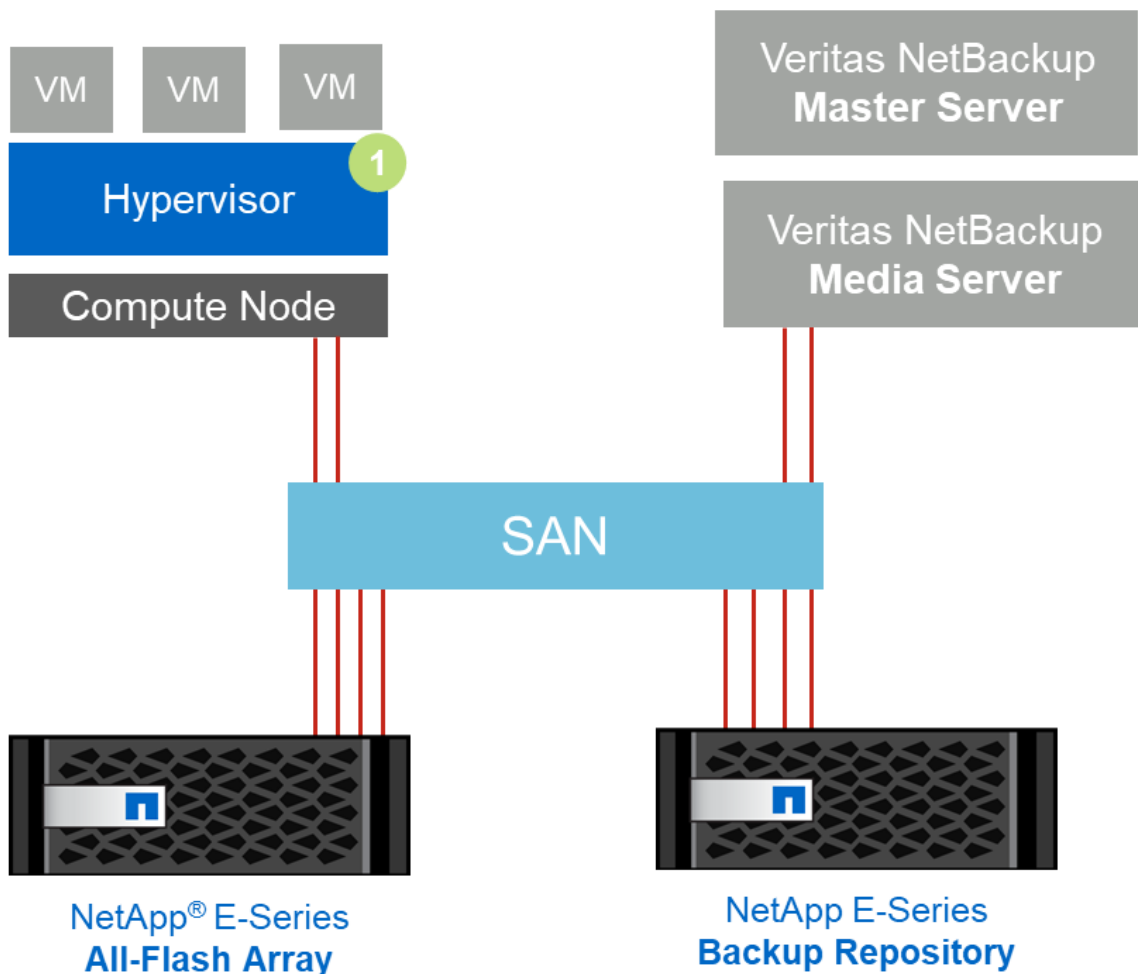
Figure 13 shows the second step of the SAN transport backup. The VMware VMDK and its underlying file system are now available; the media server can take control of the VMWare Datastore and prepare to copy the VM block by block over the SAN.

Figure 13) Step two of SAN transport backup.

Step 2: NetBackup takes ownership of the storage volume via SAN
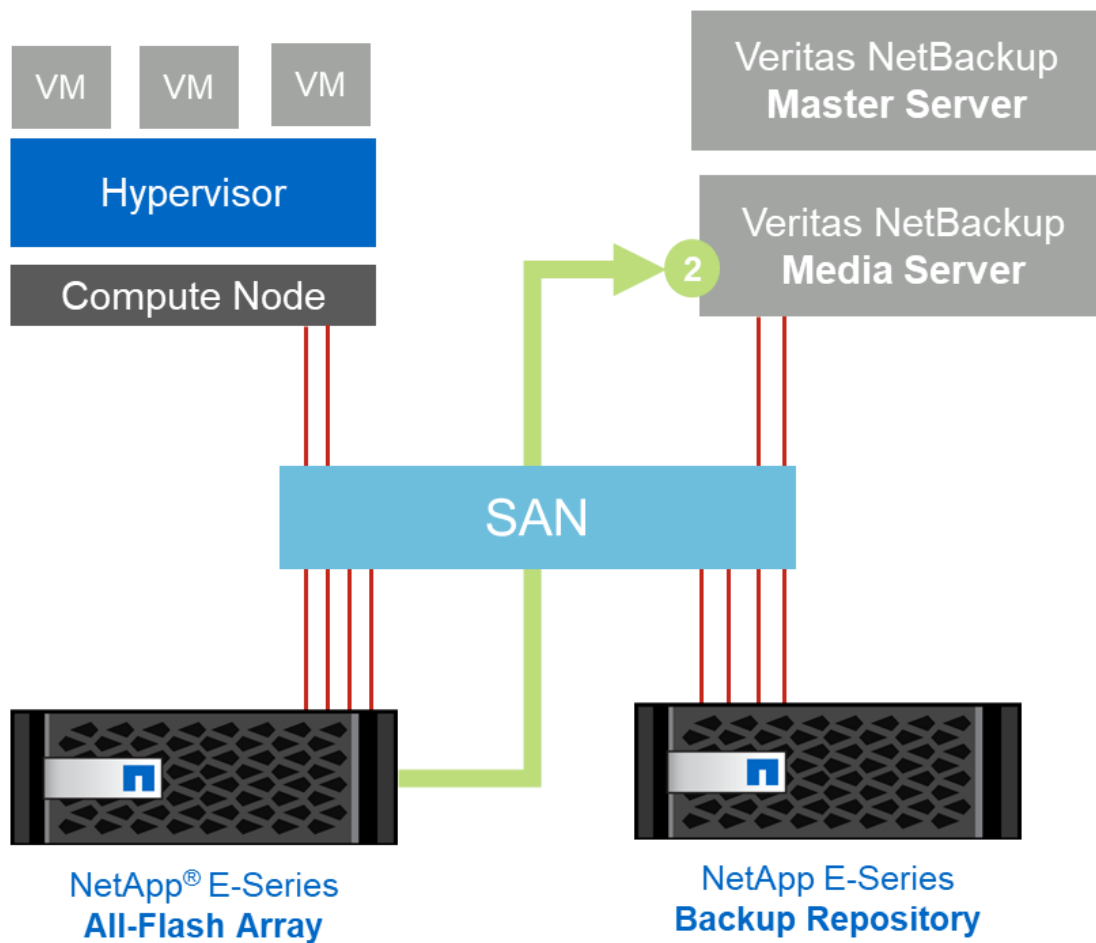
Figure 14 shows the third and final step of the SAN transport backup. The media server uses the source VMDK and the destination repository and copies the changed blocks to the backup repository. After all data has been protected, the media server releases the VMware file system and tells the hypervisor to roll up the Snapshot copy and return the VM to its initial state.

Figure 14) Step three of SAN transport backup.
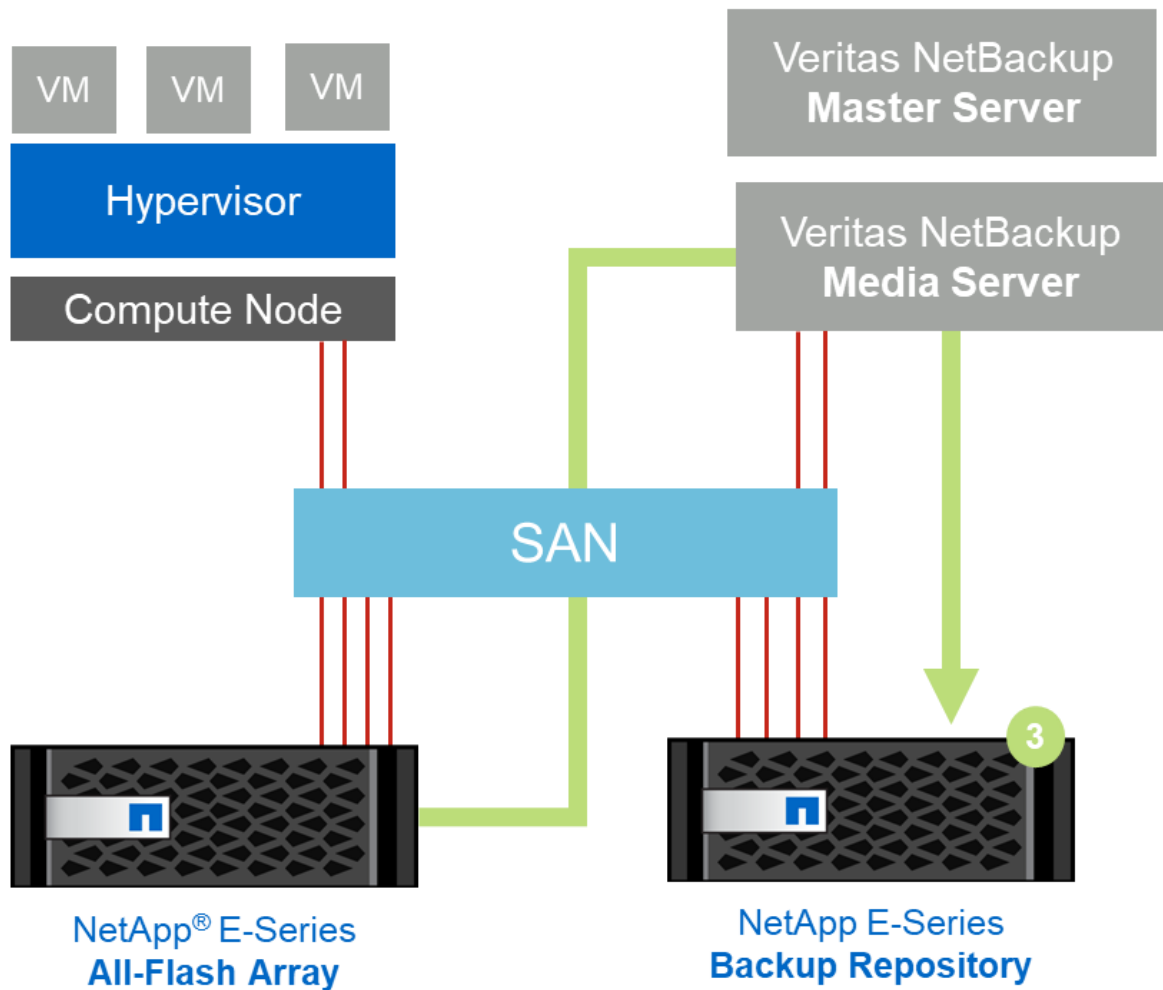
6.5 Data Restoration with Veritas NetBackup 8.1

Data restoration works similarly to the backup process. The backup server instructs VMware vCenter to create a shell VM with the specifications from the original backup on a host, including VM disks. The backup host then takes ownership of the VM datastore and writes the blocks to the VMDK files, recreating the data. When the process is complete, the backup host gives ownership back to VMware vCenter.

7   NetApp E-Series Volume Configuration Guidelines

7.1   NetApp E-Series Storage Configuration Guidelines for Veritas NetBackup 8.1 Backup Repositories

NetApp recommends not using thin volumes while setting up NetApp E-Series with NetBackup.

For optimal performance, follow these guidelines:

- Use RAID 6 (8+2) volume groups.
- Create multiple volume groups, having an even number when possible to achieve balance between owning controllers. Be sure to use Drawer Loss Protection (DLP) to reduce the risk of data unavailability and/or data loss.
- Do not use hot spares.
- Create a single volume (not thin) per volume group.
  - NetApp recommends using fewer volumes when working with HDDs to achieve better performance. The performance difference with SSD drives is not significant if more volumes are used.
- Run multiple backup jobs to each repository.

For a large configuration, follow these guidelines:

- Use NetApp Dynamic Disk Pool technology for maximum ease of use and fast rebuild times.
- Create multiple DDPs, having an even number when possible to achieve balance between owning controllers. Use DLP to reduce the risk of data unavailability and/or data loss.
- Make sure that the size of DDPs is 30 to 60 drives (recommended).
- Create even volumes (not thin) per DDP.
  - NetApp recommends using fewer volumes when working with HDDs for better performance. The performance difference with SSD drives is not significant if more volumes are used.
  - For example, if you have three DDPs, NetApp recommends having two volumes per pool. With four DDPs, you could have a single volume per pool or an even number of volumes per pool.

  Note: When creating the volumes with DDPs, the default segment size is 128KB. No additional selection is required.
- Run multiple backup jobs to each repository.

8   NetApp E-Series Host Configuration Guidelines

8.1   Host Connectivity

NetApp E-Series arrays offer multiple options for connectivity: 12Gb SAS, 16Gb FC, 10Gb Ethernet (available as optical or copper), and 40Gb or 56Gb InfiniBand in higher models. Your optimal design is based on your existing environment and how the data flows from primary storage through the Veeam server to its destination on the E-Series array. One design approach is to leverage 12Gb SAS for connectivity from the NetBackup media server to the E-Series array. This approach provides the target backup repository (E-Series) to NetBackup as a direct connection. Having a direct connection to the E-Series array prevents having to write the backup file across an existing network.

This configuration might not be ideal for larger environments in which Veeam's distributed architecture is implemented and in which multiple proxy servers process backup data. Having a dedicated network for backup targets might make more sense in those cases. Either way, the options are there for any environment, and Veeam provides a bottleneck detector to help optimize the backup data flow as you progress through your implementation.

In the case of shared storage, when possible:

- Use two separate fabrics (FC or iSCSI).
- Use redundant connectivity and multipathing policies that allow optimized connectivity of all paths (for example, VMware round robin).
- Use the highest-speed adaptors available.

8.2   NetApp E-Series Storage Host Mapping Configuration

Using NetApp SANtricity, NetApp created host mapping from the NetBackup servers to target volumes on the E5700, as shown in Figure 15. These mappings were created to allow the NetBackup media servers to have SAN-attached storage for use in testing. The SANtricity Plug-In also optimizes multipathing for each host to allow the fastest possible access to each volume.
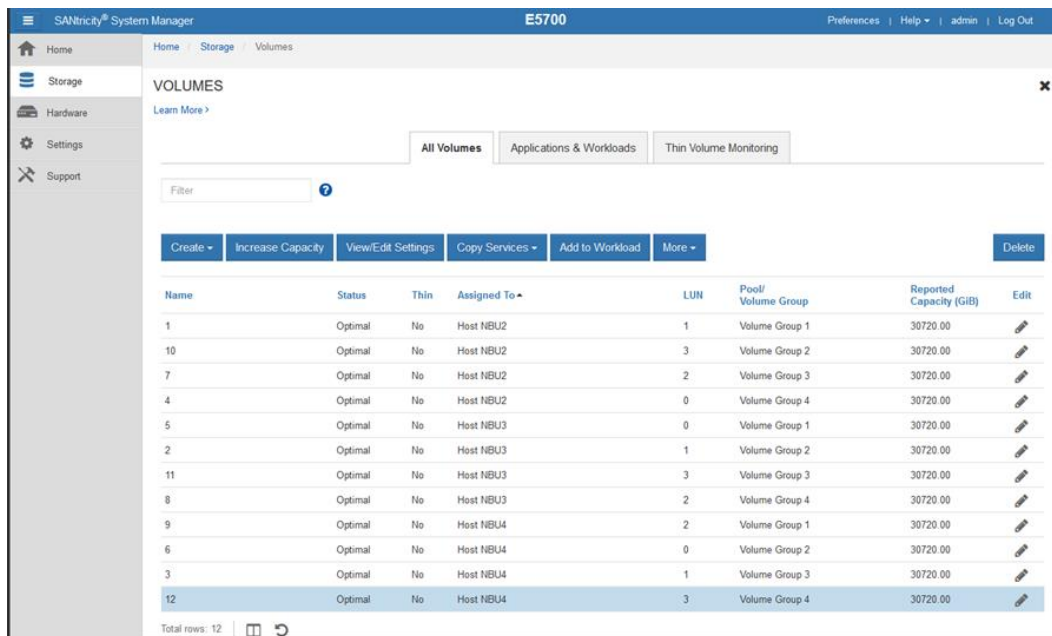
NetBackup Advanced Disk and NetBackup Pure Disk

NetBackup Advanced Disk combines disk resources together as a single pool, simplifying management and optimizing performance rather than having to make storage units from single disks. Advanced Disk allows you to create storage units containing many disk volumes from a pool of disks. Advanced Disk does not allow you to use inline deduplication and compression, and it is not ideal for replication because of how it uses groups of disks instead of individual mount points or spindles.

Like Advanced Disk, NetBackup Pure Disk allows you to make storage units, but it also offers inline deduplication, compression, and replication. Pure Disk has a slower transfer rate because of how it performs deduplication and compression inline. It uses single disks or single-disk mappings, so you cannot combine disk resources to improve performance, as you can with Advanced Disk. If SAN transfer rates are not acceptable, Veritas recommends postprocess deduplication on Advanced Disk in off hours.

During testing, NetApp configured the E-Series backup repository with four volume groups, created four volumes—one per volume group—and mapped these four volumes to a single media server. We created a NetBackup Advanced Disk pool with the four volumes and ran backups. We repeated testing with Pure Disk to perform deduplication and compression testing. Because Pure Disk can use only one mapping per server, we mapped a single volume per media server.

Figure 15) Host mapping to target volumes.

For the VMware compute storage, we set up four ESXi host mappings to two volumes on the all-flash production environment (E5600). Additionally, for NetBackup SAN transport to work, each of the NetBackup master and media servers had to be mapped to each of the compute storage volumes, as shown in Figure 16.

Figure 16) Mapping to the compute storage volumes.
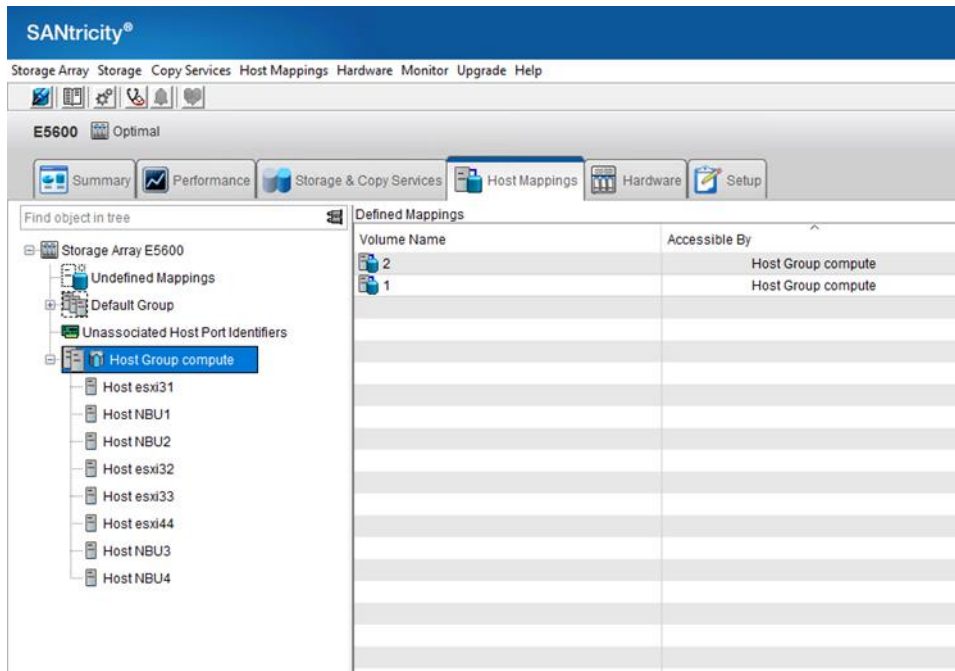
9 Performance with Veritas and NetApp E-Series

9.1 Test Environment and Setup

We tested several scenarios. A single media server was used for regular backups and three media servers were used for deduplication and compression. Testing consisted of the following scenarios:

- Veritas deduplication and compression disabled:
    - 4 ESXi hosts; 1 NetBackup media server (RAID 6), Veritas deduplication and compression disabled
    - 4 ESXi hosts; 1 NetBackup media server DDP, Veritas deduplication and compression disabled
- Veritas deduplication and compression enabled:
    - 4 ESXi hosts; 3 NetBackup media servers (RAID 6), Veritas deduplication and compression enabled
    - 4 ESXi hosts; 3 NetBackup media servers DDP, Veritas deduplication and compression enabled
- Restore scenario for a functional validation

9.2 Volume Configuration for Performance Testing

During testing, NetApp discovered that the more pools that were available to the server, the better the backup performance. For example, 1 DDP of 44 disks performed considerably slower than 4 pools of 11 disks. DDP requires a minimum of 11 disks per pool. Therefore, to use all available disks, we created 4 pools. To keep results comparable, we did the same scenario for RAID 6, although RAID 6 does not have an 11-disk requirement per RAID 6 volume group.

In addition:

- Only one volume per pool or volume group was created.
- Pools and volume groups were created in even numbers to balance across both controllers.

9.3   Backup Performance Results

The following observations were noted during testing:

- The I/O load was evenly distributed across all disks and paths.
- There were no noticeable bottlenecks at the master or media servers.
- CPU resources were used during deduplication and compression testing. This scenario did not become critical—in most cases, the CPU resources were at 50% utilization.

Performance Results with E5700

Figure 17 shows the processing speeds achieved when a NetApp E5700 array is used for backup repositories with Veritas NetBackup.

- Figure 17 shows the speeds for RAID 6 and DDPs with compression and deduplication enabled and disabled.
- During testing, a slight performance increase was observed when RAID 6 was used.
- The deduplication and compression rates were approximately 75%.
- When compression and deduplication were enabled, the processing speeds achieved were lower than when disabled. This is the result of the mix of random read and write I/Os versus 100% sequential writes of the noncompressed and nondeduplicated data.

    Note: This result could be improved by adding an SSD tier to the E5700 or SSD DAS to the media servers and relocating the deduplication.

- During testing, it was important to purge the duplication database when rerunning tests; otherwise, we achieved near a 100% deduplication ratio.

Figure 17) Processing speeds achieved when NetApp E5700 is used for backup repositories with Veritas NetBackup.
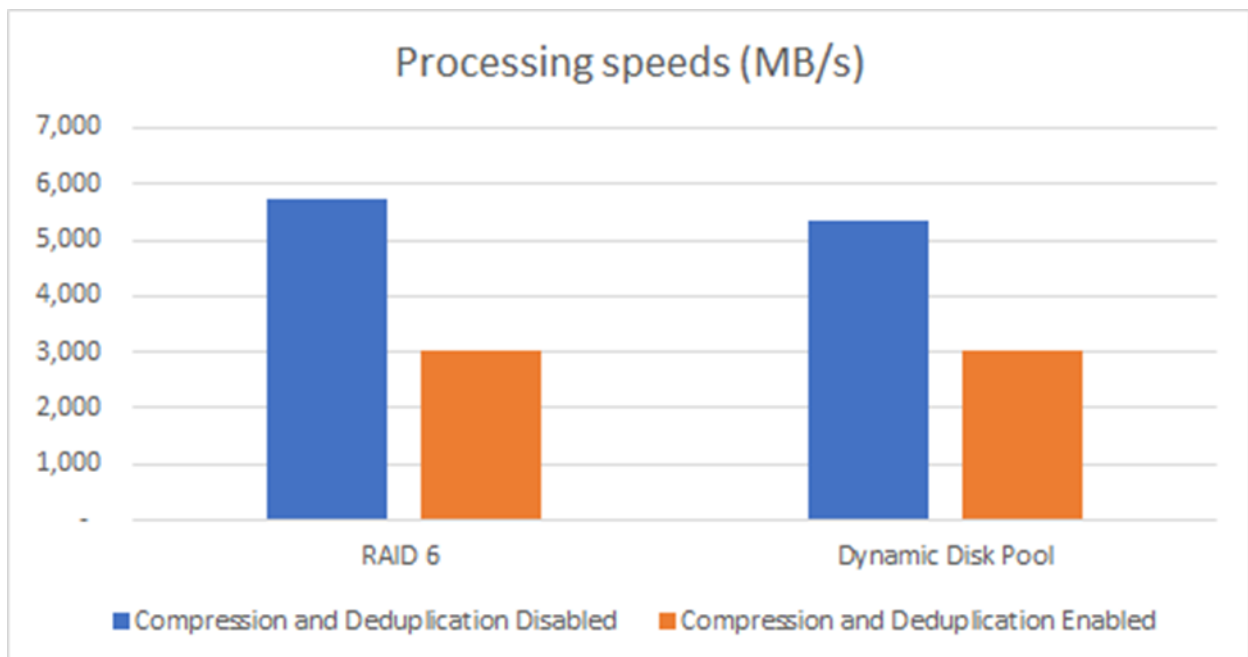
9.4 Throughput Sizing for Veritas and NetApp E-Series

With a NetBackup master server, a NetBackup media server, and a NetApp E5700 backup appliance, a sustained throughput was achieved of 5.7GBps, or 20.5TB per hour, with no compression or deduplication.

For example, assume that the rate of change for data is 20% with a backup window of 8 hours.

NetApp estimates that the E5700 can protect as much as 164TB of data (20.5TB x 8 hours) for full backups and 820TB of data ([20.5TB x 8 hours] /.20) of incremental backups and still fit into this window.

9.5 Performance Best Practices

Based on the test results, NetApp recommends the best practices described in this section for the performance, backup, and restore scenarios.

Implement the following best practices:

- **Make sure that DNS is working.** Make sure that forward and reverse DNS zones are working and that all components are registered, including master and media servers, ESXi servers, VMware vCenter, and all clients. Name resolution issues are common and sometimes difficult to diagnose.
- **Set up the E-series backup repository:**
  - **Number of disks.** When creating NetApp Dynamic Disk Pool pools or volume groups, consider the best practices recommended in NetApp E-Series Volume Configuration Guidelines.
  - **Benchmarking.** Consider benchmarking your NetApp E-Series backup target before you run backups. Because spinning disk storage arrays are typically disk bound, your performance will vary depending on RAID type and number of disks. In our testing, we used tools such as IOmeter and VDBench on a single SAN-attached media server, on a sample volume. Using a block size of 2048k + sequential writes gave us a good idea how much I/O we could expect when running NetBackup.

    For example, configure the VDBench parameter file for a single backup repository.

```
******************************begin****************************
sd=default    *,size=64m          * ,threads=1
sd=sd1,host=localhost,lun=z:\test.file
wd=wd1,sd=sd*,readpct=0,seek=sequential,openflags=directio
rd=rd1,wd=wd1,elapsed=3600,interval=10,iorate=max,forthreads=(16),forXferSize=(2048K)
************************** end ***************************
```

  - **Monitor the backup target.** Monitor the array though the SANtricity Performance Monitor. Ideal latency numbers should be below 10ms.
- **Implement Veritas NetBackup best practices:**
  - **Experiment with maximum jobs settings.** When creating a storage unit for media servers in NetBackup, be sure to experiment with the Maximum Concurrent Jobs setting. During testing, NetApp set this value to 16, as shown in Figure 18. If this setting is too high, performance can sometimes be erratic—the throughput numbers were initially high but declined over time.

Figure 18) Changing the maximum concurrent jobs setting.

- – **Set limits.** If performance is less than desirable, consider setting limits on infrastructure components, as shown in Figure 19. For example, during testing, we found that the maximum number of jobs per VMware vCenter should be limited to 24. This value depends entirely on the environment. Increasing resources to the VMware vCenter helps alleviate potential bottlenecks in backup performance.

Figure 19) Setting limits on resources.
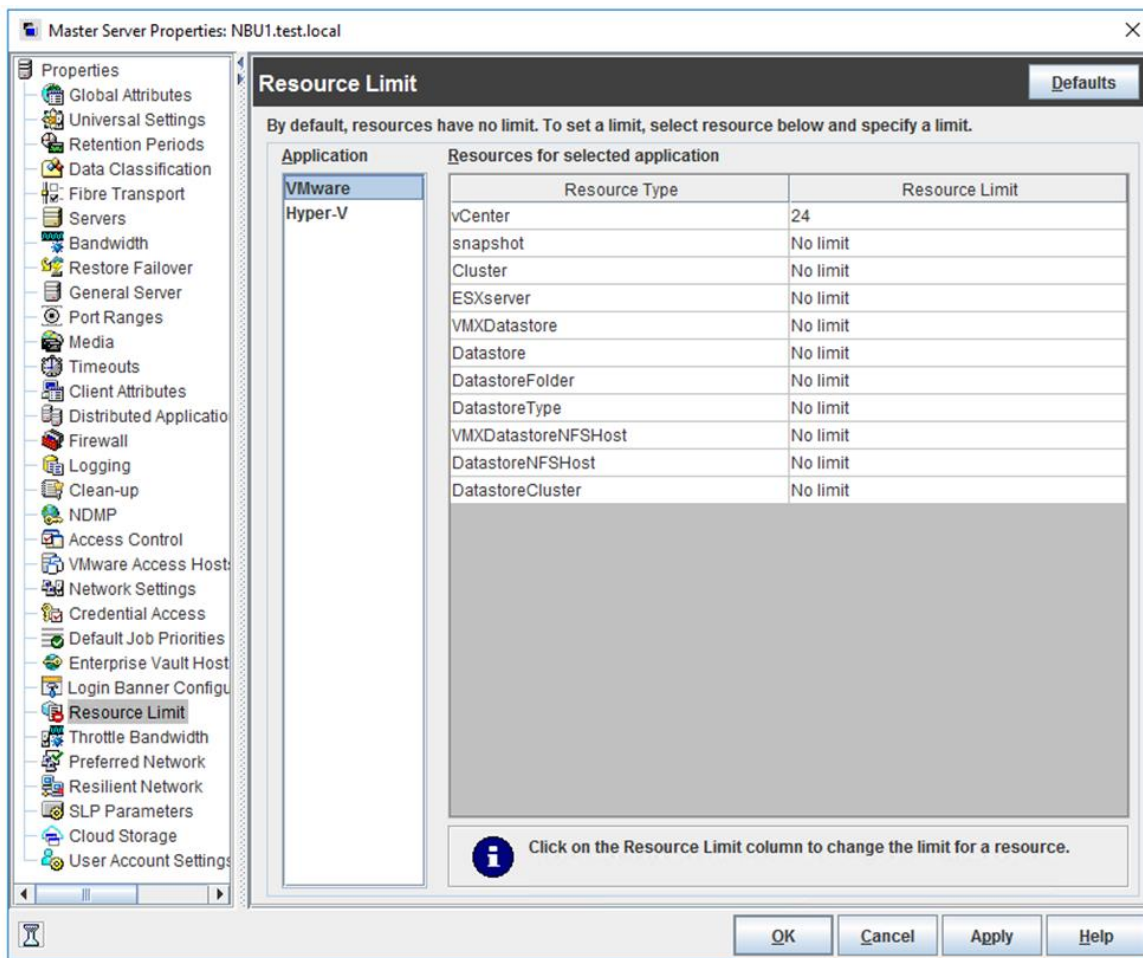
- **Change data buffer size.** Change the data buffer size, as shown in Figure 20. During testing, there was a noteworthy boost to storage throughput when the `SIZE_DATA_BUFFERS` setting for each NetBackup master and media server was changed.

  To change this setting on all master servers, follow these steps:

  a. Browse to `<NetBackup install dir>\db\config`.

  b. Create a file named `SIZE_DATA_BUFFERS` using a text editor such as Notepad.

  c. Open the file and enter `2097152`.

  d. Save and close the file. Make sure that the file name does not have an extension (for example, `.txt`).

Figure 20) Changing the buffer size.
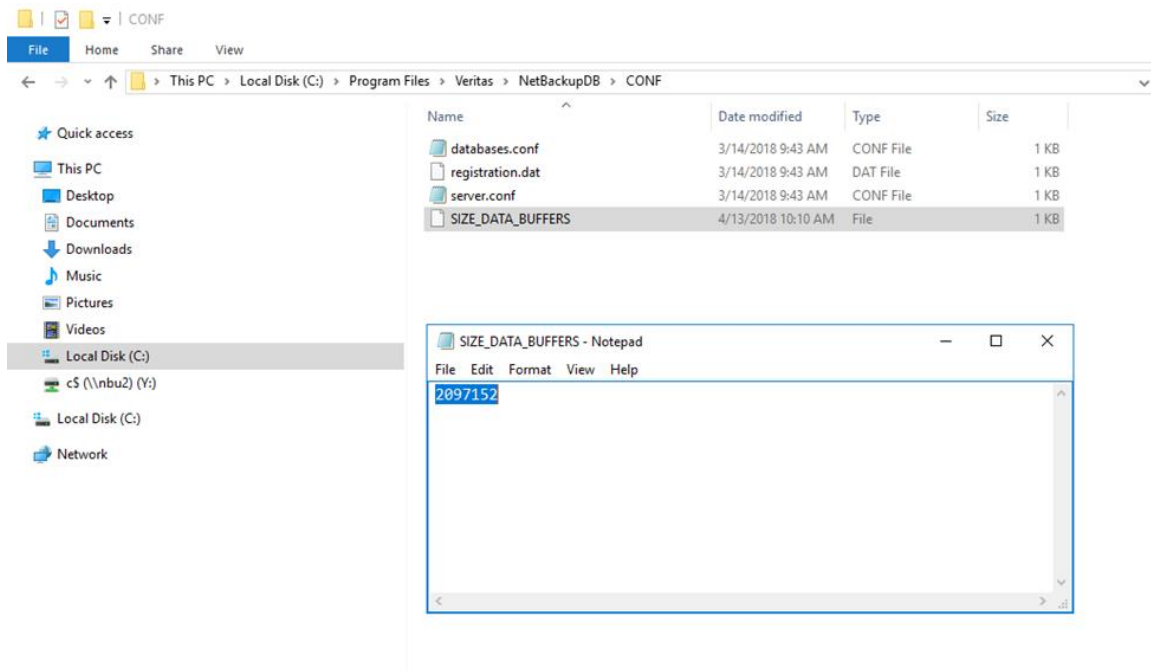
Note: Although the `<NetBackup install dir>\db\config` directory exists on the NetBackup master server, it does not exist on the media servers. Therefore, it is necessary to create the directory first and then create the `SIZE_DATA_BUFFERS` file, as was done for the master server. The `2097152` value was used—a reboot was not necessary.

10 NetBackup VMware VM Recovery Process

This section demonstrates how to recover a lost or corrupted VM from the backup repository, recovering over the SAN transport. Before you begin, make sure that the Windows master and media servers have access to the compute storage. These storage mappings should be online. However, do not format or assign Microsoft Windows drive letters—doing so could result in data loss, as shown in Figure 21.

Figure 21) Do not format or assign Microsoft Windows drive letters.
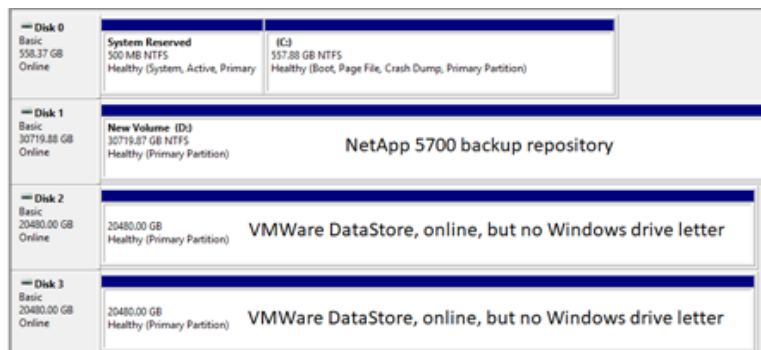
To recover a lost or corrupted VM from the backup repository, follow these steps:

1. Open the NBU admin console and log in using the appropriate credentials.

2. Select Backup, Archive, and Restore and then click the icon in the upper-right corner of the screen.
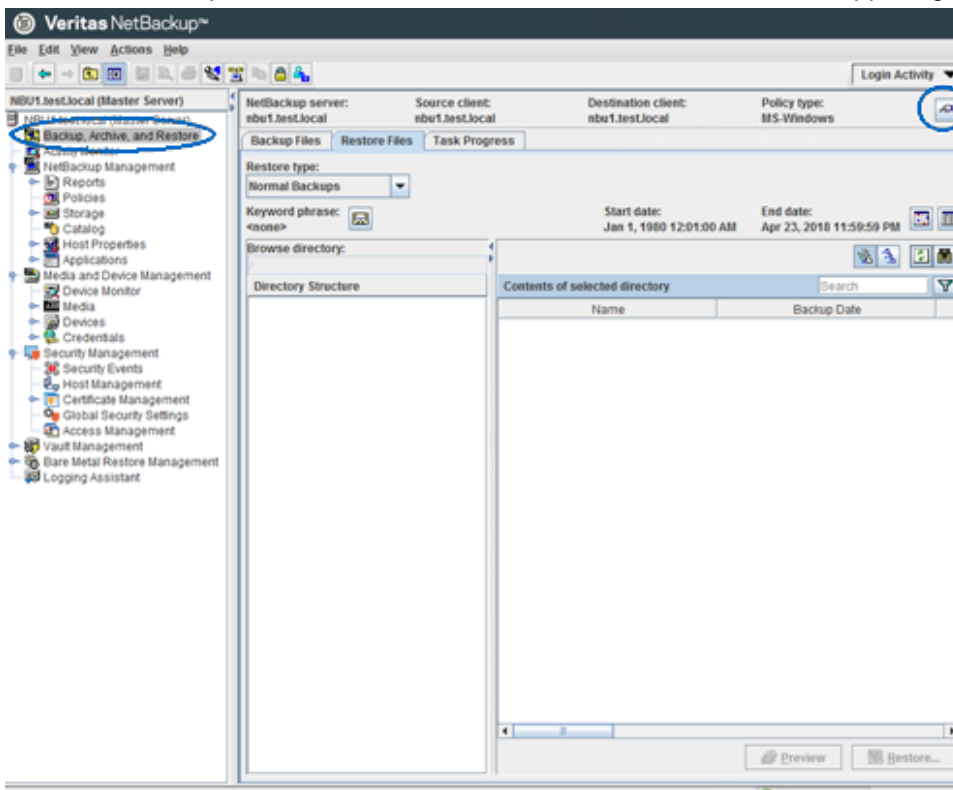
3. Click Edit Client List and select the VM to restore.

   Note: Make sure that the policy type is VMware.

4. Select the backup image and then click Restore in the lower-right corner.

5. Select where to place the restored VM. You can select the original host and storage or specify an alternate location.

6. Review the configurations on the page and click Next.

   Note: Make sure that the SAN transport is highest on the list.

7. Select Restore BIOUS UUID, Restore Instance UUID, and Overwrite Existing Virtual Machine. Click Next.

8. Click Run Prerecovery Check.

9. Click Start Recovery.
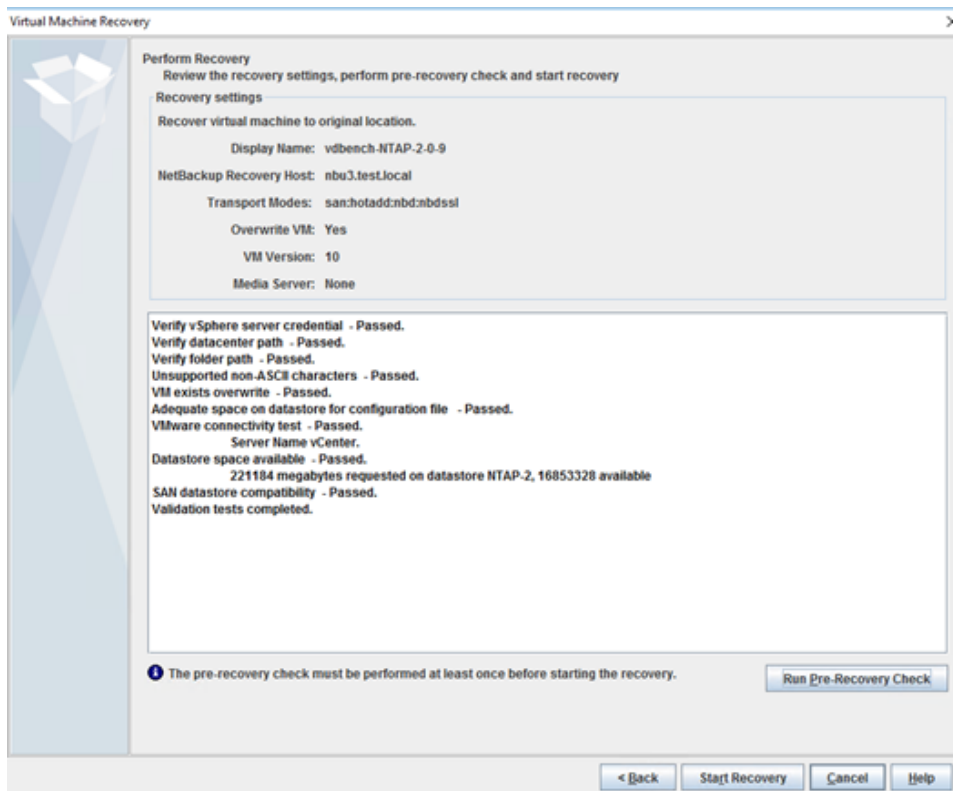
10. Review the restore log to make sure that the VM has been fully recovered. In the sample test, the VM recovery throughput was logged at 233,755KBps.

11 NetApp SANtricity Plug-In for VMware vCenter

The NetApp SANtricity Plug-In for VMware vCenter is a VMware vCenter Server plug-in that provides integrated management of E-Series storage arrays and EF-Series flash arrays from within a VMware vSphere Web Client. The VMware vSphere Web Client is a single management interface that you can use to manage the VMware infrastructure and all your day-to-day storage tasks.

The plug-in enables you to perform the following tasks:

*   Configure ESXi hosts to NetApp SANtricity E-Series storage arrays and EF-Series flash arrays.
*   Provision new and existing storage array volumes.
*   Map storage array volumes to ESXi hosts and host groups.
*   Manage synchronous and asynchronous mirroring and storage-array Snapshot copies.
*   View vCenter datastores that are on E-Series and EF-Series storage volumes.

For the latest download and details, visit the NetApp Support website.

12 Conclusion

For businesses of all sizes looking to protect their important data, NetApp E-Series storage arrays and Veritas NetBackup software combine to deliver a comprehensive data protection solution. NetApp E-Series arrays and Veritas NetBackup deliver fast performance that makes backup and restore tasks quick and easy while helping businesses to maximize data availability and reliability.

Where to Find Additional Information

To learn more about the information described in this document, refer to the following documents and/or websites:

NetApp Documentation
- NetApp E-Series Systems Documentation Center
  https://mysupport.netapp.com/info/web/ECMP1658252.html
- All other NetApp product documentation
  http://docs.netapp.com

Veritas NetBackup 8.1 Software Documentation
- Veritas NetBackup 8.1 software documentation
  https://www.veritas.com/support/en_US/article.100040277

Version History

Version	Date	Document Version History
Version 1.0	July 2018	Initial release.

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