Symantec NetBackup™ for VMware Administrator's Guide

Release 7.6

Symantec NetBackup™ for VMware Guide

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Contents

Introduction

This chapter includes the following topics:

About NetBackup for VMware

NetBackup for VMware provides backup and restore of the VMware virtual machines that run on VMware ESX servers. NetBackup for VMware takes advantage of VMware vStorage APIs for data protection. The backup process is off-loaded from the ESX server to a VMware backup host.

NetBackup for VMware does the following:

- Performs off-host backup of virtual machines (NetBackup client software is not required on the virtual machine). Off-host backup reduces the backup processing load on the VMware host.

- Increases the backup speed as compared to standard file-order backup methods, if the virtual machine is heavily populated with small files.

- Automatically creates quiesced snapshots using VSS (Windows only). Creates the quiesced snapshots on Linux if the SYMCquiesce utility is installed.

- Uses snapshot technology to keep virtual machines 100% available to users.

- Supports VMware vSphere and vCloud Director.

- Performs full backups and incremental backups, including block-level incrementals.

- Backs up the full virtual machine.

- Backs up the virtual machines even when they are turned off.

- Can restore selected files from the backup.

New features for VMware in NetBackup 7.6

NetBackup 7.6 for VMware adds the following new features:

- NetBackup can back up VMware vCloud environments and restore virtual machines back into vCloud.
  See "About NetBackup for vCloud Director" on page 191.

- Performs Instant Recovery of virtual machines. NetBackup starts the virtual machine directly from the backup image and makes it accessible to users on the ESX host immediately.
  See "About Instant Recovery for VMware" on page 166.

- Supports the Accelerator for virtual machine backup.
  See "About the NetBackup Accelerator for virtual machines" on page 130.

- Adds an option to restart jobs individually in the Activity Monitor: Right-click on the job and select **Restart Job**.

- Supports the Replication Director for protecting VMware virtual machines in a snapshot and replication environment.
  For more information, see the *NetBackup Replication Director Solutions Guide*.

- Supports vSphere 5.1.

- Adds a simplified command for restoring virtual machines (nbrestorevm).

See
See
See also the *NetBackup Commands Reference Guide*.

- For automatic selection of virtual machines in the policy, discovery performance has improved: It places much less load on the vCenter than in previous releases.

- In vSphere Client, you can monitor the status of virtual machine backups and restore virtual machines, by means of the NetBackup plug-in for vCenter.
  For more information, see the *NetBackup Plug-in for VMware vCenter Guide*.

Upgrade guidelines for the VMware policy type

Note these guidelines for upgrading to the 7.6 VMware policy type:

- To use the VMware policy type, all master servers, media servers, and clients must be upgraded to 7.6.

- Do not convert any FlashBackup-Windows policies until you have verified that the current policies work correctly with 7.6.

  FlashBackup-Windows policies can be converted in either of the following ways:

  - Use the NetBackup Administration Console to change the policy type to VMware.

  - Use the nbplupgrade command to convert policies in a batch. For details, see nbplupgrade in the *NetBackup Commands Reference Guide*.

VCB no longer supported

For NetBackup 7.6 environments (master server, media server, and backup host all at 7.6 or later), VCB backups and restores are not supported.

VCB backups are supported only when the backup host (NetBackup client) is 7.1 or earlier. For VCB-based backups with 7.1 or earlier backup hosts, you can use the FlashBackup-Windows policy type as described in the *NetBackup for VMware Administrator's Guide*, version 7.1 or 7.0.

VCB restores are supported for 7.5 clients.

File-level backup of Windows virtual machines

NetBackup 7.6 backs up the entire VMware virtual machine as virtual disk files. The backup includes all data files as well as operating system files and VMware virtual disk files. From the backup, you can recover the guest OS and the entire virtual machine. Depending on the type of backup and the guest OS file system type, you can also recover individual files from the same backup.

NetBackup 7.6 environments (master server, media server, and backup host all at 7.6 or later) do not support file-level backup of Windows virtual machines. Windows file-level backup of a VMware virtual machine requires VCB. VCB is supported only for 7.1 and earlier backup hosts (clients).

About the virtual machine backups that include database data

When NetBackup backs up a VMware virtual machine, database data in the virtual machine is backed up with the rest of the virtual machine. NetBackup allows the recovery of individual database files from the backup. This feature supports Microsoft Exchange Server, SQL Server, and SharePoint Server.

Note the following:

- To enable restore of individual database files, a NetBackup Windows client must be installed in the virtual machine during the backup.

- NetBackup uses Windows Volume Shadow Copy Service (VSS) to quiesce the database before it creates a snapshot of the virtual machine.

- A full backup is performed of the database data with each backup job, even if the policy schedule is incremental.

See "Application protection options (VMware)" on page 61.

About the NetBackup appliance as a VMware backup host

The NetBackup appliance can back up virtual machines without a separate Windows system as backup host.

Note: You must use the VMware policy type. The FlashBackup-Windows policy type is not supported with the appliance as backup host. To use the FlashBackup-Windows policy type, you need a separate Windows host that is configured as the backup host (proxy). Any reference in this guide to the FlashBackup-Windows policy assumes the use of a Windows backup host.

To convert policies to the VMware type, you can use the `nbplupgrade` command. For details, see the *NetBackup Commands Reference Guide*.

The following topics contain notes on the appliance as the backup host:

- For an overview of the appliance as backup host in a virtual environment:
  See "Appliance as backup host: component overview" on page 22.

- For configuration tasks:
  See "Overview of VMware tasks" on page 29.
  See "Overview of NetBackup tasks" on page 30.

- For a list of requirements and limitations:
  See "Notes on the NetBackup appliance as a VMware backup host" on page 37.

- For log files:
  See "NetBackup logging for VMware" on page 210.

NetBackup for VMware components

Table 1-1 describes the components that NetBackup for VMware uses.

Table 1-1   Components of NetBackup for VMware

Component	Description
Backup host	NetBackup for VMware uses a special host that is called a VMware backup host (formerly called the VMware backup proxy server). The backup host is a NetBackup client that performs backups on behalf of the virtual machines. The backup host must have access to the datastores of the virtual machines.
	The backup host is the only host on which NetBackup client software is installed. No NetBackup client software is required on the VMware virtual machines.
	Note that the backup host is referred to as the recovery host when it performs a restore.
	The backup host can be configured in either of the following ways:
	■ As a NetBackup client (Windows or Linux) with a connection to separate master and media servers. The master servers and media servers can be Windows, UNIX, or Linux.
	■ Or, the NetBackup client and master and media server can all reside on the backup host (Windows or Linux).
	See the following tech note on supported platforms for the backup host:
	http://www.symantec.com/docs/TECH127089
Discovery host	Used for the automatic selection of virtual machines for backup. This host discovers virtual machines and filters them by means of the selection rules in the policy Query Builder. The resulting list determines which virtual machines are backed up.
	The discovery host can be on any platform that NetBackup supports for master or media servers. It can also be the same host as the backup host.
	You specify this host on the policy **Clients** tab: Click **Select automatically through query**, then **NetBackup host to perform automatic virtual machine selection**.
Backup media server	A media server that can operate as the backup host.
	See "Media servers as backup or discovery hosts" on page 23.
NetBackup client	Installed on the backup host.
NetBackup master server	Manages the backups of virtual machines, by means of the NetBackup client that is installed on the backup host.
NetBackup media server	Performs the backups to storage on behalf of the NetBackup client.
Virtual machine	Virtual machines provide complete guest operating systems on virtualized hardware. In a NetBackup policy, a virtual machine is configured as a NetBackup client, even though NetBackup client software is not installed on the virtual machine.
ESX server	The VMware ESX server presents a virtualized hardware environment to multiple virtual machines; each virtual machine runs an independent operating system. Users can run applications in the virtualized OS as if the OS was installed in its own physical computer.

Table 1-1   Components of NetBackup for VMware *(continued)*

Component	Description
vCenter Server	The VMware vCenter Server (or VirtualCenter server) coordinates multiple ESX servers and workloads. It can migrate virtual machines from one ESX server to another. It also provides the ability to back up the virtual machines that are turned off.
	The vCenter Server is optional in the NetBackup for VMware environment.

Figure 1-1 shows a NetBackup for VMware environment on a local network. The backup host accesses the VMware datastore through the ESX servers.

Figure 1-1   NetBackup for VMware: components on local network
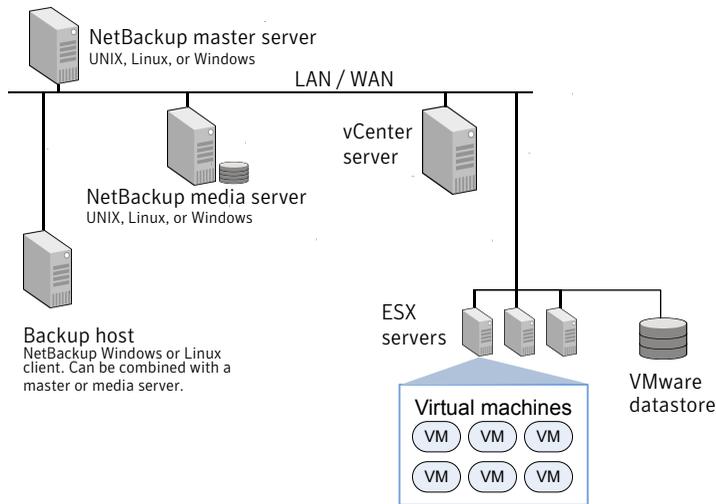
Figure 1-2 shows a NetBackup for VMware environment on a SAN. The backup host accesses the VMware datastore directly over the SAN.

Figure 1-2   NetBackup for VMware: components on SAN
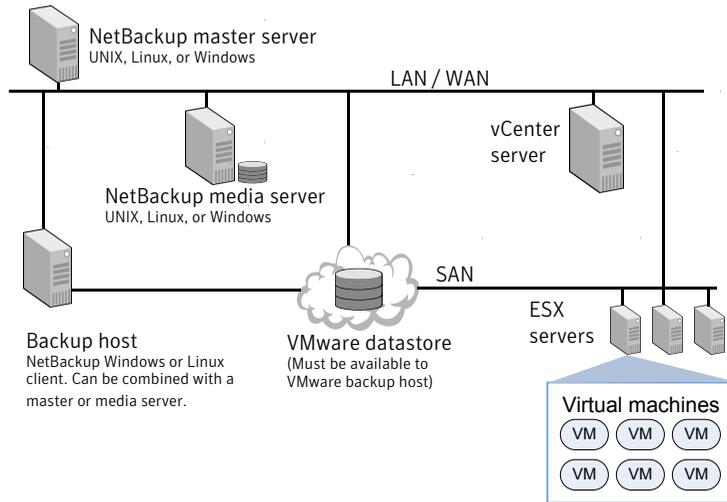
Appliance as backup host: component overview

As Figure 1-3 shows, the appliance can operate as the VMware backup host. A separate Windows backup host is not required.

The appliance as backup host can also run the NetBackup media server and master server.

Figure 1-3   NetBackup for VMware with appliance as backup host
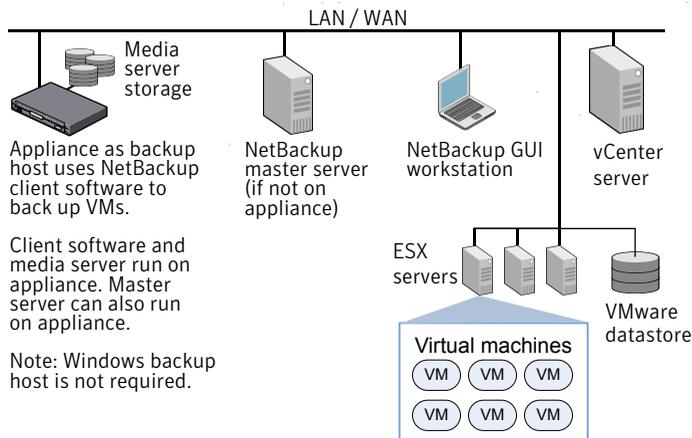
The NetBackup environment can also be on a SAN:

See Figure 1-2 on page 22.

Further information is available on the appliance as backup host:

See "Notes on the NetBackup appliance as a VMware backup host" on page 37.

Media servers as backup or discovery hosts

NetBackup for VMware uses a special host that is called a VMware backup host. The backup host is a NetBackup client that performs off-host backups of the virtual machines. The backup host must have access to the datastores of the virtual machines. The backup host reads the data from the datastore and sends it over the network to the media server. The media server backs up the data to storage.

NetBackup also uses a discovery host. For the policies that automatically select virtual machines, the discovery host filters virtual machines according to the rules in the policy Query Builder. The discovery host returns a list of virtual machines to be selected for backup.

NetBackup can use media servers as backup hosts and as discovery hosts.

Media servers acting as backup or discovery hosts can provide the following advantages:

- Host redundancy: If one media server goes down, another media server takes over.

- Faster backup: The media server can read the data from the datastore and send the data straight to the storage device. Without media server access to storage devices, an ordinary backup host must send the backup data over the local network to the media server.

Figure 1-4 shows a group of media servers that can also act as backup or discovery hosts. The media servers can discover virtual machines for automatic selection, and perform off-host backups and send the backup data directly to storage.

Figure 1-4   Backup media servers
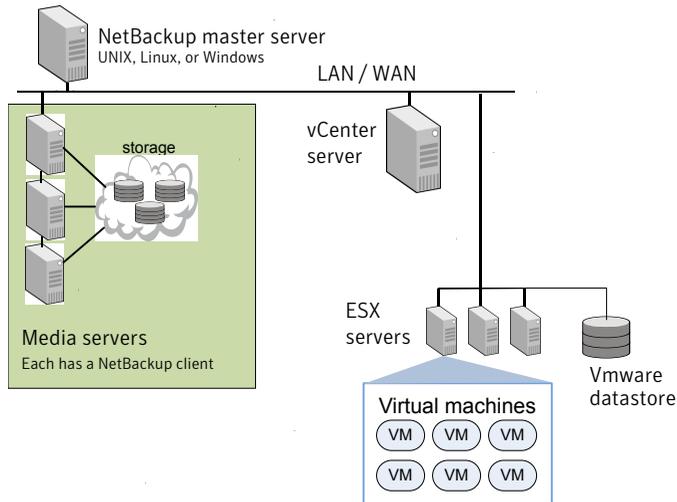
You can combine the flexibility of backup media servers with a standard feature of NetBackup: storage unit groups. Create a storage unit group that contains the storage units that your media servers can access. Any of the media servers can operate as a backup host.

Note the following requirements:

- To configure media servers as backup hosts: Set the policy **VMware backup host** field on the **VMware** tab to **Backup Media Server**.
  See "VMware backup host" on page 56.

- To configure media servers as discovery hosts: Set the policy **NetBackup host to perform automatic virtual machine selection** field on the **Clients** tab to **Backup Media Server**.
  See "Options for selecting VMware virtual machines" on page 86.

Overview of the VMware backup process

The following table describes the phases in the NetBackup backup process.

Table 1-2   NetBackup backup process

Phase	Description
Phase 1	The NetBackup master server initiates the backup.

Table 1-2 NetBackup backup process *(continued)*

Phase	Description
Phase 2	The NetBackup client on the VMware backup host initiates a VMware snapshot on the virtual machine.
Phase 3	Windows: VSS synchronizes the file system on the virtual machine.
	Linux: The SYMCquiesce utility can quiesce the file system on supported Linux operating systems.
	See "About the SYMCquiesce utility" on page 292.
Phase 4	The VMware server creates a snapshot on the virtual disk datastore.
Phase 5	The NetBackup client reads the snapshot from the datastores and writes the data to the NetBackup storage unit.

NetBackup for VMware license requirement

NetBackup for VMware requires an Enterprise Client license for each ESX Server.

To protect an application or database, note: an additional license for the appropriate NetBackup package is needed for each ESX server that hosts the application or database.

NetBackup for VMware terminology

Table 1-3 lists the terminology that is used in NetBackup for VMware.

For further explanations of VMware terminology, refer to your VMware documentation.

Table 1-3   NetBackup for VMware terms

Term	Definition
backup host	The backup host is a NetBackup client that performs backups on behalf of the virtual machines. (This host was formerly known as the VMware backup proxy server.) The backup host is the only host on which NetBackup client software is installed.
	As an option, the backup host can also be configured as a NetBackup master server or media server.
	The backup host is referred to as the recovery host when it performs a restore.
	See "NetBackup for VMware components" on page 19.
backup media server	A media server that operates as a backup host.
datastore	In NetBackup for VMware, the datastore is a disk that contains the virtual machines files.
datastore cluster	A collection of datastores that can be managed as a single unit. VMware Storage DRS manages the storage resources of the cluster.
discovery host	Discovers the virtual machines, filters them by the rules in the Query Builder, and returns a list of virtual machines to be selected for backup. The discovery host is used only for automatic selection of virtual machines.
	Can be the same host as the VMware backup host.
	See "NetBackup for VMware components" on page 19.
guest OS	An operating system that runs on a virtual machine.
hypervisor	A software virtualization layer that lets different operating systems run simultaneously on the same physical computer. The VMware hypervisor is vSphere, which runs on the ESX server host.

Table 1-3   NetBackup for VMware terms *(continued)*

Term	Definition
independent disk	A virtual disk that cannot be captured with a snapshot. An independent disk can be configured as either persistent or temporary.
	Note: NetBackup for VMware cannot back up the data on an independent disk. The backup succeeds but the backup image contains no data for the independent disk. If you restore the disk from the backup, the independent disk is restored to its original allocation size but contains no data. For example, the Windows swap file can reside on an independent disk, and is consequently not included in the virtual machine backup.
	To back up the data on an independent disk, install a NetBackup client on the virtual machine.
	See "NetBackup for VMware: notes and restrictions" on page 33.
query	The combination of rules in the policy's Query Builder, by which NetBackup selects virtual machines for backup. A query consists of one or more rules.
Query Builder	For creating filtering rules for automatic selection of virtual machines for backup. The Query Builder is on the **Clients** tab of the NetBackup policy.
query rule	A single statement in a query, by which NetBackup selects virtual machines for backup.
	An example of a query rule is: `Displayname Contains "finance"`
Raw device mapping (RDM)	Allows a virtual machine to directly access physical disks (on Fibre Channel or iSCSI). RDM allows the OS and applications in the virtual machine to have pass-thru access to raw devices.
	NetBackup for VMware cannot back up an RDM disk. NetBackup client software must be installed in the virtual machine.
	See "About VMware raw device mapping (RDM)" on page 287.
recovery host	See backup host.
virtual machine	An execution environment that the hypervisor creates for the computer hardware. The resulting virtualized environment allows different operating systems to run simultaneously on the same physical computer.

Table 1-3   NetBackup for VMware terms *(continued)*

Term	Definition
virtual network	A logical network that allows the exchange of data between virtual machines. A virtual network uses a virtual switch (VMware vSwitch). A virtual network can be connected to a physical network.
vmdk file	In a VMware ESX server, one or more vmdk files make up the disk image or virtual drive in a virtual machine. The `.vmdk` files contain the operating system, applications, and data in the virtual machine.
VMware Tools	Installed inside each VMware virtual machine. Enhances the virtual machine performance and adds backup-related functionality.
VMX datastore	Sometimes called the vmx directory or configuration datastore. Contains the configuration files that describe the virtual machine, such as .vmx files. During a backup of a virtual machine snapshot, vmdk writes are also cached on this datastore. Note that a separate vmx datastore is not a VMware requirement.
vStorage	VMware vStorage APIs enable data protection features for more efficient use of storage capacity. NetBackup can use vStorage to back up the latest vSphere environments as well as to back up earlier VMware environments.

Required tasks: overview

This chapter includes the following topics:

- Overview of VMware tasks
- Overview of NetBackup tasks

Overview of VMware tasks

The VMware components including ESX servers and virtual machines must be set up before you configure NetBackup. Table 2-1 briefly describes these VMware-specific tasks; further assistance with these tasks may be found in your VMware documentation.

Table 2-1   VMware tasks

Sequence	Tasks
Phase 1	Optional: To use the SAN transport type, set up the datastore on Fibre Channel or iSCSI. In this configuration, the VMware backup host must be able to access the datastore over the SAN. **Note:** The NetBackup appliance does not support iSCSI.
Phase 2	Install the VMware ESX server and virtual machines.
Phase 3	Install VMware Tools on the virtual machines that you plan to back up.
Phase 4	Optional: install a vCenter (or VirtualCenter) server.

Notes:

- Ensure that the hardware and the SAN are configured properly. The VMware datastore where the target virtual machine files exist must be accessible to the VMware backup host.

Note: A SAN connection between the backup host and the datastore is optional if you use the NBD transfer type or NBDSSL transfer type.

- VMware has specific hardware and configuration requirements. VMware SAN requirements can be found in the appropriate VMware SAN Configuration guide.

- VMware requires that ESX server names resolve to an IP address. Symantec highly recommends the use of DNS for the naming resolution among VMware servers. For DNS configuration instructions for VMware servers, please refer to the following VMware site:

  VMware vSphere Online Library

Overview of NetBackup tasks

Table 2-2 lists the NetBackup configuration tasks for VMware. These tasks are described in other NetBackup topics and guides, as indicated.

Table 2-2   NetBackup tasks

Sequence	Tasks
Phase 1	Install the NetBackup 7.6 master server and media server. See the *NetBackup Installation Guide*. Symantec recommends that the NetBackup media server and the VMware backup host be installed on the same host.
Phase 2	Install the NetBackup 7.6 Enterprise Client license on the master server, and install NetBackup client 7.6 software on the VMware backup host.
Phase 3	Add the VMware backup host to your NetBackup configuration. See "Adding the VMware backup host to NetBackup" on page 41. **Note:** This step is not required on the appliance: the backup host is already installed on the appliance.
Phase 4	Enter NetBackup access credentials as needed: for VMware vCenter, for vCloud Director, and for individual ESX servers. See "Adding NetBackup credentials for VMware" on page 42. **Note:** The NetBackup master server must have network access to the VMware servers that NetBackup has credentials for.
Phase 5	Create a NetBackup policy for VMware. See "Configuring a VMware policy from the Policies utility" on page 52.

Table 2-2   NetBackup tasks *(continued)*

Sequence	Tasks
Phase 6	Perform a backup or restore. See "Backing up virtual machines" on page 122. See "Restoring individual files" on page 157. See "Restoring the full VMware virtual machine" on page 143.
Phase 7	Recheck the configuration. See "NetBackup for VMware best practices" on page 204. See "NetBackup status codes related to VMware" on page 218.

Notes and prerequisites

This chapter includes the following topics:

- NetBackup for VMware prerequisites

- NetBackup for VMware: notes and restrictions

- NetBackup for VMware: notes on Linux virtual machines

- Notes on the NetBackup appliance as a VMware backup host

- NetBackup character restrictions for virtual machine display names and other vSphere objects

- NetBackup does not recognize upper vs. lower case in display names

- Notes on the hotadd transport mode

NetBackup for VMware prerequisites

The following prerequisites apply to NetBackup for VMware:

- The VMware components including ESX servers and virtual machines must be set up before you configure NetBackup.
  See "Overview of VMware tasks" on page 29.

- The VMware backup host must run on Windows or Linux. The supported hardware types are the same as for any NetBackup client. For information on the backup host, on supported guest operating systems and VMware components and versions, see *Support for NetBackup 7.x in virtual environments*:
  http://www.symantec.com/docs/TECH127089

- To use the hotadd transfer type for backup or restore, the VMware backup or restore host is installed in a virtual machine.
  See "Notes on the hotadd transport mode" on page 39.

NetBackup for VMware: notes and restrictions

Note the following about NetBackup for VMware:

- For support information regarding the backup host, guest operating systems, and VMware components and versions, see *Support for NetBackup 7.x in virtual environments*:
  http://www.symantec.com/docs/TECH127089

- NetBackup for VMware does not support the **Retain snapshot for Instant Recovery or SLP management** option on the policy **Attributes** tab of the Administration Console.

  NetBackup 7.6 supports these features as follows:

  - For instant recovery, use the nbrestorevm command.
    See "About Instant Recovery for VMware" on page 166.

  - For SLP management of snapshots, use Replication Director.
    For more information, see the *NetBackup Replication Director Solutions Guide*.

- NetBackup for VMware cannot back up the data on an independent disk, because an independent disk cannot be captured with a snapshot. The backup succeeds but the backup image contains no data for the independent disk.
  To back up the data on an independent disk, install a NetBackup client on the virtual machine. You can configure NetBackup to back up the virtual machine and any independent disks as if the client was installed on a physical host. You can restore the virtual machine and then restore the independent disk as a separate job.

- NetBackup for VMware does not back up standard iSCSI LUNs that are connected to the virtual machine. If the virtual machine has an iSCSI LUN, the backup succeeds but the drive that represents the LUN is not backed up.
  Note: NetBackup for VMware supports datastores over iSCSI.

- Several notes and limitations apply to Linux virtual machines.
  See "NetBackup for VMware: notes on Linux virtual machines" on page 36.

- For Windows backup hosts, a backup that uses the hotadd transport mode fails if a vmdk file spans multiple disks. In this case, select a different transport mode for the backup.
  VMware has acknowledged this issue (SR#12204838207). This problem will be fixed in a future release.

- If a Windows virtual machine includes Veritas Storage Foundation volumes, the **Enable file recovery from VM backup** option is not supported.

See "Storage Foundation Volume Manager volumes in the virtual machine" on page 78.

- VMware virtual machine templates are for cloning virtual machines: They cannot be turned on and used as functioning VMs. As a result, VMware has imposed the following restrictions on backup and restore of virtual machine templates:

  - A virtual machine template cannot be captured in a snapshot. NetBackup backs up the template to the designated storage unit.

  - Block level incremental backup (BLIB) cannot be used when backing up a virtual machine template.

  - A virtual machine template cannot be backed up over a SAN. You must configure the NetBackup policy to use a local network transfer type, such as nbd. Likewise, the restore of a template must be conducted over a local network.

  Note: You can use the Query Builder in the NetBackup policy to create rules for automatic selection of virtual machine templates.

- VMware does not support non-ASCII characters in virtual machine display names or in other objects that are associated with the virtual machine. (Examples are annotations, floppy image name, parallel port or serial port file name, and CD-ROM ISO name.) Note that the same character restrictions also apply when creating vCloud Director objects.
  For VMware's list of the special characters that may cause issues, see the following VMware article:
  Troubleshooting issues with virtual machines or datastore names containing special characters (2046088)
  http://kb.vmware.com/kb/2046088
  For a list of objects that VMware does not support with non-ASCII characters, see the following VMware article:
  Troubleshooting errors resulting from non-ASCII names (1003866)
  http://kb.vmware.com/kb/1003866
  In keeping with VMware's position, NetBackup does not support non-ASCII characters in display names or in other vSphere objects. Symantec recommends that you follow VMware's guidelines in naming vSphere objects.
  In addition, NetBackup has its own restrictions on characters in display names.
  See "NetBackup character restrictions for virtual machine display names and other vSphere objects" on page 37.

Note: If the virtual machine display name contains non-ASCII characters, the backup may succeed but the restore fails. To restore the virtual machine, configure a restore to an alternate location. On the **Recovery Options** dialog, change the display name to contain ASCII characters only.

- NetBackup for VMware does not support the display names that end in a period. If the policy's **Primary VM identifier** option is **VM display name**, any VM with a period at the end of the name is not backed up.

- NetBackup does not recognize case when it selects virtual machines for backup. See "NetBackup does not recognize upper vs. lower case in display names" on page 38.

- To back up a virtual machine while Storage vMotion migrates its files, NetBackup must conduct the backup through the vCenter server. See "Conflict between NetBackup and VMware Storage vMotion with vSphere 5.0 or later" on page 225.

- Several notes and limitations apply to the automatic selection of virtual machines for backup (Virtual Machine Intelligent Policy). See "NetBackup requirements for automatic virtual machine selection" on page 85.

- For hotadd backup or restore: The virtual machine to back up (or restore) and the virtual machine that contains the hotadd backup host must reside in the same VMware datacenter. See "Notes on the hotadd transport mode" on page 39.

- NetBackup for VMware supports Windows NTFS file encryption and compression, for backup and restore. However, it does not support NetBackup's compression or encryption options (in the NetBackup policy attributes). For UNIX or Linux guest operating systems: NetBackup for VMware does not support any type of compression or encryption, whether they are set in NetBackup or in the guest OS.

Note: The compressed Windows NTFS files are backed up and restored as compressed files.

- Storage optimization cannot be used if a snapshot exists on the virtual machine when VMware Changed Block Tracking is turned on. See "About reducing the size of VMware backups" on page 118.

- If the policy's **Primary VM identifier** option is set to **VM hostname**, note: NetBackup cannot select a VMware virtual machine for backup if it cannot obtain an IP address for the virtual machine.

- For Exchange, SharePoint, and SQL applications, NetBackup for VMware supports Granular Recovery Technology (GRT) restores from full backups only.

- Exchange, SharePoint, and SQL Server databases are not cataloged and backed up if they exist in mount point volumes.

- See "Restore notes and restrictions" on page 138.

NetBackup for VMware: notes on Linux virtual machines

The following notes apply to virtual machines with Linux guest operating systems:

- NetBackup cannot exclude unused or deleted blocks from the backup if the virtual machine is configured with software RAID volumes. The policy's **Exclude deleted blocks** option is not supported.

- On Linux virtual machines, NetBackup requires a special utility (SYMCquiesce) to quiesce the file system in preparation for taking the snapshot. Without SYMCquiesce, NetBackup cannot guarantee that data in the file system is in a consistent state when the snapshot occurs.
  See "About the SYMCquiesce utility" on page 292.
  See "Installing the SYMCquiesce utility" on page 293.
  For the Linux virtual machines that do not have the SYMCquiesce utility: To guarantee that the file system is consistent at the time of backup, consider turning off the virtual machine before the backup. When the virtual machine is turned off, data buffers are flushed to disk and the file system is consistent.
  For a description of file system quiesce, see the *NetBackup Snapshot Client Administrator's Guide*.

- If the Linux file system was not quiesced before the snapshot, some files may be inconsistent. Such files can be recovered from the NetBackup.lost+found directory.
  See "About the NetBackup.lost+found directory on Linux" on page 164.

- Unmounted LVM2 volumes must start with /dev
  If the path of an unmounted LVM2 volume does not start with /dev, the backup of the virtual machine fails. Note: The path of the volume is set with the "dir" parameter on the LVM volume configuration file. An example of this configuration file is /etc/lvm/lvm.conf.

- For Linux files or directories, NetBackup for VMware has the same path name restriction as NetBackup on a Linux physical host. Files or directories with path names longer than 1023 characters cannot be individually backed up or restored. Such files can be restored when you restore the entire virtual machine from a full virtual machine backup.

- The Linux ext4 file system includes a persistent pre-allocation feature, to guarantee disk space for files without padding the allocated space with zeros. When NetBackup restores a pre-allocated file (to any supported ext file system), the file loses its preallocation and is restored as a sparse file. The restored file is only as large as the last byte that was written to the original file. Subsequent writes to the restored file may be non-contiguous.

  Note: The restored file contains all of its original data.

- See "Restore notes and restrictions on Linux" on page 141.

Notes on the NetBackup appliance as a VMware backup host

Note the following requirements and limitations for the appliance as the backup host:

- The appliance must be version 2.5 or later. If the master server is on a separate host (not on the backup host), the master server must use NetBackup 7.5.0.1 or later.

- On the host that runs the NetBackup Administration Console or the Backup, Archive, and Restore interface, NetBackup must be at 7.5.0.1 or later.

- You must use the VMware policy type. The FlashBackup-Windows policy type is not supported.

- The appliance does not support iSCSI connections. References to iSCSI in this guide do not apply to the appliance.

NetBackup character restrictions for virtual machine display names and other vSphere objects

When VMware virtual machines are included in a NetBackup policy, certain characters are not allowed in the virtual machine display name or in the names of other vSphere objects.

If the name contains the wrong characters, the backup may fail.

For NetBackup, the following characters are allowed in virtual machine display names, cluster names, datastore names, file names, or folder names:

- Uppercase and lowercase ASCII characters

- Numbers

- Period (.)
  Note however that a display name cannot end with a period.

- Hyphen (-)

- Underscore (_)

- Plus sign (+)

- Percent sign (%)

- Left and right parentheses ()

- Spaces

Note: No other characters are allowed.

For the policies that select virtual machines automatically:

- A space in a display name is converted to "%20" in the test query results if the virtual machine is listed as included.

- A percent (%) in a display name is converted to %25 in the test query results if the virtual machine is listed as included. When you specify the display name in a query, replace the % character with %25.

See "Primary VM identifier options (VMware)" on page 58.

NetBackup does not recognize upper vs. lower case in display names

In VMware vSphere, virtual machine display names are case-sensitive. A virtual machine with the name "vm1" is a different virtual machine from one that is named "VM1." NetBackup however does not recognize case when it selects virtual machines for backup. It considers VM1 and vm1 to be the same virtual machine.

To ensure that all VMs are correctly backed up, avoid the use of VM names that are differentiated only by upper vs. lower case.

Notes on the hotadd transport mode

NetBackup supports several transport modes for sending snapshot data between the VMware datastore and the VMware backup host during a backup or restore. One of those transport modes (**hotadd**) is used when the VMware backup host is installed in a virtual machine.

Note the following about the hotadd transport mode:

- For a list of VMware restrictions on the hotadd transport mode, refer to VMware's documentation. For example:
  http://www.vmware.com/support/developer/vddk/VDDK-500-ReleaseNotes.html

- The VMware backup host must be installed in a virtual machine.

- The following is a VMware requirement: The virtual machine to back up and the virtual machine that contains the hotadd backup host must reside in the same VMware datacenter. The same VMware requirement applies to virtual machine restore: The virtual machine to restore and the virtual machine that contains the hotadd restore host must reside in the same VMware datacenter.
  For hotadd backup, Symantec recommends at least one hotadd backup host for each datacenter.

- NetBackup does not support IDE disks on the virtual machine.

- On the virtual machine to back up, no two disks should have the same name. (Identical names can occur if the disks reside on different datastores.)

- The ESX server (where the backup-host virtual machine resides) must have access to the datastore of the virtual machines that you want to back up.

- The datastore for the backup-host virtual machine must have some free space before the hotadd backup begins. Otherwise, the backup may fail.

- For additional hotadd information, see the following VMware document:
  VDDK 5.0 Release Notes

- The **Enable file recovery from VM backup** option does not work with the hotadd transport mode in the following case: The virtual machine that contains the backup host is a clone of the virtual machine that is backed up (or vice versa). In this case, a backup that uses the hotadd transfer mode may appear to succeed. However, some of the virtual machine volumes may be incorrectly mapped and cannot be restored.
  The converse is also true. The virtual machine that you back up with the hotadd transport mode cannot be a clone of the virtual machine that contains the backup host. Furthermore, the two virtual machines must not be clones of the same parent.

VMware has identified this issue as software defect SR#1442259141. To use the hotadd transport mode with your backup, do the following: Make sure the virtual machine that contains the VMware backup host and the virtual machine you back up are not clones of each other.

Configure NetBackup communication with VMware

This chapter includes the following topics:

- Adding the VMware backup host to NetBackup

- Adding NetBackup credentials for VMware

- Changing the host name of a VMware server in NetBackup

- Setting privileges for posting events to vCenter

- Authentication token for the NetBackup vCenter plug-in

- Web Services and the NetBackup vCenter plug-in

- Setting global limits on the use of VMware resources

Adding the VMware backup host to NetBackup

Use this procedure to enable a NetBackup client as the backup host.

Note: This procedure is not needed for media servers that operate as backup hosts with the policy **Backup Media Server** option. With that option, NetBackup automatically enables media servers as backup hosts.

In the NetBackup Administration Console, do the following.

To add the VMware backup host

1   Click **Host Properties > Master Servers**, double click the NetBackup master server, and click **VMware Access Hosts**.

2   Click **Add**.

3   Enter the fully qualified domain name of the VMware backup host, and click **Add**.

4   When you are finished adding hosts, click **Close**.

5   Click **Apply** and then **OK**.

6   If the NetBackup master server is clustered in a failover environment: repeat this procedure to add the backup host to each master server node in the cluster.

Adding NetBackup credentials for VMware

To back up or restore virtual machines, the NetBackup server requires logon credentials to the VMware ESX servers or the VMware vCenter servers. In the NetBackup Administration Console, do the following.

To add NetBackup credentials

1   Click **Media and Device Management > Credentials > Virtual Machine Servers**.

2   Click **Actions > New > New Virtual Machine Server**.

3   On the **Add Virtual Machine Server** dialog, enter the name of a virtual machine server (vCenter server or ESX server).

Note: Enter the server name in the same format in which it is registered in DNS and in the VMware server (whether short or fully-qualified).

Note: Symantec recommends the use of fully qualified names. The entire name must be properly formed without empty or null elements. For example, a fully-qualified name must include the domain name and not end in a period (.).

Note: The ESX server name is case-sensitive. Enter the ESX server name exactly as it is in the VMware environment. If the case is wrong, the credential validation fails and states "...expecting <correct_name_of_server>."

NetBackup needs access to this server for either of the following reasons:

■   To browse the server's virtual machines and back them up.

- To use the server as a target for restoring virtual machines.

  Use the next dialog to identify the type of this server (vCenter, ESX, or ESX for restore only).

4   In the **Credentials** pane of the **Virtual Machine Server** dialog, enter the following:

Virtual machine server type

Select the type of VMware server that NetBackup needs to access:

- **VMware Virtual Center server**

  Designates a vCenter (or VirtualCenter) server that manages ESX servers. When you create a policy to back up this server's virtual machines, NetBackup can browse this server and list its virtual machines. If the credentials provide full access privileges to the vCenter server, you can restore virtual machines to this server.

  Note: Do not enter logon credentials for the individual ESX servers that this vCenter server manages. NetBackup needs credentials for the vCenter only.

  Note: NetBackup 7.6 backup hosts do not support VirtualCenter server 2.5 or earlier. To use VirtualCenter server 2.5 or earlier, the backup host must be 7.5.x or earlier.

- **VMware ESX Server**

  Designates a standalone ESX server that is not managed by a vCenter server. NetBackup can browse the ESX server to present a list of its virtual machines for backup. You can also restore virtual machines to this ESX server. To use the server as a target for restores, enter the credentials that provide full access privileges to the ESX server.

  Note: Backup hosts at NetBackup 7.6 do not support ESX servers at 3.5 or earlier. To use ESX servers at 3.5 or earlier, the backup host must be 7.5.x or earlier.

- **VMware Restore ESX Server**

  Designates an ESX server to which NetBackup can restore virtual machines. You must enter the credentials that provide full access privileges to the server.

Note: NetBackup accesses this type of server for restores only, not for backups.

The restore ESX server type has the following advantages:

■ For large environments with hundreds of hosts, NetBackup may not need full access to the vCenter server. With the restore ESX server type, you can give NetBackup full access to a single ESX server that is dedicated to restore.

■ SAN-based restores that go directly to a restore ESX server are faster than restores that go through the vCenter server.

■ Allows restoring to an ESX 5 server that a vCenter 5 server manages. NetBackup uses vCenter to create the virtual machine. NetBackup then writes the .vmdk files directly to the ESX server using the Restore ESX Server credentials to that server.

Note: VMware does not support the restore of virtual machines directly to an ESX 5.x server that vCenter manages. To restore the virtual machine, select the vCenter server as the destination. As an alternative, you can set up an independent ESX server to be used for restores. You must add NetBackup restore credentials for that ESX server by means of the **VMware Restore ESX Server** type.

For further information on the restore ESX server, refer to the following Symantec tech note:
http://www.symantec.com/docs/TECH128513

■ **VMware vCloud Director**
Designates a vCloud Director server. NetBackup can browse the vCloud environment on this server to present a list of its virtual machines for backup. You can also restore virtual machines to this server.

Note: For backup and restore to vCloud Director, both vCloud and vCenter credentials are required (**VMware Virtual Center server**).

Note: If the vCloud environment uses a load-balancer to manage multiple cells (nodes), add credentials for the load balancer, not for the cells. If vCloud Director has multiple cells but no load balancer, add credentials for only one of the cells, not for all of them. Note also: If the domain name system (DNS) cannot resolve the name of the load balancer or cell, do the following: Include a line in the hosts file on the VMware backup host that specifies the IP address of the load balancer or cell.

User name

Enter the user name for the virtual machine server. Note that spaces in user names are not allowed.

In the Java Administration Console:

To enter a domain name with a user name, use a double backslash or enclose the name in single or double quotes, as follows:

```
domain\\username
'domain\username'
"domain\username"
```

Note: In the Windows Administration Console, quotes are not needed.

Password

Enter the password (and confirm it) for the virtual machine server.

You can use the **For backup host** pull-down to select a particular backup host for which to validate the credentials. Note that a backup host appears in the pull-down list if it was added to the master server's Host Properties dialog.

See "Adding the VMware backup host to NetBackup" on page 41.

If **For backup host** is set to <Any> (the default), NetBackup attempts to validate the credentials using each backup host in turn. NetBackup continues checking only until validation succeeds for a particular backup host or the list of backup hosts is exhausted.

During validation: An invalid user name or password is deleted if you have entered it for the first time and you do not select a backup host. If validation fails for any reason, the entry is removed.

If your VMware backup host is running a version of NetBackup that is earlier than 6.5.4, the credentials cannot be validated. An error message is displayed. You must verify that the credentials you entered are correct for the VMware server. If the credentials are correct, you can ignore the error message.

Connect using port number

If the default port number has not been changed on the VMware server, no port specification is required. In that case, make sure that the **Connect using port number** box is not checked.

If the VMware server has been configured to use a different port, click the **Connect using port number** box and specify that port number.

5   Click **OK**.

6   If your site has multiple standalone ESX servers, use the **Virtual Machine Server** dialog to enter credentials for each ESX server.

7   If the NetBackup master server is clustered, do the following on the other master server nodes to verify the credentials for each backup host.

- Fail over to the next master server node, to make it the active node.

- On the active node, click on **Media and Device Management > Credentials > Virtual Machine Servers** and double-click on the virtual machine server credential.

- In the **For backup host** field, select a particular backup host (do not select **Any**).
  If the backup host does not appear in the list, you must add the correct credentials for the backup host. (Click **Actions > New > New Virtual Machine Server**.)

- Click **OK**.
  NetBackup validates the credentials.

- Double-click the same virtual machine server credential and validate the credentials for another backup host (if any).

- For other master server nodes, repeat step 7.

See "Setting global limits on the use of VMware resources" on page 48.

Changing the host name of a VMware server in NetBackup

Use the following procedure if you need to change a VMware server's host name as it is stored in NetBackup.

Example reasons for changing the VMware server name are the following:

- You used a short host name for the server for its NetBackup credentials, and need to replace that name with the fully qualified host name.

- Two hosts currently resolve to the same IP address, and one of them must be renamed and assigned a new IP address.

To change the host name of a VMware host in NetBackup

1 Remove the current credentials that were entered for the VMware host.

Do the following:

- In the NetBackup Administration Console, click on **Media and Device Management > Credentials > Virtual Machine Servers**.

- Right-click on the credentials definition for the VMware server and select **Delete** (or press the Delete key).

2 Remove the VMware host from the NetBackup EMM database.

Enter the following command:

```
nbemmcmd -deletehost -machinename VMware_server_name
   -machinetype virtual_machine
```

3 In the NetBackup Administration Console, re-enter NetBackup's credentials for the VMware server.

See "Adding NetBackup credentials for VMware" on page 42.

Make sure to enter the correct host name for the VMware server.

See "Setting global limits on the use of VMware resources" on page 48.

Setting privileges for posting events to vCenter

With the **Post events to vCenter** option, NetBackup can send backup related events to the vCenter server, to view in vSphere Client.

Note the following requirements:

- You must enter the credentials that give NetBackup access to the vCenter server.
  See "Adding NetBackup credentials for VMware" on page 42.

- Make sure that the **Post events to vCenter** option is enabled in the policy.
  See "VMware - Advanced Attributes dialog" on page 62.

- You must set the correct role privileges in vCenter, as explained in this topic.

Note: If your vCenter role is configured for all privileges, you can skip the following procedure.

To set privileges for posting events to vCenter

1   Go to the vSphere Client Home page on the vCenter server and click **Roles**.

2   Right-click on the role for the vCenter user that was entered for the NetBackup credentials, and click **Edit Role**.

    See "Adding NetBackup credentials for VMware" on page 42.

3   In the Edit Role screen, place a check mark on the **Extension** privilege to include all three extension privileges: Register extension, Unregister extension, Update extension.

4   In the Edit Role screen, expand the Global privilege group and select the following privileges: Log event, Manage custom attributes, Set custom attribute.

5   Click **OK**.

Authentication token for the NetBackup vCenter plug-in

With the NetBackup plug-in for vCenter, the VMware administrator can use vSphere Client to recover virtual machines. To allow the vCenter plug-in to communicate with the NetBackup master server, you must provide an authentication token to the VMware administrator.

To create the authentication token, see the *Symantec NetBackup Plug-in for VMware vCenter Guide*.

Web Services and the NetBackup vCenter plug-in

By default, the NetBackup Web Services are disabled on the master server. To allow the NetBackup plug-in for vCenter to recover virtual machines, the NetBackup Web Services must be enabled.

See the *Symantec NetBackup Plug-in for VMware vCenter Guide*.

Setting global limits on the use of VMware resources

You can use the NetBackup Resource Limit dialog to control the number of simultaneous backups that can be performed on a VMware resource type. The settings apply to all NetBackup policies.

For example, to avoid overloading the ESX server, you can place a limit on the number of concurrent backup jobs per ESX server. To control I/O overhead on the datastore's array, you can limit the number of concurrent backups per datastore.

Note: The Resource Limit screen applies only to policies that use automatic selection of virtual machines (Query Builder). If virtual machines are selected manually on the Browse for Virtual Machines screen, the Resource Limit settings have no effect.

Note: To limit the number of simultaneous jobs per policy, use the **Limit jobs per policy** setting on the policy **Attributes** tab. The effect of this option depends on how the policy selects virtual machines.

See "Limit jobs per policy on the Attributes tab (for VMware)" on page 56.

To set limits on the use of VMware resources

1   In the NetBackup Administration Console, click **Host Properties > Master Servers** and double-click the NetBackup master server.

2   In the Properties screen, scroll down in the left pane and click **Resource Limit**.

3   Click in the **Resource Limit** column to set the maximum NetBackup usage for the resource type. The settings apply to all policies.

Resource Limit		Defaults
By default, resources have no limit. To set a limit, select resource below and specify a limit.		

Application	Resources for selected application	
VMware	**Resource Type**	**Resource Limit**
	vCenter	No Limit
	snapshot	No Limit
	Cluster	No Limit
	ESXserver	No Limit
	VMXDatastore	No Limit
	Datastore	4
	DatastoreFolder	No Limit
	DatastoreType	No Limit
	VMXDatastoreNFSHost	No Limit
	DatastoreNFSHost	No Limit
	DatastoreCluster	No Limit

For each resource type, the default is 0, (No Limit). A resource limit of 4 for datastore means that NetBackup policies can perform no more than four simultaneous backups on any particular datastore.

Table 4-1 describes the limits:

Table 4-1   Resource types and limits

Resource type	Resource limit
vCenter	The maximum number of simultaneous backups per vCenter server.
snapshot	The maximum number of simultaneous snapshot operations (create or delete) per vCenter.
Cluster	The maximum number of simultaneous backups per VMware cluster.
ESXserver	The maximum number of simultaneous backups per ESX server.
VMXDatastore	The maximum number of simultaneous backups per vmx datastore. See "NetBackup for VMware terminology" on page 25.
Datastore	The maximum number of simultaneous backups per datastore.
DatastoreFolder	The maximum number of simultaneous backups per datastore folder.
DatastoreType	The maximum number of simultaneous backups per datastore type.
VMXDatastoreNFSHost	The maximum number of simultaneous backups per NFS host of the vmx datastore.
DatastoreNFSHost	The maximum number of simultaneous backups per NFS host of the datastore.
DatastoreCluster	The maximum number of simultaneous backups per datastore cluster.

Other resource-related considerations may be of interest.

See "NetBackup for VMware best practices" on page 204.

Configure NetBackup policies for VMware

This chapter includes the following topics:

Configuring a VMware policy from the Policy Wizard

Use the following procedure.

To create a backup policy by means of the Policy Configuration Wizard

1 In the NetBackup Administration Console (on the NetBackup master server), click on the name of the master server.

2 Click **Create a Policy**.

3 Under **Create a backup policy for,** click **VMware and Hyper-V**.

4 Enter a name for the policy.

5 Click **VMware** as the virtual machine type.

6 Select the backup host from the **VMware backup host** drop-down list.

   Instead of a particular host, you can select **Backup Media Server**. This option enables the use of one or more media servers as the backup host, for host redundancy and faster backups.

   Note: The individual backup hosts (not the media servers) are defined in the Administration Console in the following location:

   Host Properties > Master servers > double-click the master server **> Master Server Properties > VMware Access Hosts**.

7 Click **Next**.

8 Follow the remaining panels in the wizard.

   The wizard creates the policy according to your selections.

Configuring a VMware policy from the Policies utility

You can create a NetBackup policy (full or incremental) to back up the virtual machine in either of two ways:

- Use the **Policies** utility of the NetBackup Administration Console (described in this topic).

- Use the Policy Configuration Wizard.
  See "Configuring a VMware policy from the Policy Wizard " on page 51.

Note: To configure a policy for Replication Director, see the *NetBackup Replication Director Solutions Guide*.

To configure a policy to back up the virtual machine

1 In the NetBackup Administration Console, click **Policies** and select **Actions > New > New Policy**.

2 Select the **VMware** policy type.

3   For the Java Administration Console, click **Apply**.

VMware backup options are available on the **VMware** tab (described later in this procedure).

4   Select a policy storage unit or storage unit group.

Storage unit groups are described in the *NetBackup Administrator's Guide, Volume I*.

5   In most cases, you can leave the **Disable client-side deduplication** option at the default (unchecked).

The **Disable client-side deduplication** option is described in the *NetBackup Administrator's Guide, Volume I*.

6   To enable the Accelerator, click **Use Accelerator**.

When you click **Use Accelerator**, **Perform block level incremental backups** is automatically selected and grayed out. On the **VMware** tab, the **Enable block-level incremental backup** option is also selected and grayed out.

See "About the NetBackup Accelerator for virtual machines" on page 130.

7 Click the **VMware** tab.
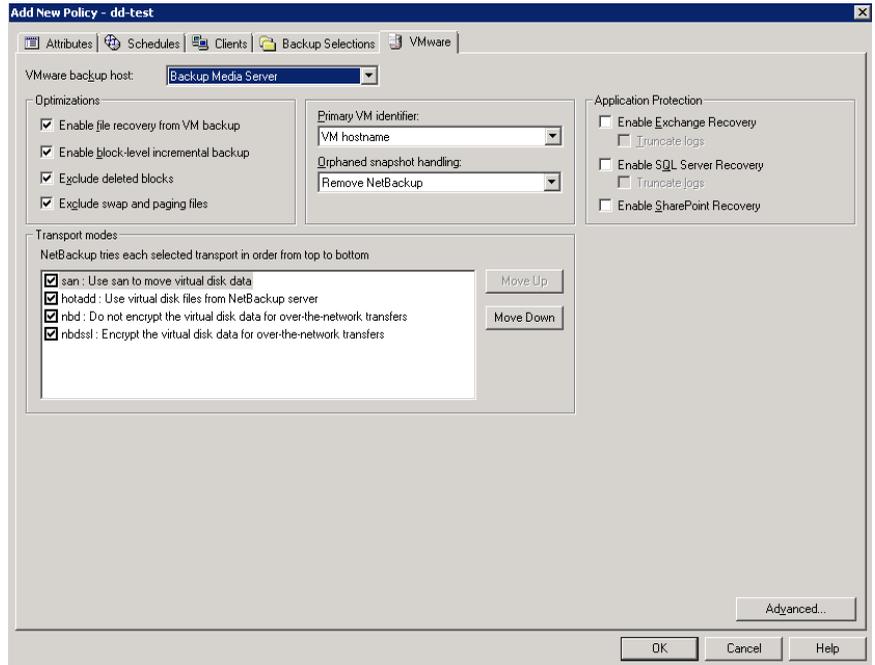
Use this dialog to set VMware-related options.

See

8 Use the **Schedules** tab to define a schedule (click **New**).

For assistance with the **Accelerator forced rescan** option:

See

On the **Schedules Attributes** tab, you can select **Full backup**, **Differential Incremental Backup**, or **Cumulative Incremental Backup**.

Note that incremental backups require one of the following selections on the policy **VMware** tab:

■ **Enable file recovery from VM backup**, or

■ **Enable block-level incremental backup**.
 Enable block-level incremental backup requires an ESX server 4.0 and a virtual machine at vmx-07 or later.
 The following topic contains additional information.
 See

9 Use the **Clients** tab to select the virtual machines to back up.

You can specify virtual machines in either of two ways:

Select manually, and click **New**.	The Browse for VMware Virtual Machines screen appears. You can type the host name in the **Enter the VMware hostname** field, or click **Browse and select virtual machine**.
	Note: The **Backup Selections** tab is set to ALL_LOCAL_DRIVES. Individual drives cannot be specified.
	See "Browse for VMware Virtual Machines" on page 69.
Select automatically through query	With this option, NetBackup can automatically select virtual machines for backup based on the filtering criteria that you enter. The following topics explain how to specify the criteria:
	See "About automatic virtual machine selection for NetBackup for VMware" on page 80.
	See "Configuring automatic virtual machine selection" on page 89.
	Note: The **Backup Selections** tab is filled in with the filtering rules from the query. NetBackup uses the ALL_LOCAL_DRIVES directive to back up the virtual machines.
Enable vCloud Director integration	Enables backup of the virtual machines that reside in a vCloud environment. Requires the automatic selection of virtual machines.
	With this option, the policy selects for backup only the virtual machines that vCloud manages: it skips the virtual machines that are not in vCloud.
	See "About NetBackup for vCloud Director" on page 191.
NetBackup host to perform automatic virtual machine selection	This host discovers virtual machines and automatically selects them for backup based on the query rules.
	See "About automatic virtual machine selection for NetBackup for VMware" on page 80.

Note: In the NetBackup Java Administration Console, the **Install Software** option is for installing NetBackup client software on trusting UNIX clients. This option does not apply to virtual machines.

10 When you click **Apply** or **OK** on the policy Attributes tab, a validation process checks the policy and reports any errors. If you click **Close**, no validation is performed.

Limit jobs per policy on the Attributes tab (for VMware)

The **Limit jobs per policy** option operates as follows, depending on how the policy selects virtual machines.

For the policies that select virtual machines automatically (Query Builder)

The **Limit jobs per policy** option controls the number of parent (discovery) jobs that run simultaneously for the policy. This option does not limit the number of snapshot jobs and backup (bpbkar) jobs that the parent job launches. For example, if this option is set to 1 and you begin a backup of a policy that discovers 100 virtual machines: all the snapshot jobs and backup jobs for each of the 100 virtual machines are allowed to execute simultaneously. Only the initial discovery job counts against **Limit jobs per policy**. If you begin a second backup of the policy, its discovery job cannot start until all the child jobs from the first backup are complete.

For the policies that use manual selection of virtual machines

Limit jobs per policy controls the number of virtual machines that the policy can back up simultaneously. Because no discovery job is needed, each virtual machine backup begins with a snapshot job. Each snapshot counts against the **Limit jobs per policy** setting. If this option is set to 1: the backup of the next virtual machine that is specified in the policy cannot begin until the first snapshot job and its backup are complete.

See "Setting global limits on the use of VMware resources" on page 48.

Backup options on the VMware tab

In the Administration Console, the VMware tab appears when you select VMware as the policy type.

The following options apply to the VMware policy type.

VMware backup host

The VMware backup host is a NetBackup client that performs backups on behalf of the virtual machines.

Table 5-1   VMware backup host selection

Option	Description
Backup Media Server	This option allows a media server that is selected in the policy to operate as the backup host. (The storage unit determines the selection of the media server.) To operate as the backup host, the media server must contain NetBackup client software.
	Note: The storage unit that is specified in the policy must be unique to your media servers. If the storage unit is available on another media server, the snapshot cannot succeed.
	Note: When the **Backup Media Server** option is selected, NetBackup cannot determine a host to perform policy validation. To validate the policy, temporarily select one of the possible media servers as the backup host (do not select **Backup Media Server**). When the policy validates successfully, reset the backup host to **Backup Media Server**.
	See "Media servers as backup or discovery hosts" on page 23.
backup_host_name	Select a particular backup host to perform the backup. (See the note after this table.)

Note: The backup hosts (but not backup media servers) must be identified in the Administration Console as follows: Go to **Host Properties > Master servers >** double-click the master server **> Master Server Properties > VMware Access Hosts**.

See "Adding the VMware backup host to NetBackup" on page 41.

Optimizations options (VMware)

The following options set the type and scope of the VMware virtual machine backup.

Table 5-2   Optimizations

Option	Description
Enable file recovery from VM backup	This option allows restore of individual files from the backup. With or without this option, you can restore the entire virtual machine.
	You can also use this option for incremental backups: in the policy schedule, select differential incremental backup or cumulative incremental backup.
	To perform a VMware backup to a deduplication storage unit, select this option. This option provides the best deduplication rates.
	To back up a virtual machine that contains Veritas Storage Foundation Volume Manager volumes, disable this option. Also make sure that the **Exclude deleted blocks** option is disabled.

Table 5-2   Optimizations *(continued)*

Option	Description
Enable block-level incremental backup	For block-level backups of the virtual machine. This option reduces the size of the backup image.
	For the Exchange, SQL, and SharePoint Agents, enable this option if you use Accelerator. Otherwise, disable this option.
	See "Block-level backup (BLIB): full vs incremental" on page 119.
Exclude deleted blocks	Reduces the size of the backup image by excluding any unused or deleted blocks within the file system on the virtual machine. This option supports the following file systems: Windows NTFS, and Linux ext2, ext3, and ext4.
	This option uses proprietary mapping technology to identify vacant sectors (allocated but empty) within the file system.
	See "About reducing the size of VMware backups" on page 118.
	To back up a virtual machine that contains Veritas Storage Foundation Volume Manager volumes, disable this option. Also make sure that the **Enable file recovery from VM backup** option is disabled.
Exclude swapping and paging files	Reduces the size of the backup image by excluding the data in the guest OS system paging file (Windows) or the swap file (Linux).
	Note: This option does not exclude the swapping and paging files from the backup: it only excludes the data in those files. If the files are restored, they are restored as empty files.

Primary VM identifier options (VMware)

This setting specifies the type of name by which NetBackup recognizes virtual machines when it selects them for backup.

Table 5-3   Primary VM identifier

Option	Description
VM hostname	The network host name for the virtual machine. (This option is the default.) NetBackup obtains the host name by means of a reverse lookup on the virtual machine's IP address.
	Note: For NetBackup to look up the IP address, the virtual machine must already be turned on.
	If no host name can be found, the IP address is used as the host name.
	See "Preventing browsing delays caused by DNS problems" on page 214.

Table 5-3	Primary VM identifier *(continued)*

Option	Description
VM display name	The name of the virtual machine as displayed in the VMware interface. A display name is assigned to the virtual machine when the virtual machine is created.
	When virtual machines are included in a NetBackup policy, restrictions apply to the characters that are allowed in the virtual machine display name.
	See "NetBackup character restrictions for virtual machine display names and other vSphere objects" on page 37.
	Note: The restrictions also apply to other vSphere objects, such as floppy image name, parallel port or serial port file name, and CD-ROM ISO name.
	Each display name must be unique in your VMware environment.
	See "NetBackup for VMware: notes and restrictions" on page 33.
	See "Restoring individual files" on page 157.
VM BIOS UUID	The ID assigned to the virtual machine when the virtual machine is created. This ID may or may not be unique, depending on whether the virtual machine has been duplicated. This option is included for compatibility with the policies that use the older VM UUID identifier.
VM DNS Name	The VMware DNS Name of the virtual machine. In vSphere Client, this name appears on the virtual machine's Summary tab.
	Note: This name may or may not be associated with the virtual machine's IP address. VMware Tools obtains this name from the host name that is configured in the virtual machine. For further information on this name, refer to the documentation for the guest operating system.
VM instance UUID	The globally unique ID assigned to the virtual machine when the virtual machine is created. This ID uniquely identifies the virtual machine within a vCenter server. Even if the virtual machine has been duplicated (such as within a vCloud), only the original virtual machine retains this instance ID. (The virtual machine duplicates are assigned different instance UUIDs.)
	This option is recommended instead of the **VM BIOS UUID** option.

Orphaned snapshot handling options (VMware)

This option specifies the action that NetBackup takes when a snapshot is discovered before NetBackup creates a new snapshot for the virtual machine backup. After it creates a snapshot, NetBackup usually deletes the snapshot when the backup completes. If snapshots are not automatically deleted (whether created by NetBackup or not), the performance of the virtual machine may eventually decline.

Undeleted snapshots can cause restore failures due to lack of disk space. If the virtual machine was configured on multiple datastores and a leftover snapshot existed on the virtual machine when it was backed up, note: NetBackup tries to restore all .vmdk files to the snapshot datastore. As a result, the datastore may not have enough space for the .vmdk files, and the restore fails. (For a successful restore, you can restore the virtual machine to an alternate location. Use the Storage Destination dialog in the **Virtual Machine Recovery** dialogs to select a datastore for the .vmdk files.)

Table 5-4   Orphaned snapshot handling: Options

Option	Description
Ignore	NetBackup ignores any existing virtual machine snapshots (including snapshots previously created by NetBackup) and proceeds with snapshot creation and the backup.
Abort	If any snapshot exists on the virtual machine, NetBackup aborts the job for that virtual machine only.
Remove NBU	If a virtual machine snapshot exists that a NetBackup backup previously created: NetBackup removes the old snapshot, creates an updated snapshot, and proceeds with the virtual machine backup. (This option is the default.)

Transport modes options (VMware)

The transport modes determine how the snapshot data travels from the VMware datastore to the VMware backup host. The appropriate mode depends in part on the type of network that connects the VMware datastore to the VMware backup host.

By default, all modes are selected. NetBackup tries each transport mode in order, from top to bottom. It uses the first mode that succeeds for all disks in the virtual machine.

Table 5-5   Transport Modes

Mode	Description
san	For unencrypted transfer over Fibre Channel (SAN) or iSCSI.
hotadd	Lets you run the VMware backup host in a virtual machine. See "Notes on the hotadd transport mode" on page 39. For instructions on this transport mode and on installing the backup host in a VMware virtual machine, refer to your VMware documentation.

<div align="center">

Table 5-5   Transport Modes *(continued)*

</div>

Mode	Description
nbd	For unencrypted transfer over a local network that uses the Network Block Device (NBD) driver protocol. This mode of transfer is usually slower than Fibre Channel.
nbdssl	For encrypted transfer (SSL) over a local network that uses the Network Block Device (NBD) driver protocol. This mode of transfer is usually slower than Fibre Channel.
Move Up, Move Down	Use these buttons to change the order in which NetBackup tries each selected mode. Highlight a mode and click Move Up or Move Down. For example: assume that all four transport modes are selected, and the order is san, hotadd, nbd, and nbdssl. If one of the virtual disks cannot be accessed using san, the san transport mode is not used for any of the virtual machine's disks. NetBackup then tries to use the hotadd mode for all the disks. NetBackup continues to try each mode until it finds one that succeeds for all the disks.

Application protection options (VMware)

To enable file-level recovery of database data that resides in the virtual machine, select from the following options. These options apply to full backups of the virtual machine; they do not apply to incremental backups.

<div align="center">

Table 5-6   Application Protection options

</div>

Database option	Description
Enable Exchange Recovery	This option enables recovery of the Exchange databases or mailbox messages from the virtual machine backups. If this option is disabled, you can recover the entire virtual machine from the backup, but you cannot recover the databases or mailbox messages individually. To use the **Enable Exchange Recovery** option, you must enable the **Enable file recovery from VM backup** option. Enable the **Enable block-level incremental backup** option if you use Accelerator. For backups without Accelerator, disable that option. For more information, refer to the *NetBackup for Microsoft Exchange Server Administrator's Guide*.
Truncate logs	For Exchange, this option truncates the transaction logs when the snapshot of the virtual machine is complete. Truncating the logs frees up disk space in the virtual machine. **Note:** To use this option, install the Symantec VSS provider on the virtual machine. For instructions on how to install the Symantec VSS provider, refer to the *NetBackup for Microsoft Exchange Server Administrator's Guide*. If you do not select **Truncate logs**, the logs are not truncated.

	Table 5-6	Application Protection options *(continued)*

Database option	Description
Enable SQL Server Recovery	This option enables recovery of individual files from Microsoft SQL data in the virtual machine backup. If this option is disabled, you can recover the entire virtual machine from the backup, but you cannot recover the SQL files individually.
	To use the **Enable SQL Server Recovery** option, you must enable the **Enable file recovery from VM backup** option. Enable the **Enable block-level incremental backup** option if you use Accelerator. For backups without Accelerator, disable that option.
	For more information, refer to the *NetBackup for Microsoft SQL Server Administrator's Guide*.
Truncate logs	For SQL Server, this option truncates the transaction logs when the backup occurs. Truncating the logs frees up disk space in the virtual machine.
	Note: To use this option, install the Symantec VSS provider on the virtual machine. For instructions on how to install this provider, refer to the *NetBackup for Microsoft SQL Server Administrator's Guide*.
	If you do not select **Truncate logs**, the logs are not truncated.
Enable SharePoint Recovery	This option enables recovery of SharePoint objects from the virtual machine backup. If this option is disabled, you can recover the entire virtual machine from the backup, but you cannot recover the SharePoint objects individually.
	To use the **Enable SharePoint Recovery** option, you must enable the **Enable file recovery from VM backup** option. Enable the **Enable block-level incremental backup** option if you use Accelerator. For backups without Accelerator, disable that option.
	For more information, refer to the *NetBackup for Microsoft SharePoint Server Administrator's Guide*.

VMware - Advanced Attributes dialog

This dialog appears when you click **Advanced** on the **VMware policy** tab.

You can use the VMware Advanced Attributes dialog to set the following additional parameters for VMware backup. In most situations, the best settings are the defaults.

	Table 5-7	VMware Advanced Attributes

Configuration parameter	Description
Virtual machine quiesce	This option is enabled by default. In the great majority of cases, you should accept the default.
	I/O on the virtual machine is quiesced before NetBackup creates the snapshot. Without quiescing file activity, data consistency in the snapshot cannot be guaranteed. If not consistent, the backed up data may be of little or no value.
	If this option is disabled, the snapshot is created without quiescing I/O on the virtual machine. In this case, you must perform your own checks for data consistency in the backup data.
	Caution: Symantec does not recommend that you disable quiesce. In most cases, this option should be enabled.
	Note: To use this option, VMware Tools must be installed on the virtual machine.
	Note: To use this option with Linux virtual machines, you must also install the SYMCquiesce utility.
	See "Installing the SYMCquiesce utility" on page 293.
Virtual disk selection	Determines the kind of disks on the virtual machine that are included in the backup. This option can reduce the size of the backup, but should be used with care. These options are intended only for the virtual machines that have multiple virtual disks.
	The following options are available:
	■ **Include all disks** Backs up all virtual disks that are configured for the virtual machine.
	■ **Exclude boot disk** The virtual machine's boot disk (for example the C drive) is not included in the backup. Any other disks (such as D) are backed up. Consider this option if you have another means of recreating the boot disk, such as a virtual machine template for boot drives. See "About the Exclude disk options for Virtual disk selection" on page 67.
	Note: A virtual machine that is restored from this backup cannot start up. Data files are available in the restored data disks.
	■ **Exclude data disks** The virtual machine's data disks (for example the D drive) are not included in the backup for this policy. Only the boot disk is backed up. Consider this option only if you have a different policy that backs up the data disks. See "About the Exclude disk options for Virtual disk selection" on page 67.
	Note: When the virtual machine is restored from the backup, the virtual machine data for the data disk may be missing or incomplete.
	See "Restoring data from the backups that excluded the boot disk or data disks" on page 69.

| Table 5-7 | VMware Advanced Attributes *(continued)* |

Configuration parameter	Description
Ignore diskless VMs	If this option is enabled:
	NetBackup does not back up a replicated (passive) VM in a vCenter Site Recovery Manager (SRM) environment if that VM has no vmdk files. NetBackup skips that VM and backs up the corresponding active VM, which has vmdk files.
	Note that virtual machines without vmdk files can occur in a vCenter SRM environment. If a replicated virtual machine has never been active, it is in passive mode and may have no vmdk file(s).
	Note: If this option is enabled and NetBackup does not have access to the vCenter where the active virtual machine runs: the Query Builder policies run without error and no attempt is made to back up the virtual machine. For the policies that use manual selection of virtual machines, backups fail with status 156, because the virtual machine cannot be located.
	If this option is disabled:
	NetBackup attempts to back up a virtual machine regardless of whether it has vmdk files. If the virtual machine has no vmdk files, the backup fails with status 156.

	Table 5-7	VMware Advanced Attributes *(continued)*

Configuration parameter	Description
Post events to vCenter	Enables NetBackup to send backup related events to the vCenter server. The events appear in vSphere Client under **Home > Inventory > Hosts and Clusters**, **Tasks & Events** tab. More information is available on how to view the events:
	Note: To post events to vCenter, NetBackup must perform the backup through a vCenter server. If NetBackup accesses the ESX server directly, the backup information cannot be displayed in vSphere Client.
	See "Viewing NetBackup activity in vSphere Client" on page 126.
	You must set the required permissions in vCenter:
	See "Setting privileges for posting events to vCenter" on page 47.
	This option also records the date and time of the last successful backup of the virtual machine. The date and time appear in vSphere Client on the **Summary** tab as a custom attribute under **Annotations**. The attribute is labeled NB_LAST_BACKUP.
	For **Post events to vCenter**, the following options are available:
	■ All Events NetBackup posts an event to vCenter server on each backup success or failure. This setting is the default. ■ No Events Disables the **Post events to vCenter** option. NetBackup does not post any events to the vCenter server. ■ Error Events NetBackup posts an event to the vCenter server only for backup failures.
	Note: If a vSphere administrator created an attribute named NB_LAST_BACKUP of type Global, NetBackup cannot post backup events to that attribute. You must remove the NB_LAST_BACKUP attribute from vSphere. Make sure that **Post events to vCenter** is set to All Events or Error Events. At the next backup, NetBackup creates a NB_LAST_BACKUP attribute of type Virtual Machine and posts events to that attribute.
Multiple organizations per policy	This option is disabled by default. If it is enabled, the query rules can select virtual machines from different vCloud Director organizations and back them up to the same storage unit.
	If you do not want backups of virtual machines from different organizations to be stored on the same drive, leave this option disabled.

Table 5-7   VMware Advanced Attributes *(continued)*

Configuration parameter	Description
Ignore Instant Recovery VMs	If this option is enabled (the default): NetBackup skips any virtual machine that was restored with Instant Recovery for VMware if the virtual machine is running from a NetBackup NFS datastore.
	When the virtual machine data files have been migrated to the production datastore, the virtual machine can be backed up.
	NetBackup identifies Instant Recovery virtual machines according to the following criteria:
	■ The virtual machine has a snapshot that is named `NBU_IR_SNAPSHOT`,
	■ And the virtual machine is running from a datastore and the name of the datastore begins with `NBU_IR_`.
	If the virtual machine meets all these criteria, it is not backed up if this option is enabled.
	If this option is disabled: NetBackup backs up the virtual machine even if it is running from the NetBackup NFS datastore.
Snapshot retry count	Sets the number of times the snapshot is retried. The default is 10. The range is 0 to 100.
	This option and the snapshot timeout and snapshot creation interval provide flexibility in the creation of snapshots. For most environments, the default values are usually best. In special circumstances, it may be helpful to adjust these settings. Example considerations are the size of the virtual machine and the processing load on the VMware server.
Snapshot timeout (minutes)	Sets a timeout period (in minutes) for completion of the snapshot. The default is 0, which means no timeout.
	If snapshots do not complete, set this option to a specific period to force a timeout. Consider using the snapshot creation interval to retry the snapshot at a later time.
Snapshot creation interval (seconds)	Determines the wait time (in seconds) before the snapshot is retried. The default is 10 seconds. The range is 0 to 3600.

| Table 5-7 | VMware Advanced Attributes *(continued)* |

Configuration parameter	Description
VMware server list	Specifies a colon-delimited list of virtual machine servers that NetBackup communicates with for this policy. In large virtual environments, you can use this list to improve backup performance: NetBackup communicates only with the servers that are in this list. For example, exclude from the list any vCenter or vCloud servers that do not contain virtual machines to be backed up by this policy. Also, if a duplicate of the virtual machine exists on a different server: the duplicate is not backed up if it resides on a server that is not included in this list. **Note:** Each host name must match exactly the name as configured in the NetBackup credentials. **Note:** Separate the names with a colon (:) not a comma (,). This option does not affect either of the following: the list of all possible values in the Query Builder for automatic selection of virtual machines, or browsing of virtual machines for manual selection. If the list is blank (the default), NetBackup communicates with any servers in the virtual environment.

About the Exclude disk options for Virtual disk selection

The VMware - Advanced Attributes dialog has an option called **Virtual disk selection**. The default setting is **Include all disks**. You should use this setting in most cases.

The other options are **Exclude boot disk** and **Exclude data disks**. These options are intended for the virtual machines that have multiple virtual disks. You should use these options with care.

To exclude a boot disk or data disk, note the following requirements:

- The virtual machine must have more than one disk.

- NetBackup must be able to identify the boot disk.

- The boot disk must not be part of a managed volume (Windows LDM or Linux LVM). The boot disk must be fully contained on a single disk.

The boot disk must include the following:

- The boot partition.

- The system directory (Windows system directory or Linux boot directory).

Important! The exclude disk options are meant only for the following cases:

- **Exclude boot disk**: Consider this option if you have another means of recreating the boot disk, such as a virtual machine template for boot drives. If **Exclude boot disk** is enabled, the policy does not back up the boot disk.

Note: When the virtual machine is restored from the backup, the virtual machine data for the boot disk may be missing or incomplete.

Note the following about **Exclude boot disk**:

- If the virtual machine has a boot disk but has no other disks, the boot disk is backed up. It is not excluded.

- If the virtual machine's boot disk is an independent disk, but the virtual machine has no other disks, the boot drive is backed up. The restored boot drive however contains no data, because NetBackup cannot back up the data in an independent disk.

- If the virtual machine has a boot drive and an independent drive, the boot drive is not backed up. Only the independent drive is included in the backup. Since NetBackup cannot back up the data in an independent disk, the restored independent disk contains no data. Refer to the explanation on independent disks in the following topic:
  See "NetBackup for VMware terminology" on page 25.

- Adding a virtual disk and changing this option before the next backup can have unexpected results.
  See "Virtual disk selection options: examples to avoid" on page 69.

- **Exclude data disks**: Consider this option if you have a different policy or other backup program that backs up the data disks. If **Exclude data disks** is enabled in a policy, that policy does not back up the data disks.

  Note the following about **Exclude data disks**:

  - If the virtual machine has only one disk (such as C:), that drive is backed up. It is not excluded.

  - If the virtual machine's boot disk is an independent disk, and the virtual machine has a separate data disk, the boot disk is backed up. The restored boot disk however contains no data, because NetBackup cannot back up the data in an independent disk.

Note: When the virtual machine is restored from the backup, the virtual machine data for the data disk may be missing or incomplete.

Caution: Use of the exclude disk options can have unintended consequences if these rules are not followed.

The following topics contains important guidance on the exclude disk options:

Virtual disk selection options: examples to avoid

You should use the **Virtual disk selection** option with care. For example, if you add a disk to the virtual machine and change the **Virtual disk selection** setting, note: The next backup may not capture the virtual machine in the state that you intended. You should back up the entire virtual machine (**Include all disks**) before using **Virtual disk selection** to exclude a disk from future backups.

Note: When you change an exclude disk option to disabled, do a full backup (**Virtual disk selection** set to **Include all disks**) before the next incremental or differential backup.

Restoring data from the backups that excluded the boot disk or data disks

If the policy's **Virtual disk selection** option excluded the boot disk or data disks, you can restore the backed up data as follows:

- If **Enable file recovery from VM backup** was enabled on the backup policy: You can restore individual files from those portions of the virtual machine that the Virtual disk selection option did not exclude.
  See "Restoring individual files" on page 157.

- If the **Virtual disk selection** option was set to **Exclude boot disk**: You can restore the virtual machine and move the restored data disk(s) to another virtual machine.

Browse for VMware Virtual Machines

When you configure a NetBackup policy, you can use the Browse for Virtual Machines screen to select virtual machines for backup. You can enter the virtual machine's host name manually or browse and select it from a list.

As an alternative, NetBackup can automatically select virtual machines based on a range of criteria.

See "About automatic virtual machine selection for NetBackup for VMware" on page 80.
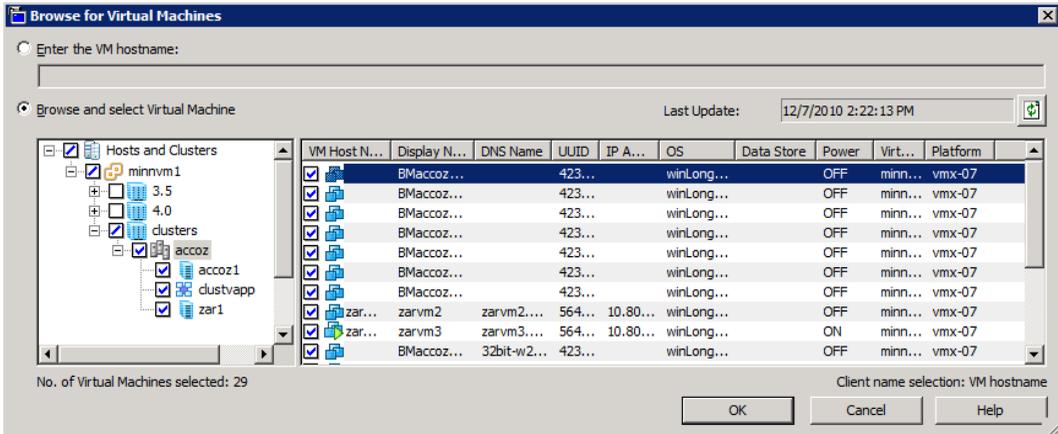
■ **Enter the VM hostname**

Click this option if you want to manually enter the name of a virtual machine. The format of the name depends on your system. It may be the fully qualified name or another name, depending on your network configuration and how the name is defined in the guest OS. If NetBackup cannot find the name you enter, policy validation fails.

To enter a host name, make sure that **Browse and select Virtual Machine** is not selected.

■ **Browse and select Virtual Machine**

Click this option to discover vCenter servers, clusters, datacenters, vApps, and ESX servers (shown in the left pane). You can select virtual machines from a list (in the right pane).

NetBackup uses the following icons for vSphere objects:

 vCenter server

 Datacenter

 Cluster
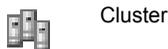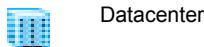
 vApp

ESX server

Virtual machine

The virtual machines that are contained in a VMware vApp are displayed in the right pane along with other virtual machines.

The virtual machine names that are listed may be derived from a cache file. Use of the cache file is faster than rediscovering the virtual machines on the network if your site has a large number of virtual machines.

If NetBackup cannot obtain the IP address of the virtual machine, the host name and IP address are displayed as NONE.

Note that virtual machine host names or display names must be unique within a master server's policies:

See "Virtual machine host names and display names must be unique in a master server's policies" on page 75.

- **Last Update**

  To update the cache file and re-display virtual machines, click the refresh icon to the right of the **Last Update** field. This field shows the date and time of the most recent cache file that contains the names of virtual machines.

  For NetBackup to access the virtual machines, note the following:

  - The NetBackup master server must have credentials for the VMware vCenter or ESX server(s).
    See "Adding NetBackup credentials for VMware" on page 42.

  - DNS problems may prevent or slow down discovery of the virtual machines.
    See "Preventing browsing delays caused by DNS problems" on page 214.

  - To limit the search to particular vCenter or ESX servers, you can create a `BACKUP` registry entry as an exclude list. Excluding unneeded servers can dramatically speed up the search for virtual machines.
    See "Limiting the VMware servers that NetBackup searches when browsing for virtual machines" on page 73.

  - The browsing timeout value must not be set too low.
    See "Changing the browsing timeout for virtual machine discovery" on page 215.

- **VM Host Name, Display Name, UUID,** etc.

When you select an ESX server in the left pane, information about its virtual machines appears in columns in the right pane. You can change the arrangement of these columns by right-clicking on any of the column headers.

The columns are the following:

VM Host Name	The host name of the virtual machine.
Display Name	The display name of the virtual machine.
UUID	The UUID of the virtual machine.
VM DNS Name	The VMware "DNS Name" of the virtual machine. In vSphere Client, this name appears on the virtual machine's Summary tab. See "Primary VM identifier options (VMware)" on page 58.
IP Address	The IP address of the virtual machine.
OS	The guest OS system as defined when the virtual machine was created.
Data Store	The datastore where the virtual machine configuration files are stored. If the datastore is in a datastore cluster, NetBackup displays the name of the datastore (not the name of the cluster).
Power	The power on/off status of the virtual machine when it was last discovered.
RDM Status	Shows whether the virtual machine has a physical disk in raw device mapping mode (RDM) or has an independent drive.
Platform	The VMware release version of the virtual machine (vmx-04, vmx-07, or vmx-08).
Discovered Timestamp	The time and date at which the virtual machine's UUID was initially discovered and cached.
Change Tracking Support	Shows whether the virtual machine supports the VMware Changed Block Tracking feature (for BLIB). Changed Block Tracking requires ESX server 4.0 and a virtual machine at vmx-07 or later.
ESX Host	The ESX server in which the virtual machine resides (also appears in the left pane).
Data Center	The datacenter that contains the virtual machine (also appears in the left pane).

VirtualCenter Name	The vCenter server that manages the ESX server (also appears in the left pane).

The virtual machines you selected are listed in the **Clients** tab.
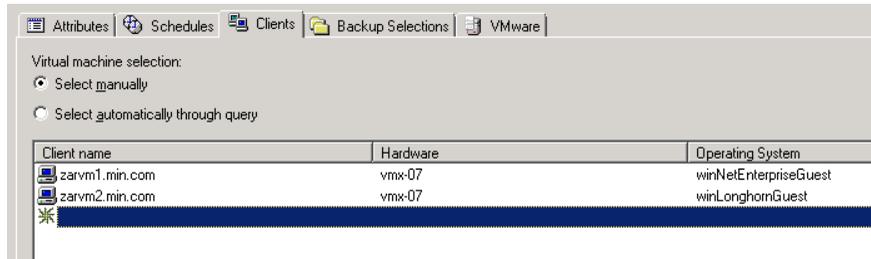
Limiting the VMware servers that NetBackup searches when browsing for virtual machines

As part of creating a NetBackup policy, you must specify which virtual machines to back up. One approach is to let NetBackup search the network and list all available virtual machines. However, if your VMware environment contains many VMware servers and virtual machines, it may take too long to search and list all of them. For example, consider an environment with 10 vCenter servers. To back up the virtual machines on one of the 10 vCenter servers, browsing virtual machines on all 10 servers is unnecessary.

To speed up browsing, you can exclude particular VMware servers from the search. When it probes the network for virtual machines, NetBackup queries only the VMware servers that are not named in the exclude list for the backup-host.

Use one of the following procedures, depending on the platform of the backup host (Windows or Linux).

To limit the VMware servers that NetBackup discovers, per Windows backup host

1   On the Windows desktop of the backup host, click **Start > Run** and enter `regedit`.

2   To be on the safe side, make a backup of the current registry (**File > Export**).

3   Go to **HKEY_LOCAL_MACHINE > SOFTWARE > Veritas > NetBackup > CurrentVersion > Config** and create a key called `BACKUP`.

4   Right-click in the right pane and click **New > String Value**. Enter `excludeVMservers` as the name.

5   Right-click the `excludeVMservers` name and click **Modify**.

6   In the **Edit String** dialog, enter a comma-delimited list of the VMware servers that are NOT to be queried when NetBackup browses the network. Do not enter spaces. You can enter vCenter servers and individual ESX servers.

Note: The exclude list is used on the next backup. If any bpfis processes are running, the exclude list has no effect on them.

The exclude list applies only to this backup host. The servers are not queried when NetBackup browses for virtual machines to list on the policy's **Browse for Virtual Machines** dialog of the NetBackup Administration Console.

To limit the VMware servers that NetBackup discovers, per Linux backup host

1   On the Linux backup host, create (or open) the following file:

`/usr/openv/netbackup/virtualization.conf`

2   Add the following to the file:

```
[BACKUP]
"excludeVMservers"="server1,server2,server3"
```

where *server1,server2,server3* is a comma-delimited list of the VMware servers that are NOT to be queried when NetBackup browses the network. Do not enter spaces. You can enter vCenter servers and individual ESX servers.

Note: If the file already contains a `[BACKUP]` line, do not add another `[BACKUP]` line. Any other lines that already exist under `[BACKUP]` should remain as they are.

3   Save the file.

Note: The exclude list is used on the next backup. If any bpfis processes are running, the exclude list has no effect on them.

The exclude list applies only to this backup host. The servers are not queried when NetBackup browses for virtual machines to list on the policy's **Browse for Virtual Machines** dialog of the NetBackup Administration Console.

As an alternative, NetBackup can automatically select virtual machines based on a range of criteria.

See "About automatic virtual machine selection for NetBackup for VMware" on page 80.

Virtual machine host names and display names must be unique in a master server's policies

Certain VMware environments do not require unique names for virtual machines. For instance, virtual machines within a vCenter server can have the same host or display names as virtual machines in another vCenter server. The same is true of datacenters, which are logical groupings of virtual resources within a vCenter server. Virtual machine host names or display names must be unique within a datacenter. They do not need to be unique between two datacenters on the same vCenter. A virtual machine named VM1 can exist in datacenter A. Another virtual machine (also named VM1) can exist in datacenter B, on the same vCenter server.

Identically named virtual machines however present a problem in the following case: the same NetBackup master server is configured to back up the virtual

machines by means of the same host name or display name. The virtual machines that are backed up by a particular NetBackup master server must be uniquely identified across all of its policies.

To back up the two virtual machines named VM1, do one of the following:

- Change their VMware names so they are unique in the master server's policies.

- Configure the policies to identify the virtual machines by their UUIDs. Use the type of UUID that is appropriate for your virtual machine environment.
  See "Primary VM identifier options (VMware)" on page 58.

Primary VM identifier option and manual selection of virtual machines

This topic applies to the manual selection of virtual machines on the NetBackup **Browse for VMware Virtual Machines** screen.

A change to the policy's **Primary VM identifier** value can affect backups. If you change this option, you may have to delete the virtual machine selections on the **Clients** tab and re-enter them. Otherwise, NetBackup may no longer be able to identify the virtual machines to back up.

For example, the host names in the **Clients** tab cannot be used and the virtual machines are not backed up in the following case:

- If you change the **Primary VM identifier** from **VM hostname** to **VM display name**, and

- The display names of the virtual machines are different from the host names.

In this case, delete the host name entries on the **Clients** tab and browse the network to select the virtual machines by display name.

See "Browse for VMware Virtual Machines" on page 69.

Note: When creating virtual machines, use the same name for both host name and display name. If the **Primary VM identifier** is changed, the existing entries on the **Clients** tab still work.

If the policy selects virtual machines automatically, refer to the following topic:

See "Effect of Primary VM identifier parameter on Selection column in Test Query results" on page 114.

About incremental backups of virtual machines

NetBackup enables full virtual machine and file-level incrementals in the same backup (the **Enable file recovery from VM backup** option).

Better support for incremental backup is available when you use BLIB (**Enable block-level incremental backup**). BLIB requires ESX 4.x and virtual machines at vmx-07 or later.

Note: Individual file recovery is supported from full backups and from incremental backups, as long as the **Enable file recovery from VM backup** policy option is enabled.

Note: Make sure that the virtual machines to back up are time synchronized with the backup host. Otherwise, some changed data may not be included in the backup, depending on the clock differential between the backup host and the virtual machine.

Note: For incremental backups, you do not have to configure the client on the VMware backup host for timestamps. The VMware policies automatically default to the use of timestamps.

Configuring incremental backups

Use the following procedure for virtual machine backup.

To configure incremental backup of a virtual machine

1   In the NetBackup policy **Attributes** tab, select the **VMware** policy type.

2   On the **VMware** tab, select the VMware backup host.

3   Optional: for BLIB, select **Enable block-level incremental backup**.

4   Select **Enable file recovery from VM backup**.

   More information is available on the VMware options.

5   Click **OK**.

6   On the **Schedules** tab, select **Differential Incremental Backup** or **Cumulative Incremental Backup**.

7   Fill in the **Clients** tab.

Storage Foundation Volume Manager volumes in the virtual machine

To back up a virtual machine that contains Veritas Storage Foundation Volume Manager volumes, make sure the following options on the policy's VMware tab are disabled:

Enable file recovery from VM backup

Exclude deleted blocks.

Note: Restore of selected files from a backup of the full virtual machine is not supported if the virtual machine contains Storage Foundation Volume Manager volumes.

See "NetBackup for VMware: notes and restrictions" on page 33.

About older NetBackup policies and pre-7.x backup hosts

A NetBackup 7.x master server can use the policies that were created for NetBackup 6.5.x. NetBackup however does not convert the 6.5.x options to 7.x options. It uses the policies as is, without modification or conversion.

Even if the policies are updated to the 7.x options, a 6.5.x backup host ignores those options. The backup host must be updated to 7.x to recognize and use the 7.x policy options.

Configure automatic selection of virtual machines for backup

This chapter includes the following topics:

- Query rules for resource pools

- Query rules for datacenter folders (host folder)

- Query rules for duplicate names

- Query Builder field reference

- Test Query screen

- Test Query: Failed virtual machines

- Effect of Primary VM identifier parameter on Selection column in Test Query results

- Effect of Primary VM identifier parameter on VM Name column in Test query results

About automatic virtual machine selection for NetBackup for VMware

Instead of manually selecting the virtual machines for backup, you can configure NetBackup to automatically select virtual machines based on a range of criteria. You specify the criteria (rules) in the **Query Builder** on the NetBackup policy **Clients** tab. NetBackup creates a list of the virtual machines that currently meet the rules and adds those virtual machines to the backup.

This feature is called the Virtual Machine Intelligent Policy.

Automatic selection of virtual machines has the following advantages:

- Simplifies the policy configuration for sites with large virtual environments.
  You do not need to manually select virtual machines from a long list of hosts: NetBackup selects all the virtual machines that meet the selection rules in the policy's Query Builder.

- Allows the backup list to stay up-to-date with changes in the virtual environment. Eliminates the need to revise the backup list whenever a virtual machine is added or removed.

- Virtual machine selection takes place dynamically at the time of the backup.

Examples of automatic virtual machine selection are the following:

Table 6-1   Examples for automatic virtual machine selection

Example	Description
Add new virtual machines	At the next backup, the policy can automatically discover the virtual machines that have recently been added to the environment. If the virtual machines match the query rules that you configure in the policy, they are automatically backed up.
Limit the backup list to the virtual machines that are currently turned on	If some of your virtual machines are occasionally turned off, NetBackup can be configured to automatically exclude those from the backup list. Among the virtual machines it discovers, NetBackup backs up only the virtual machines that are turned on.
Back up virtual machines based on physical boundaries	Examples of physical boundaries are vCenter servers, ESX servers, datastores, and clusters. For example, a query rule can select all the virtual machines in a particular ESX server, so the policy backs up only those virtual machines.
Back up virtual machines based on logical boundaries	Examples of logical boundaries are folders, vApps, templates, and resource pools. For example, a query rule can select all the virtual machines in a particular folder, so the policy backs up only those virtual machines.

The basics of a NetBackup query rule

For automatic virtual machine selection, NetBackup uses query rules to determine which VMware virtual machines to select for backup. You create the rules in the Query Builder, on the **Clients** tab of the policy.

A query rule consists of the following:

- A keyword, such as **Displayname** or **Datacenter** (many keywords are available). For example: For automatic selection of the virtual machines with the display names that contain certain characters, you need the **Displayname** keyword in the rule.

- An operator, such as **Contains**, **StartsWith**, or **Equal**. The operator describes how NetBackup analyzes the keyword. For example: **Displayname StartsWith** tells NetBackup to look for the display names that start with particular characters.

- Values for the keyword.

For the **Displayname** keyword, a value might be "prod". In that case, NetBackup looks for the virtual machines that have the display names that include the characters prod.

- An optional joining element (AND, AND NOT, OR, OR NOT) to refine or expand the query.

The policy uses these elements to discover and select virtual machines for backup.

Table 6-2 contains the examples of rules.

Table 6-2   Examples of rules

Rule	Description
Displayname Contains "vm"	NetBackup selects the virtual machines that have the characters vm anywhere in their display names.
Displayname EndsWith "vm"	NetBackup selects the virtual machines that have the characters vm at the end of their display names.
Datacenter AnyOf "datacenter1","datacenter2"	NetBackup selects the virtual machines that use datacenter1 or datacenter2.
Powerstate Equal poweredOn	NetBackup selects only the virtual machines that are currently turned on.

Important notes on automatic virtual machine selection

The Virtual Machine Intelligent Policy feature in NetBackup is a different approach to VMware virtual machine selection in the policy. It represents a paradigm shift in the way you select virtual machines for backup. As with all major changes, the effective use of this feature requires forethought, preparation, and care.

Table 6-3   Important notes on automatic virtual machine selection!

Note!	Explanation
Create rules carefully....	Instead of manually selecting virtual machines for backup, you create guidelines for automatic selection of virtual machines. The guidelines are called rules; you enter the rules in the policy's query builder.
	You make the rules, and NetBackup follows them.
	If the rules state: Back up all virtual machines with a host name that contains "prod", NetBackup does that. Any virtual machine that is added to the environment with a host name containing "prod" is automatically selected and backed up when the policy runs. Virtual machines with the names that do not contain "prod" are not backed up. To have other virtual machines automatically backed up, you must change the query rules (or create additional policies).
Changes to the virtual environment can affect backup times.	If many virtual machines are temporarily added to your environment and happen to fall within the scope of the query rules, they are backed up. The backups can therefore run much longer than expected.
Test the query rules.	Test the query rules ahead of time. The policy includes a Test Query function for that purpose. It's important to verify that your query operates as expected. Otherwise, the query may inadvertently select too many or too few virtual machines.
	As an alternative, you can use the `nbdiscover` command to test a query. Refer to the *NetBackup Commands Reference Guide*.
	Note also: The policy's **Primary VM identifier** parameter can affect the automatic selection process.
	See "Effect of Primary VM identifier parameter on Selection column in Test Query results" on page 114.

Table 6-3   Important notes on automatic virtual machine selection! *(continued)*

Note!	Explanation
A query test does not create the backup list. NetBackup creates the backup list when the backup runs. Query test Backup execution	The automatic selection process is dynamic. Changes in the virtual environment may affect which virtual machines the query rules choose when the backup runs. **Note:** If virtual machine changes occur, the virtual machines that are selected for backup may not be identical to those listed in your query test results.
The policy does not display a list of the virtual machines that are to be backed up. Use the Activity Monitor or OpsCenter. 	If you select virtual machines manually (with the Browse for Virtual machines screen), the selected virtual machines are listed on the policy Clients tab. But when you use the query builder for automatic selection, the selected virtual machines are not listed on the **Clients** tab. For a list of the backed up virtual machines, use the NetBackup Activity Monitor or the OpsCenter web interface. See "Using the Activity Monitor to monitor virtual machine backups" on page 124. See "Using OpsCenter to report on virtual machine backups" on page 129.
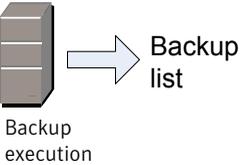
| Table 6-3 | Important notes on automatic virtual machine selection! *(continued)* |

Note!	Explanation
When you save the policy, the query rules are not validated. Policy	When you save a policy, policy validation does not consult the query rules and select virtual machines for backup. Because of the potential for changes in the virtual environment, virtual machine selection must wait until the backup runs. As a result, when you save the policy, NetBackup does not check the policy attributes against a backup list. If the query rules select the virtual machines that are incompatible with a policy attribute, policy validation cannot flag that fact. The incompatibility becomes apparent when NetBackup determines the backup list at the time of the backup. Take for example a policy that is configured for **Enable block-level incremental backup** (BLIB). BLIB works only with ESX 4.0 virtual machines at version vmx-07 or later. If the query rules select a virtual machine at a version earlier than vmx-07, the policy cannot back up that virtual machine. The mismatch between the policy and the virtual machine is revealed when the backup runs, not when the policy is validated. The Activity Monitor's job details log indicates which virtual machines can or cannot be backed up.
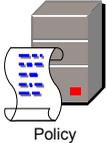
NetBackup requirements for automatic virtual machine selection

Note the following requirements for automatic selection of VMware virtual machines:

- The system where the NetBackup Administration Console runs must have access to the vCenter server.

- The NetBackup master server must have network access to the VMware servers that NetBackup has credentials for.

- Automatic virtual machine selection requires no additional license beyond the NetBackup Enterprise Client license.

- Refer to the following Symantec document for updates on NetBackup support requirements:
  Support for NetBackup 7.x in virtual environments
  http://www.symantec.com/docs/TECH127089

Automatic virtual machine selection: Task overview

This topic is a high-level overview of how to set up a NetBackup policy for automatic selection of VMware virtual machines. Follow the links in the table for more details.

| Table 6-4 | Automatic selection of virtual machines: overview of the tasks |

Steps to configure automatic selection	Description and notes
Configure a VMware policy	Use the policy Attributes tab. See "Configuring a VMware policy from the Policies utility" on page 52.
Set rules for virtual machine selection in the policy Query Builder	On the policy **Clients** tab, click **Select automatically through query**. Choose a host for virtual machine selection (default is the VMware backup host). To add rules, use the Query Builder drop-down fields. See "Configuring automatic virtual machine selection" on page 89. See "Options for selecting VMware virtual machines" on page 86.
Test the rules	Click **Test Query** in the Query Builder on the **Clients** tab. Virtual machines are labeled as included or excluded, based on the rules. **Note:** The list of virtual machines is not saved in the **Clients** tab. **Note:** The query rules are also displayed in the **Backup Selections** tab. The backup selections are pre-set to All_LOCAL_DRIVES (not displayed). As an alternative, you can use the nbdiscover command to test a query. Refer to the *NetBackup Commands Reference Guide*.
Execute a backup	When the policy executes, NetBackup consults the rules in the Query Builder, creates a list of virtual machines, and backs them up.
Check the backup	To see which virtual machines were backed up, use the Activity Monitor, or run a **Virtual Client Summary** report in OpsCenter. See "Using the Activity Monitor to monitor virtual machine backups" on page 124. See "Using OpsCenter to report on virtual machine backups" on page 129.

Options for selecting VMware virtual machines

This topic describes the options on the policy **Clients** tab or on the **Automatic Discovery Options** panel of the Policy Wizard.

You can use these options to manually select virtual machines, or to configure NetBackup to select virtual machines automatically. For automatic selection, you specify the selection criteria (rules) in the policy's Query Builder. When the backup job runs, NetBackup discovers the virtual machines that currently meet the criteria and backs up those virtual machines.

A procedure is available.

See "Configuring automatic virtual machine selection" on page 89.

Table 6-5 Virtual machine selection (not available on the **Automatic Discovery Options** wizard panel)

Option	Description
Select manually	Click this option and click **New** to manually enter virtual machines names, or to browse and select them from a list.
	See "Browse for VMware Virtual Machines" on page 69.
	Note: The rest of the fields and options are for automatic selection of virtual machines.
Select automatically through query	Click this option to allow NetBackup to automatically select virtual machines for backup based on the rules that you enter in the Query Builder.
NetBackup host to perform automatic virtual machine selection	This host discovers virtual machines and automatically selects them for backup based on your query rules. The resulting list determines which virtual machines are backed up.
	To designate your media servers as discovery hosts, select **Backup Media Server** from the pull-down.

Table 6-6 Query Builder

Option	Description
Query Builder (Join, Field, Operator, Values)	Use these pull-down fields to define rules for automatic selection of virtual machines. From left to right, each pull-down refines the rule.
	Click the plus sign to add the rule to the **Query** pane.
	Click the reset icon (curved arrow) to blank out the pull-down fields.
	See "Query Builder field reference" on page 104.
	See "Examples for the NetBackup Query Builder" on page 95.
Advanced	Places the Query Builder in Advanced Mode for manual entry of rules.
	See "Using the Query Builder in Advanced Mode" on page 92.
	See "Query Builder field reference" on page 104.
	See "Examples for the NetBackup Query Builder" on page 95.
Basic	Returns the Query Builder from Advanced Mode to Basic Mode.
	See "Query Builder field reference" on page 104.

Table 6-6   Query Builder *(continued)*

Option	Description
Edit	Use this option to change an existing query rule when in Basic Mode, as follows: ■ Click the rule and then click **Edit**. ■ Make new selections in the Query Builder pull-down fields. ■ Click the save option (diskette icon).
Remove	Deletes a query rule when in Basic Mode. Click on the rule and then click **Remove**.
Test Query	Click this option to test which virtual machines NetBackup selects based on the rules in the Query Builder. **Note:** This test option does not create the backup list for the policy. When the next backup runs from this policy, NetBackup re-discovers virtual machines and consults the query rules. At that time, NetBackup backs up the virtual machines that match the rules. See "Test Query screen" on page 111. As an alternative, you can use the `nbdiscover` command to test a query. Refer to the *NetBackup Commands Reference Guide*.
Reuse VM selection query results for:	Sets the refresh rate of an internal cache of the query results. NetBackup uses the cache to determine which virtual machines to select at the time of the backup. The cache speeds up the selection of virtual machines without burdening the vCenter server at each scheduled backup. A faster cache refresh rate synchronizes the cache with the changes recorded in vCenter, such as the addition or removal of virtual machines. However, each cache refresh consumes vCenter resources. With a slower refresh rate, new virtual machines may not be included immediately in the next backup. New or changed virtual machines are included when the cache is refreshed. Note that fewer vCenter resources are consumed with a slower refresh rate. The default is eight hours. For eight hours, NetBackup uses the cache and does not attempt to rediscover virtual machines. Changes to the virtual environment do not affect the cache during that period. After eight hours, the next execution of the policy causes NetBackup to rediscover virtual machines. If any changes match a rule in the query, the list of selected virtual machines is modified accordingly. **Note:** The cache is refreshed before the next scheduled backup whenever the policy is changed and saved. More information is available on the **Reuse VM selection query results for:** option: See "About the Reuse VM selection query results option" on page 284.

Configuring automatic virtual machine selection

NetBackup can automatically select VMware virtual machines for backup based on the criteria that you enter. You specify the criteria (rules) in the Query Builder on the NetBackup policy **Clients** tab. You can set up rules to include certain virtual machines for backup, or to exclude virtual machines.

When the backup job runs, NetBackup creates a list of the virtual machines that currently meet the query rules and backs them up.

The following is the policy Clients tab with **Select automatically through query** selected.

Figure 6-1   Policy Clients tab for automatic selection of virtual machines
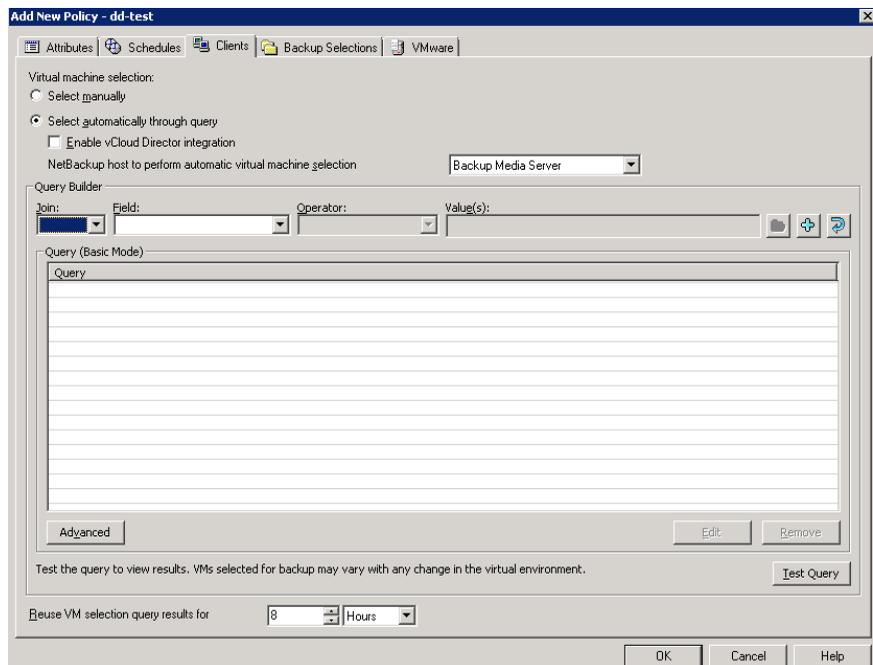
The Query Builder can operate in Basic Mode or in Advanced Mode.

To configure automatic virtual machine selection in Basic Mode

1   On the policy **Attributes** tab, select **VMware** for the policy type.

2   On the policy **VMware** tab, select a VMware backup host.

    Review the other options on the **VMware** tab.

    See "Backup options on the VMware tab" on page 56.

3   Make other policy selections as needed (for example, create a Schedule).

4   Click the **Clients** tab, and click **Select automatically through query**.

       If you selected virtual machines in the **Browse for Virtual Machines** dialog, those virtual machines are removed from the policy.

5   To back up virtual machines in vCloud Director, click **Enable vCloud Director integration**.

       More information is available on backups and restores into vCloud.

       See "About NetBackup for vCloud Director" on page 191.

Note: Enable vCloud Director integration makes several vCloud Director keywords available in the policy Query Builder Field, for rule-based selection of virtual machines. If this option is not selected, NetBackup cannot use the vCloud keywords to locate virtual machines in vCloud Director, and the backup fails.

---

6 To create a rule, make selections from the pull-down menus.

For the first rule, you can start with the **Field** pull-down, depending on the type of rule. (For the first rule, the only selections available for the **Join** field are blank (none), or NOT.)
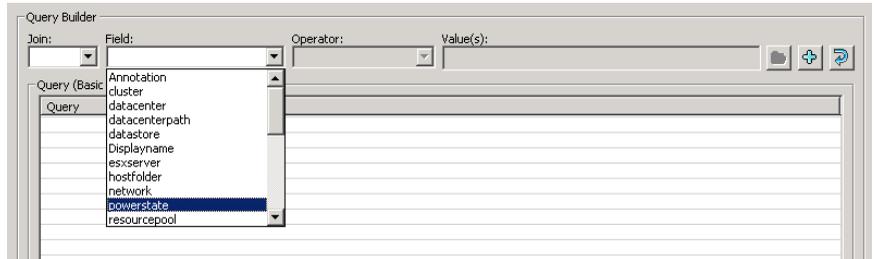
For the **Value(s)** field: you can click the folder icon to browse for values, enter the value manually, or in some cases use the **Value(s)** drop-down. The characters you enter in the **Values** field must be enclosed in single quotes or double quotes. Note that browsing for values may take some time in large virtual environments.

See "Query Builder field reference" on page 104.
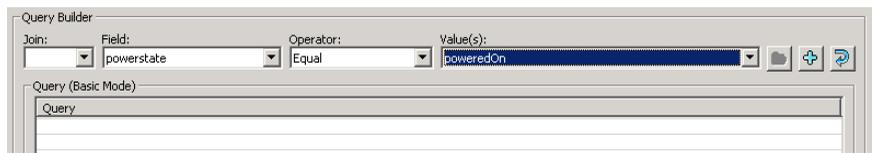
7 Click the plus sign to add the rule to the **Query** pane.
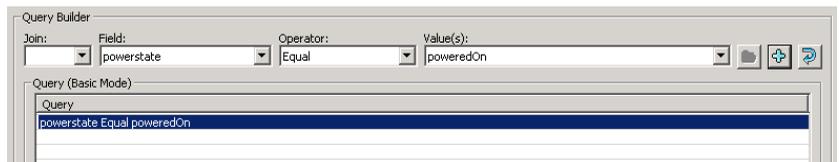
8 Create more rules as needed.

See "Query Builder field reference" on page 104.

See "Examples for the NetBackup Query Builder" on page 95.

9   To see which virtual machines NetBackup currently selects based on your
     query, click **Test Query**.

     On the Test Query screen, the Virtual machines in your current environment
     that match the rules for selection in the policy are labeled INCLUDED. Note
     however that the Test Query option does not create the backup list for the
     policy. When the next backup runs from this policy, NetBackup re-discovers
     virtual machines and consults the query rules. At that time, NetBackup backs
     up the virtual machines that match the query rules.

     The list of virtual machines is saved but the virtual machines are not displayed
     in the policy's **Clients** tab.

     See "Test Query screen" on page 111.

10   You can specify how long NetBackup uses the latest query results as the
     backup list for future executions of the policy. Set the time period in **Reuse VM
     selection query results for**.

     The default is eight hours.

     More information is available on this setting:

     See "About the Reuse VM selection query results option" on page 284.

11   To create queries manually (Advanced Mode) instead of using the pull-down
     menus, click **Advanced**.

     See "Using the Query Builder in Advanced Mode" on page 92.

Editing an existing query in Basic Mode

To edit an existing query in Basic Mode

1   Click on the query rule you want to change and click **Edit**.

2   Make selections in the pull-down menus.

3   Click the save option (diskette icon).

4   To delete a rule, click on it and click **Remove**.

See "Using the Query Builder in Advanced Mode" on page 92.

Using the Query Builder in Advanced Mode

The Query Builder's Advanced Mode provides more flexibility in crafting rules for
virtual machine selection, including the use of parentheses for grouping.

To use the Query Builder in Advanced Mode

1 Set up a VMware policy and specify a VMware backup host or backup media server.

For assistance, you can refer to the first few steps of the following procedure:

See "Configuring automatic virtual machine selection" on page 89.

2 Click the **Clients** tab.

3 Click **Select automatically through query**.

4 Beneath the Query Builder pane, click **Advanced**.

Note that the following appears at the start of the query:

```
vmware:/?filter=
```

This string must be the first entry in the query. It should appear only once, no matter how many rules are added in the **Query** pane.

5 You can use the Query Builder drop-down menus to add query rules. You can also type in rules manually.

Here are a few example queries:

```
vmware:/?filter=VMFolder Contains "mango"
```

```
vmware:/?filter=Datastore StartsWith "Acc" OR Datastore StartsWith
"Prod"
```

```
vmware:/?filter=vCenter Contains "ROS" AND ESXserver Equal
"VM_test1" AND Powerstate Equal poweredOn
```

6 To insert a rule between existing rules, place the cursor where you want the new rule to start and type it in.

When you create a rule with the drown-down menus, it appears at the end of the query. You can cut and paste it into the proper location.

7 To establish the proper order of evaluation in compound queries, use parentheses to group rules as needed. Compound queries contain two or more rules, joined by AND, AND NOT, OR, or OR NOT.

More information is available on the use of parentheses and on the order of precedence.

See "AND vs. OR in queries" on page 94.

See "Order of operations in queries (precedence rules)" on page 98.

See "Parentheses in compound queries" on page 100.

AND vs. OR in queries

The **Join** field in the Query Builder provides connectors for joining rules (AND, AND NOT, OR, OR NOT). The effect of AND versus OR in the Query Builder may not be obvious at first glance.

In essence, AND and OR work in this way:

- AND limits or restricts the scope of the query.
- OR opens up the query to an additional possibility, expanding the scope of the query.

Note: Do not use AND to join the rules that are intended to include additional virtual machines in the backup list. For instance, AND cannot be used to mean "include virtual machine X AND virtual machine Y."

For example: To include the virtual machines that have either "vm1" or "vm2" in their names, use OR to join the rules:

```
Displayname Contains "vm1"
OR Displayname Contains "vm2"
```

If you use AND to join these rules:

```
Displayname Contains "vm1"
AND Displayname Contains "vm2"
```

the result is different: the backup list includes only the virtual machines that have both vm1 and vm2 in their names (such as "acmevm1vm2"). A virtual machine with the name "acmevm1" is not included in the backup.

Table 6-7 provides the examples with AND and OR.

Table 6-7   Queries with AND, OR

Query	Description
Displayname Contains "vm1" OR Displayname Contains "vm2"	This query selects any virtual machine that has either vm1 or vm2 in its display name. For example, this query selects both "seabizvm1" and "seabizvm2" for backup.
vCenter Equal "vCenterServer_1" AND Datacenter Equal "dc_A" AND ESXserver Equal "prod" AND VMHostName Contains "manu"	This query is very specific. Virtual machines with the host names that contain "manu" are included in the backup only if: they reside in vCenter server "vCenterServer_1", datacenter "dc_A", and ESX server "prod". The virtual machines that do not reside in that hierarchy are not included. For example: if a virtual machine resides in "vCenterServer_1" and datacenter "dc_A", but not in ESX server "prod", that virtual machine is not included.

	Table 6-7	Queries with AND, OR *(continued)*

Query	Description
vCenter Equal "vCenterServer_1" OR Datacenter Equal "dc_A" OR ESXserver Equal "prod" OR VMHostName Contains "manu"	This query uses the same keywords and values, but combines them with OR. The result may be a much larger list of virtual machines. A virtual machine that meets any of these rules is included: ■ Any virtual machines in vCenter "vCenterServer_1". Their host names, datacenter, or ESX server do not matter. ■ Any virtual machines in datacenter "dc_A". Their host names or server do not matter. ■ Any virtual machines in ESXserver "prod". Their host names, datacenter, or vCenter server do not matter. ■ Any virtual machines with a host name that contains "manu". Their server or datacenter do not matter.

Examples for the NetBackup Query Builder

The following table provides example query rules.

To use the Query Builder, you must click **Select automatically through query** on the **Client** tab.

	Table 6-8	Query Builder examples

Example query	Query result when backup job executes
No query rules specified (Query pane is empty)	All virtual machines are added to the backup list. Exceptions are those that do not have a host name, or that have invalid characters in the display name. See "Effect of Primary VM identifier parameter on Selection column in Test Query results" on page 114.
Displayname Contains "prod"	All virtual machines with the display names that contain the string "prod" are added to the backup list. See "Effect of Primary VM identifier parameter on Selection column in Test Query results" on page 114.
powerstate Equal "poweredOn"	Any virtual machine that is turned on is added to the backup list.
VMGuestOS Equal "windows7Guest"	All virtual machines with a guest OS of Windows 7 are added to the backup list.

	Table 6-8	Query Builder examples *(continued)*

Example query	Query result when backup job executes
DisplayName AnyOf "grayfox7","grayfox9"	The virtual machines named "grayfox7"and "grayfox9" are added to the backup list. (Note that each value must be enclosed in its own quotes, with a comma in between.)
powerstate Equal "poweredOn" AND Datastore Equal "Storage_1" AND VMGuestOS Equal "rhel4Guest"	In datastore Storage_1: any virtual machine that is turned on and has a guest OS of Red Hat Linux 4 is added to the backup list.
vCenter Equal "vCenterServer_1" AND ESXserver Contains "prod"	In the vCenter server vCenterServer_1, virtual machines that are in ESX servers with names containing "prod" are added to the backup list.
Cluster Equal "VMcluster_1" AND ESXserver AnyOf "ESX_1","ESX_2","ESX_3" AND VMHostName Contains "Finance"	In cluster VMcluster_1, all virtual machines with the host names that contain "Finance", in ESX servers ESX_1, ESX_2, ESX_3, are added to the backup list.
VMFolder StartsWith "Prod" OR VMFolder NotEqual "VM_test"	For any folder whose name starts with "Prod" or whose name is not "VM_test", add its virtual machines to the backup list.
Examples with IsSet	See "The IsSet operator in queries" on page 96.

Click **Advanced** to see the query rule in Advanced Mode. Only Advanced Mode supports the use of parentheses for grouping sets of rules.

See "Using the Query Builder in Advanced Mode" on page 92.

The IsSet operator in queries

In a query, you can use the IsSet operator to ensure that certain virtual machines are included or excluded from the backup.

For example: if the **Primary VM identifier** parameter is set to VM hostname, NetBackup is unable to identify virtual machines for backup that do not have a host name. You can use IsSet to exclude such virtual machines from the backup list.

	Table 6-9	Examples of queries with the IsSet operator

Query rules with IsSet operator	Effect of the query on virtual machine selection
Cluster Contains "dev" AND VMDNSName IsSet	INCLUDED: Any virtual machine in a cluster that has a name that contains the string "dev" if the virtual machine also has a VMware DNS name. EXCLUDED: Any virtual machines that do not have a VMware DNS Name. Without VMDNSName IsSet in this query, virtual machines without a DNS name cannot be excluded. They would be listed as FAILED.
Displayname Contains "prod" AND VMHostName IsSet	INCLUDED: Any virtual machine with a display name that contains the string "prod" if the virtual machine also has a host name. EXCLUDED: Any virtual machines that do not have host names. Without VMHostName IsSet in this query, virtual machines without a host name cannot be excluded. They would be listed as FAILED.

The policy's **Primary VM identifier** parameter has an important effect on which virtual machines NetBackup can back up. This parameter affects the test query results.

See "Effect of Primary VM identifier parameter on Selection column in Test Query results" on page 114.

About selecting virtual machines by means of multiple policies

If your virtual environment has many virtual machines with inconsistent naming conventions, you may need multiple policies working in tandem. It may be difficult to create a single policy that automatically selects all the virtual machines that you want to back up.

For this situation, configure several policies such that each policy backs up a portion of the environment. One policy backs up a particular set or group of virtual machines, such as those that have host names. A second policy backs up a different group of virtual machines that were not backed up by the first policy, and so forth. When all the policies have run, all the virtual machines are backed up.

The following table describes the policies that are designed to back up the virtual environment in three phases. Note that each policy relies on a different setting for the **Primary VM identifier** parameter.

Table 6-10   Three policies that back up virtual machines in phases

Policy	Query Builder rules	Backup result
First policy **Primary VM identifier** parameter: VM hostname	VMHostName IsSet	This policy backs up all virtual machines that have a host name. Any virtual machines that do not have a host name are excluded from the backup.
Second policy **Primary VM identifier** parameter: VM display name	NOT VMHostName IsSet AND VMHasVDSName Equal 'TRUE'	This policy backs up all virtual machines that do not have a host name but that do have a valid display name. Any virtual machines that do not have a host name or a valid display name are excluded from the backup. See "NetBackup character restrictions for virtual machine display names and other vSphere objects" on page 37.
Third policy **Primary VM identifier** parameter: VM UUID	NOT VMHostName IsSet AND NOT VMHasVDSName Equal 'TRUE'	This policy backs up the virtual machines that were not backed up by the first two policies. This policy selects the virtual machines that do not have a host name or a valid display name, but that do have a UUID.

More information is available on the **Primary VM identifier** parameter and its effect on virtual machine selection.

See "Effect of Primary VM identifier parameter on Selection column in Test Query results" on page 114.

Order of operations in queries (precedence rules)

The information in this topic is for advanced users who understand precedence in programming languages. In the Query Builder, the order in which operations occur can determine which virtual machines are selected and backed up.

The following table lists the order of operations, or precedence, from highest to lowest (7 is the highest). For example, an operation with a precedence of 6 (such as Contains) is evaluated before an operation with a precedence of 5 (such as Greater).

Table 6-11   Order of operations

Operation	Description	Precedence
!x	Produces the value 0 if x is true (nonzero) and the value 1 if x is false (0).	7
x Contains y	Does y exist somewhere in x	6

Table 6-11   Order of operations *(continued)*

Operation	Description	Precedence
x StartsWith y	Does x start with y	6
x EndsWith y	Does x end with y	6
x AnyOf list	Does x appear in list	6
x Greater y	Is x greater than y	5
x GreaterEqual y	Is x greater than or equal to y	5
x Less y	Is x less than y	5
x LessEqual y	Is x less than or equal to y	5
x Equal y	Is x equal to y	4
x NotEqual y	Is x not equal to y	4
Not x	operator produces the value 0 if x is true (nonzero) and the value 1 if x is false (0).	3
x And y	True if both x and y are true	2
x OR y	True if either x or y are true	1

Note the following:

■ AND has a higher precedence than OR.
   In the Query Builder's Advanced Mode, you can use parentheses to change the order of evaluation in the rules that use AND or OR.
   See "Parentheses in compound queries" on page 100.

■ In the Query Builder's Advanced Mode, you can combine two or more operations in a single rule without AND or OR to join them. Precedence determines the order in which the operations are evaluated within the rule.
   Example of a rule that includes three operations:

```
Displayname StartsWith "L" NotEqual Displayname contains "x"
```

   This rule selects the following virtual machines:
   Virtual machines with the names that start with L.
   Virtual machines with the names that do not start with L but that do contain x.
   Explanation: The StartsWith and Contains operations have a precedence of 6, whereas NotEqual has a lower precedence of 3. Starting on the left, the StartsWith operation is evaluated first and the Contains operation is evaluated next. The last operation to be evaluated is Not Equal.

Parentheses in compound queries

You can use the Query Builder to make precise queries containing as many rules as necessary to identify the appropriate virtual machines. In a query such as powerstate Equal "poweredOn", the result of the query is easy to predict: only the virtual machines that are turned on are included in the backup. But if several rules are combined with AND and OR, the result may not be obvious. This kind of query is called a compound query. Compound queries contain two or more rules, joined by AND, AND NOT, OR, or OR NOT.

The order in which the Query Builder evaluates compound rules affects the outcome of the query. Grouping the rules with parentheses can change the order of evaluation and thus the outcome of the query.

The examples in the following table demonstrate how the Query Builder evaluates compound queries with and without parentheses.

Note: Only the Query Builder's Advanced Mode supports the use of parentheses.

Table 6-12   Examples of compound queries with and without parentheses

Example query	The following virtual machines are selected
ESXServer Equal "ESX001" OR Folder Equal "FolderEngA" AND powerstate Equal ON	All virtual machines under ESX001 (regardless of power state), and virtual machines under FolderEngA that are turned on To select only the virtual machines that are turned on in the ESX server and in the folder, use parentheses (see next example).
(ESXServer Equal "ESX001" OR Folder Equal "FolderEngA") AND powerstate Equal ON	All the virtual machines that are turned on in ESX001 and in FolderEngA.

Query rules for resource pools

If the resource pool that you query is nested, the choice of Operator determines which virtual machines in the resource pool hierarchy are discovered.

For example, assume the following hierarchy of resource pools that contain virtual machines:

```
Res/ResourcePool_1
                VM1
```

```
               VM2
 /ResourcePool_2
               VM3
               VM4
               /ResourcePool_3
                            VM5
                            VM6
```

where ResourcePool_1 contains virtual machines VM1 and VM2, and so forth.

The following table shows the query results with the Contains, Equal, StartsWith, and EndsWith operators. (Other operators can be used.)

Note: If you want the query to include all virtual machines in a hierarchy of nested resource pools, do not use Equal as the Operator.

Table 6-13   Example rules for nested resource pools

Query rule	Included virtual machines
Resourcepool Contains "Res/ResourcePool_1"	Includes all the virtual machines in the three resource pools (VM1 through VM6).
Resourcepool Equal "Res/ResourcePool_1"	Includes only the virtual machines that are in ResourcePool_1 (VM1, VM2). Virtual machines in the sub-pools are not included (VM3 through VM6).
Resourcepool Equal "Res/ResourcePool_1/ResourcePool_2"	Includes only the virtual machines that are in ResourcePool_2 (VM3, VM4).
Resourcepool StartsWith "Res/ResourcePool"	Includes all the virtual machines in the three resource pools (VM1 through VM6).
Resourcepool StartsWith "Res/ResourcePool_1/ResourcePool_2"	Includes only the virtual machines that are in ResourcePool_2 and 3. Virtual machines in ResourcePool_1 are not included.
Resourcepool EndsWith "ResourcePool_2"	Includes the virtual machines in ResourcePool_2 (VM3, VM4) but not in ResourcePool_1 or 3.

These examples also apply to host folders.

See "Query rules for datacenter folders (host folder)" on page 102.

Query rules for datacenter folders (host folder)

In NetBackup terminology, a host folder is a folder that has been defined within a VMware datacenter. A host folder can contain ESX servers or clusters, as well as other folders. For example:

```
Folder_1
        ESX1
        ESX2
        subfolder_A
                    ESX3
                    ESX4
        subfolder_B
                    ESX_5
                    ESX_6
```

If you want NetBackup to select all the virtual machines within the top-level folder and any subfolders, use the Contains or StartsWith operator. For example:

HostFolder Contains "Folder_1"

Note: If you want the query to include all virtual machines in the hierarchy of folders, do not use Equal as the Operator.

If you want NetBackup to select the virtual machines within a subfolder only (such as subfolder_A), use the Contains or Equal operator. For example:

HostFolder Equal "Folder_1/subfolder_A"

In this case, NetBackup includes only the virtual machines that reside on servers ESX3 and ESX4.

For host folders, these operators work the same as they do for resource pools. For further query builder examples, refer to the following topic (substitute host folder for resource pool in the examples):

See "Query rules for resource pools" on page 100.

Note: If an ESX cluster is not contained within a folder and you click the browse for values button: The ESX cluster name appears in the **Select From List** dialog.

Query rules for duplicate names

If you have clusters, datastores, or virtual machine display names that have duplicates elsewhere in your virtual environment, note: The query rules must specify the parent datacenter or host folder to avoid conflicts during discovery. (A host folder is one that has been defined within a datacenter.)

Take the following example of duplicate virtual machine names:

```
Folder_1
        ESXi_prod
                VM_1
Folder_2
        ESXi_mrkt
                VM_1
```

To back up `ESXi_prod/VM_1` but not `ESXi_mrkt/VM_1`, use the following query:

```
HostFolder Equal "Folder_1"
AND ESXserver Equal "ESXi_prod"
AND Displayname Equal "VM_1"
```

To back up only `ESXi_mrkt/VM_1`, use the following query:

```
HostFolder Equal "Folder_2"
AND ESXserver Equal "ESXi_mrkt"
AND Displayname Equal "VM_1"
```

Note: To back up both of these virtual machines from the same policy, include both of these rules in the policy, as follows:
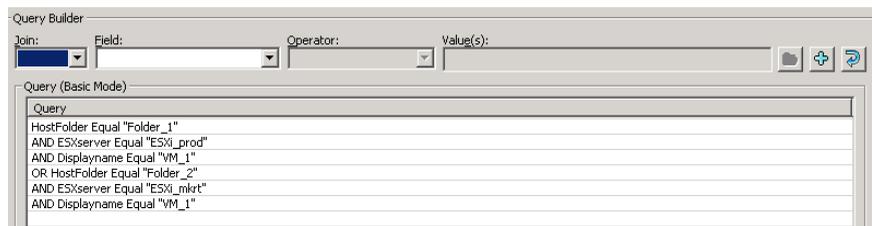
Instead of `Equal`, you can use other field values, such as `Contains`.

Query Builder field reference

Table 6-14 describes the drop-down fields and options for creating rules in the Query Builder.

Table 6-14   Query Builder drop-down options: Join, Field, Operator, Value(s)

Query Builder drop-down fields	Description
Join	Selects a connector to join rules.
	For the first rule, choices are blank (none) or NOT. After you add a rule, the available connectors are AND, AND NOT, OR, OR NOT.
Field	Selects a parameter on which to build the rule. Select one from the list (scroll down for additional parameters).
	You can type the first character to speed up selection. For example, on entering "d", the list moves to first entry starting with "d". Another entry of "d" moves through the list to the next entry starting with "d". The selected entry is automatically filled in.
	See Table 6-15 on page 105.
Operator	Selects an operator. The available operators depend on the parameter that is selected for **Field**.
	See Table 6-16 on page 110.
Value(s)	Specifies a value for the **Field** parameter.
	The **Value** field allows manual entry. It may also be a drop-down, depending on the selections that are made in the other fields.
	For manual entry, you can specify multiple comma-separated values.
	See Table 6-17 on page 111.
	Allows browsing for specific values, depending on the selections that are made in the other drop-down fields.
	Adds the current drop-down selections to the **Query** pane as a new rule.
	Blanks out the drop-down fields.

Field (keywords)

Table 6-15 describes the keywords available in the **Field** drop-down. The table also indicates whether the values for each keyword (in the **Values** field) are case-sensitive.

Note that the inclusion or exclusion of virtual machines is not determined by the **Field** keyword alone, but depends on the rule you construct: the combination of Join, Field, Operator, and Value(s).

Table 6-15 Keywords in the **Field** drop-down

Field keyword	Data type	Description
Annotation	Alphanumeric string	The text that is added to virtual machine annotations in vSphere Client. Values are case-sensitive.
Cluster	Alphanumeric string	The name of the cluster (a group of ESX servers) that the virtual machine is configured in. Values are not case-sensitive. **Note:** A virtual machine may be assigned to an ESX server that is not in a cluster. Note also that in VMware, a cluster name need only be unique within a datacenter path.
Datacenter	Alphanumeric string	The name of the VMware datacenter. Values are not case-sensitive.
DatacenterPath	Alphanumeric string	The folder structure that defines the path to a datacenter. Use this option if the datacenter name that you want to filter on is not unique in your environment. Values are case-sensitive.
Datastore	Alphanumeric string	The name of the datastore. Values are case-sensitive. **Note:** Multiple ESX servers can share access to the same datastore. Also, a datastore name can be duplicated between multiple ESX servers. Use DatacenterPath or ESXserver to uniquely identify the datacenter.
DatastoreCluster	Alphanumeric string	The name of the datastore cluster that contains the datastores. Values are not case-sensitive.

	Table 6-15	Keywords in the **Field** drop-down *(continued)*

Field keyword	Data type	Description
DatastoreFolder	Alphanumeric string	The name of the folder that contains the datastores. Values are not case-sensitive.
DatastoreNFSHost	Alphanumeric string	The name of the datastore's NFS host. Values are not case-sensitive.
DatastoreNFSPath	Alphanumeric string	The folder structure that defines the path to an NFS datastore. Use this option if the NFS host name of the datastore that you want to filter on is not unique in your environment. Values are not case-sensitive.
DatastoreType	Alphanumeric string	The type of the datastore. Values are NFS or VMFS. Values are not case-sensitive.
Displayname	Alphanumeric string	The virtual machine's display name. Values are case-sensitive.
ESXserver	Alphanumeric string	The name of the ESX server. Values are not case-sensitive. The ESX host name must match the name as defined in the vCenter server.
HostFolder	Alphanumeric string	The folder path between the datacenter level and a cluster, ESX hosts, or a subfolder. If an ESX cluster is not contained within a folder and you click the browse for values button, note: The ESX cluster name appears in the **Select From List** dialog. Values are not case-sensitive. See "Query rules for datacenter folders (host folder)" on page 102.
Network	Alphanumeric string	The name of the network switch (on an ESX server) or distributed switch. Values are not case-sensitive.
NetworkFolder	Alphanumeric string	The name of the folder that contains the network. Values are not case-sensitive.
Powerstate	Alphabetic	The power state of the virtual machine. Values are poweredOff, poweredOn, suspended.

	Table 6-15	Keywords in the **Field** drop-down *(continued)*
Field keyword	**Data type**	**Description**
Resourcepool	Alphanumeric string	The name of the resource pool. (A resource pool is similar to a vApp.) Values are case-sensitive. If a resource pool contains other resource pools (sub-pools), the choice of Operator determines whether virtual machines in the sub-pools are included. See "Query rules for resource pools" on page 100.
Template	Boolean	TRUE if the virtual machine is a virtual machine template.
vApp	Alphanumeric string	The name of the vApp. Values are case-sensitive. A vApp is a collection of virtual machines. vApps can also contain resource pools and other vApps. vApps are components of standalone ESX servers or of clusters. Like vSphere Client, NetBackup refers only to the top level of a vApp that contains sub vApps. For the following rule: `vApp Equal "vapp1"` if vapp1 has a sub vApp named "vapp2", any virtual machines in vapp1 or vapp2 are included. You cannot make a rule that refers specifically to vapp2.
vCDCatalog	Alphanumeric string	The name of the vCloud Director catalog. Values are not case-sensitive.
vCDIsExpired	Alphabetic	Expired if the vCloud Director vApp or vApp template is expired. Possible values are Expired, Not Expired, and Unknown. Unknown indicates that an error occurred between vCloud Director and the vSphere environment. Examples are errors in provisioning or in a deletion operation.
vCDIsvAppTemplate	Boolean	TRUE if the vCloud Director vApp is a template.
vCDOrg	Alphanumeric string	The name of the vCloud Director organization. Values are not case-sensitive.
vCDOrgvDC	Alphanumeric string	The name of the organization virtual datacenter in vCloud Director. Values are not case-sensitive.

Table 6-15 Keywords in the **Field** drop-down *(continued)*

Field keyword	Data type	Description
vCDServer	Alphanumeric string	The name of the vCloud Director server. Values are not case-sensitive.
vCDvApp	Alphanumeric string	The name of the vCloud Director vApp. Values are not case-sensitive.
vCenter	Alphanumeric string	The name of the vCenter server. Values are not case-sensitive. The vCenter name that is specified in the Query Builder must match the name as entered in the Administration Console for NetBackup credentials. (**Media and Device Management > Credentials > Virtual Machine Servers**.) Note that a fully qualified domain name is recommended.
VMDNSName	Alphanumeric string	The virtual machine DNS name in vSphere Client. Values are not case-sensitive.
VMFolder	Alphanumeric string	The folder structure (within a datacenter) to a virtual machine folder, including all subfolders. Values are not case-sensitive. Examples are: /clusters/discovered virtual machine /standalone/folder1/folder2
VMGuestOS	Alphanumeric string	The virtual machine guest OS type that is recorded in vSphere Client. Values are case-sensitive.
VMHasIDE	Boolean	TRUE if the virtual machine has IDE drives.
VMHasMDS	Boolean	TRUE if the virtual machine has multiple datastores. You can use this keyword to select any virtual machine that is configured to use more than one datastore.
VMHasRDM	Boolean	TRUE if the virtual machine uses Raw Device Mapping (RDM).
VMHasSnap	Boolean	TRUE if a VMware snapshot of the virtual machine is currently active.
VMHasVDSName	Boolean	TRUE if the virtual machine has a display name that is valid for use as the host name.

Table 6-15   Keywords in the **Field** drop-down *(continued)*

Field keyword	Data type	Description
VMHostName	Alphanumeric string	The virtual machine name that is derived from a reverse lookup of its IP address. Values are not case-sensitive.
VMIsConn	Boolean	TRUE if the virtual machine is connected and available. For example: If a virtual machine's ESX server is down, that virtual machine is not connected.
VMVersion	Alphanumeric string	The VMware version of the virtual machine. Values are case-sensitive. For example: vmx-04, vmx-07, vmx-08.
VMXDatastore	Alphanumeric string	The name of the vmx datastore (sometimes called the vmx directory or configuration datastore). Values are case-sensitive. More information on the vmx datastore is available. See "NetBackup for VMware terminology" on page 25.
VMXDatastoreFolder	Alphanumeric string	The name of the folder that contains the vmx datastores. Values are not case-sensitive.
VMXDatastoreNFSHost	Alphanumeric string	The name of the vmx datastore's NFS host. Values are not case-sensitive.
VMXDatastoreNFSPath	Alphanumeric string	The folder structure that defines the path to a vmx NFS datastore. Use this option if the NFS host name of the datastore that you want to filter on is not unique in your environment. Values are not case-sensitive.
VMXDatastoreType	Alphanumeric string	The type of the vmx datastore. Values are NFS or VMFS. Values are not case-sensitive.
[vSphere custom attributes]	Alphanumeric string	The value of a custom attribute that is set in vSphere Client for one or more virtual machines. Note: in vSphere Client, the attribute must have a value for at least one virtual machine. The attribute type must be Virtual Machine. The values are case-sensitive.

Operators

Table 6-16 describes the operators available in the **Operator** drop-down.

Table 6-16　　　　Operators in the **Operator** drop-down

Operator	Description
AnyOf	Matches any of the specified values in the Value(s) field.
	For example: If the ESX servers in the Value(s) field are "ESX01","ESX02,"ESX03", AnyOf matches any ESX server that has one of those names. If the names of your servers are not identical to any of the specified values, no match occurs. A server named ESX01A is not a match.
Contains	Matches the value in the Value(s) field wherever that value occurs in the string.
	For example: If the Value(s) entry is "dev", Contains matches strings such as "01dev", "01dev99", "devOP", and "Development_machine".
EndsWith	Matches the value in the Value(s) field when it occurs at the end of a string.
	For example: If the Value(s) entry is "dev", EndsWith matches the string "01dev" but not "01dev99", "devOP", or "Development_machine".
Equal	Matches only the value that is specified in the Value(s) field.
	For example: If the display name to search for is "VMtest27", Equal matches virtual machine names such as VMTest27 or vmtest27 or vmTEST27, and so forth. The name VMtest28 is not matched.
Greater	Matches any value that is greater than the specified Value(s), according to the ASCII collating sequence.
GreaterEqual	Matches any value that is greater than or equal to the specified Value(s), according to the ASCII collating sequence.
IsSet	Determines whether a value is returned for the **Field** keyword. Use IsSet with another rule as a condition, to ensure that the query selects the appropriate virtual machines.
	Note that you do not make an entry under Value(s) for a rule that uses IsSet.
	See "The IsSet operator in queries" on page 96.
	See "Effect of Primary VM identifier parameter on Selection column in Test Query results" on page 114.
	See "Test Query: Failed virtual machines" on page 113.
Less	Matches any value that is less than the specified Value(s), according to the ASCII collating sequence.
LessEqual	Matches any value that is less than or equal to the specified Value(s), according to the ASCII collating sequence.
NotEqual	Matches any value that is not equal to the value in the Value(s) field.

Table 6-16   Operators in the **Operator** drop-down *(continued)*

Operator	Description
StartsWith	Matches the value in the Value(s) field when it occurs at the start of a string. For example: If the Value(s) entry is "box", StartsWith matches the string "box_car" but not "flatbox".

Value(s)

Table 6-17 describes the characters that can be entered in the **Value(s)** field. The **Field** keyword determines case sensitivity.

Note: The character string you enter in the **Value(s)** field must be enclosed in single quotes or double quotes.

Table 6-17   Characters you can enter for Value(s)

Character types	String characters allowed
Alphanumerics	A to Z, a to z, 0 to 9, - (minus sign), and special characters. **Note:** Decimal numbers only.
Wildcards	* (asterisk) matches everything. For example: "*prod*" matches the string "prod" preceded or followed by any characters. ? (question mark) matches any single character. For example: "prod??" matches the string "prod" followed by any two characters.
Escape character	\ (backslash) escapes the wildcard or meta-character that follows it. For example: To search for a string that contains an asterisk (such as test*), enter "test*"
Quotation marks	Note: The characters you enter in Value(s) must be enclosed in single or double quotes. To search for a string that contains quotation marks, either escape each quote (\") or enclose the entire string in the opposite type of quotes. For example: To search for a string that includes double quotes (such as "name"), enter '"name"' (enclosing it in single quotes) or "\"name\""

Test Query screen

This screen lists the virtual machines that NetBackup discovered in your virtual environment when you clicked **Test Query**. Later changes in the virtual environment may affect which virtual machines match the query rules. For example: if virtual

machines are added, the test results may not be identical to the virtual machines that are selected for backup when the backup runs.

When the next backup runs from this policy, the following occur: NetBackup re-discovers virtual machines, consults the query rules, and backs up the virtual machines that match the rules.

The list of backed up virtual machines is saved but the virtual machines are not displayed in the policy's **Clients** tab. You can use the Activity Monitor to view the virtual machine jobs, or you can run a **Virtual Client Summary** report in OpsCenter.

Note: An alternative to the Test Query screen is the `nbdiscover` command. For more information, see the *NetBackup Commands Reference Guide*.

See "Using the Activity Monitor to monitor virtual machine backups" on page 124.

See "Using OpsCenter to report on virtual machine backups" on page 129.

The **Test Query** function runs in the background. You can continue to configure the policy while the test runs. Any changes you make in the Query Builder however are not included in the currently running test. You must re-initiate the test to see the results of your Query Builder changes.

Testing query for policy	Lists the rules in the Query Builder that were used in this test. The rules are specified in the Query Builder on the policy **Clients** tab.
Test query results	**VM Name**: Shows the display name of all discovered virtual machines.

Selection: Lists the virtual machines that were discovered, as follows:

- **INCLUDED**: The virtual machine matches the rules in the query.
- **EXCLUDED**: The virtual machine does not match the rules in the query.
- **FAILED**: The virtual machine cannot be selected for backup because of a host name problem or other error. Also, the query cannot exclude the virtual machine. An explanation appears at the bottom of the **Test Query** screen. For example:

```
VM does not have a host name to use as a
client name, display name =
```

See "Test Query: Failed virtual machines" on page 113.
The operator IsSet can be used to filter out such virtual machines. More information is available on IsSet.
See Table 6-16 on page 110.
See "The IsSet operator in queries" on page 96.

Included:	The bottom of the screen gives a tally of how many virtual machines were included, excluded, or failed in the test.
Excluded:	
Failed:	

See "Using the Activity Monitor to monitor virtual machine backups" on page 124.

See "About automatic virtual machine selection for NetBackup for VMware" on page 80.

See "Configuring automatic virtual machine selection" on page 89.

Test Query: Failed virtual machines

If the query rules cannot exclude a virtual machine, and that virtual machine cannot be selected for backup, it is marked as FAILED. The virtual machine is listed as not run in the job details log.

For example: the virtual machine does not have the type of name specified by the **Primary VM identifier** parameter (such as host name or display name). Or the virtual machine name contains invalid characters. In any case, a virtual machine that is listed as FAILED should be investigated: it may be one that you want to back up.

To see the reason for the failure, click on the virtual machine in the Test Query Results. An explanation appears at the bottom of the screen.

For example:
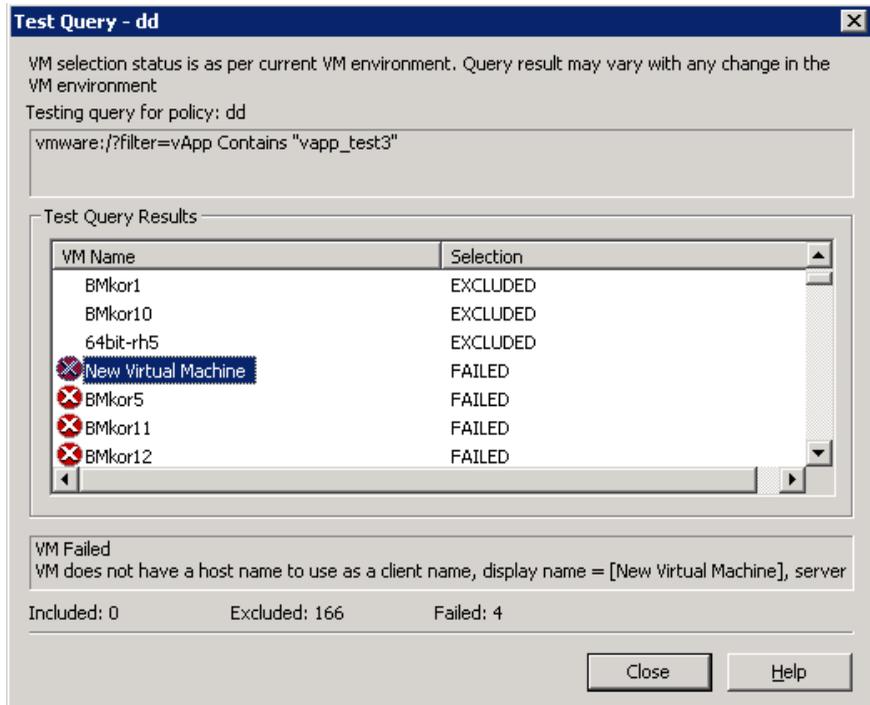
Explanation: The virtual machine that is listed as **New Virtual Machine** in the example does not have a VMware host name. In the NetBackup policy, on the **VMware** tab, the **Primary VM identifier** parameter may be set to **VM hostname**. In that case, NetBackup cannot refer to the virtual machine by its host name and thus cannot back it up.

You can fix this problem in a couple of ways:

■ Use vSphere Client to configure a host name for the virtual machine.

■ To exclude the virtual machines that have no host name, construct a query with the IsSet operator.

See "The IsSet operator in queries" on page 96.

Effect of Primary VM identifier parameter on Selection column in Test Query results

The NetBackup policy's **Primary VM identifier** parameter tells NetBackup how to identify virtual machines. For example, if the parameter is set to **VM hostname**,

NetBackup identifies virtual machines by their host names. If they do not have a host name, the policy cannot back them up.

The **Primary VM identifier** parameter has a direct effect on the query test results. Note that for each virtual machine, the query test result is one of three possibilities: INCLUDED, EXCLUDED, or FAILED.

If NetBackup cannot identify a virtual machine according to the **Primary VM identifier** parameter, one of two test results can occur:

- If the virtual machine is filtered out by the query rules, it is listed as EXCLUDED.

- If the virtual machine is not filtered out by the query rules, it is listed as FAILED. The following table gives the test query results from example combinations of the **Primary VM identifier** parameter and a query rule.

Table 6-18   Effect of Primary VM identifier parameter and query rules on test query results

Primary VM identifier setting on VMware policy tab	Query rule in Query Builder	Test query result
VM hostname	VMHostName Contains "VM"	INCLUDED: Any virtual machines with a host name that contains "VM". Since the Primary VM identifier parameter tells NetBackup to select the virtual machine by host name, it can back up the virtual machines.
		EXCLUDED: All other virtual machines.
VM hostname	Displayname Contains "VM"	INCLUDED: Any virtual machines that have a host name and that have a display name that contains "VM".
		EXCLUDED: Any virtual machines that have a host name, but that do not have a display name containing "VM".
		FAILED: Any virtual machines that do not have a host name. Since the **Primary VM identifier** parameter is set to VM hostname, NetBackup cannot select the virtual machine for backup.
VM hostname	Displayname Contains "VM" AND VMHostName IsSet	INCLUDED: Any virtual machines that have a host name and that have a display name that contains "VM".
		EXCLUDED: All other virtual machines. The IsSet rule means that if a virtual machine does not have a host name, it is excluded.

Table 6-18   Effect of Primary VM identifier parameter and query rules on test query results *(continued)*

Primary VM identifier setting on VMware policy tab	Query rule in Query Builder	Test query result
VM hostname	Displayname Contains "VM" AND VMHostName IsSet OR Annotation Contains "test" AND NOT VMHostName IsSet	INCLUDED: ■ Any virtual machines that have a host name and that have a display name that contains "VM". ■ Any virtual machines without a host name that have an annotation that contains "test". EXCLUDED: All other virtual machines.
VM display name	Displayname Contains "VM"	INCLUDED: Any virtual machines with the display names that contain "VM". Since the Primary VM identifier parameter tells NetBackup to select the virtual machine by display name, it can back up the virtual machines. EXCLUDED: All other virtual machines.
VM display name	VMHostName Contains "VM"	INCLUDED: Any virtual machines that have a display name and that have a host name that contains "VM". EXCLUDED: Any virtual machines that have a display name, but that do not have a host name containing "VM". FAILED: Any virtual machines that do not have a display name. Since the **Primary VM identifier** parameter is set to VM display name, NetBackup cannot select those virtual machines for backup.

Effect of Primary VM identifier parameter on VM Name column in Test query results

The policy's **Primary VM identifier** parameter affects the type of virtual machine name that appears in the **VM Name** column of the Test Query screen, as follows:

■ If a virtual machine is EXCLUDED or FAILED, it is listed according to its virtual machine display name. The **Primary VM identifier** parameter does not matter.

■ But if a virtual machine is listed as INCLUDED, note: The name that appears under **VM Name** is the type of name that is specified on the **Primary VM identifier** parameter.

For example: If the **Primary VM identifier** parameter is VM hostname, the included virtual machine is listed according to its host name. Even if the query

rule specified Display name (such as `Displayname Equal "vm1"`), the virtual machine appears on the Test Query screen by its host name.

See "Primary VM identifier options (VMware)" on page 58.

Reduce the size of backups

This chapter includes the following topics:

- About reducing the size of VMware backups
- Block-level backup (BLIB): full vs incremental
- Deleting a vSphere Client snapshot

About reducing the size of VMware backups

NetBackup provides the following options for reducing the backup size for a VMware virtual machine:

Table 7-1 Options for reducing the virtual machine backup size

Option	Description
Block level incremental backup (BLIB)	BLIB reduces the size of backups (full and incremental) by tracking block-level changes. Only the blocks that have changed since the last full or incremental are included in the backup. For incremental backups, this option applies to cumulative and to differential backups.
	BLIB works with VMware's Changed Block Tracking in vSphere to track block-level changes in the virtual machine.
	The **Enable block-level incremental backup** option is enabled by default on the NetBackup policy **VMware** tab. NetBackup uses BLIB for storage optimization when the backup runs.
	Note: The first backup you run with BLIB must be a full backup.
	See "Block-level backup (BLIB): full vs incremental" on page 119.
	Note: BLIB works only with ESX 4.0 or later virtual machines at version vmx-07 or later.
	Note: If you have used the vSphere Client interface to manually create a snapshot of the virtual machine and that snapshot is currently active, you may have to delete the snapshot.
	See "Deleting a vSphere Client snapshot" on page 120.

Table 7-1   Options for reducing the virtual machine backup size *(continued)*

Option	Description
Exclusion of deleted blocks.	Reduces the size of virtual machine backups by excluding any deleted sectors in the file system on the virtual machine.
	To enable this option, click **Exclude deleted blocks** on the policy **VMware** tab.
	Refer to **Exclude deleted blocks** in the following topic:
	See "Optimizations options (VMware)" on page 57.

Block-level backup (BLIB): full vs incremental

When you use the **Enable block-level incremental backup** option in the policy, NetBackup uses VMware's Changed Block Tracking feature (CBT) to reduce the backup size.

This option reduces the size of full backups as well as the size of incremental backups, as follows.

Table 7-2   Block-level backup of the virtual machine: full vs incremental schedule

Type of backup	Optimization that is used in backup
Backup of entire virtual machine, with full schedule	Backs up only the blocks that have changed since the .vmdk was created. Note that uninitialized blocks are excluded from the backup.

Table 7-2   Block-level backup of the virtual machine: full vs incremental
schedule *(continued)*

Type of backup	Optimization that is used in backup
Backup of entire virtual machine, with incremental schedule	Backs up only the blocks that have changed since the last backup, as follows: ■ For cumulative incrementals, BLIB backs up only the blocks that changed since the last full backup. ■ For differential incrementals, BLIB backs up only the blocks that changed since the previous backup of any kind. **Note:** On incremental backups, the **Enable block-level incremental backup** option backs up the changed files as well as their metadata. **Note:** VMware CBT may occasionally reset tracking of file changes in the virtual machine, such as after a power failure or hard shutdown. In that case, for the next backup, NetBackup reads all the data from the vmdk files and the backup takes longer than expected. If deduplication is enabled, the deduplication rate is lower than expected. The following VMware article contains more information on CBT: Changed Block Tracking (CBT) on virtual machines (1020128)

Deleting a vSphere Client snapshot

To use BLIB with NetBackup for VMware, you must delete an existing vSphere Client snapshot if both of the following are true:

■ You used the vSphere Client interface to manually create a snapshot of the virtual machine and that snapshot is currently active.

■ A NetBackup policy with the **Enable block-level incremental backup** feature had never been used to back up the virtual machine before you started the vSphere Client snapshot.

In this case, NetBackup cannot enable BLIB for the virtual machine. You must delete the vSphere Client snapshot. Then, when the NetBackup policy runs, BLIB is enabled.

More information is available on NetBackup block-level backups:

To delete a vSphere Client snapshot

1   In the vSphere Client interface, right-click on the virtual machine and select
    Snapshot > Snapshot Manager.

2   Select the snapshot and click **Delete**.

3   To back up the virtual machine with BLIB, you can now run a NetBackup policy
    that uses **Enable block-level incremental backup**.

    NetBackup backups from this policy continue to use storage optimization, even
    if you manually create a snapshot of the virtual machine using vSphere Client.

Back up virtual machines

This chapter includes the following topics:

- Backing up virtual machines

- Using the Activity Monitor to monitor virtual machine backups

- Restarting jobs individually in the Activity Monitor

- Viewing NetBackup activity in vSphere Client

- Using OpsCenter to report on virtual machine backups

Backing up virtual machines

Virtual machine backups initiate from a NetBackup policy. You can start the backup manually from a policy, or have it run automatically according to a schedule that is defined in the policy.

To create the policy, you can use the **Policies** utility in the NetBackup Administration Console, or the Policy Configuration Wizard .

See "Configuring a VMware policy from the Policies utility" on page 52.

See "Configuring a VMware policy from the Policy Wizard " on page 51.

For further information on policies and backup schedules, see the "Creating backup policies" chapter of the *NetBackup Administrator's Guide, Volume I*.

To back up a virtual machine manually from an existing policy

1   Click on **Policies** in the NetBackup Administration Console, select the policy, and click **Actions > Manual Backup**.
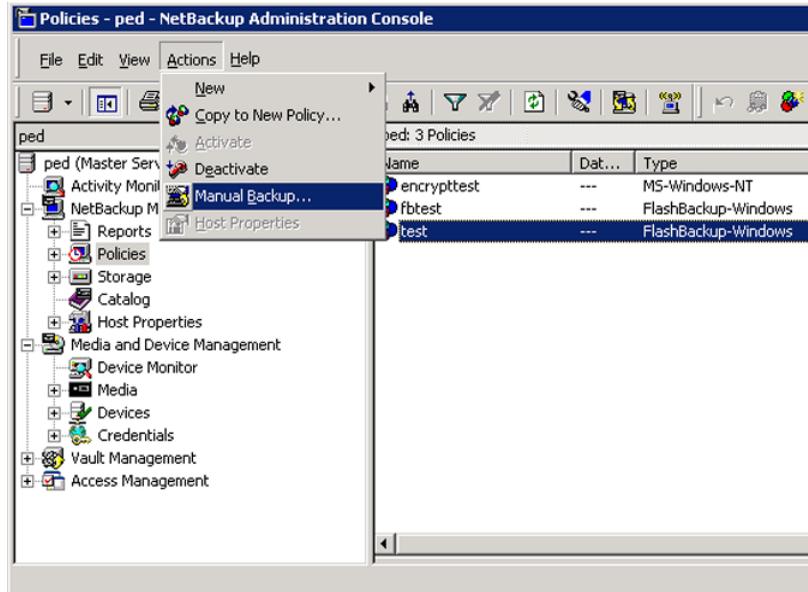
The Manual Backup dialog appears.
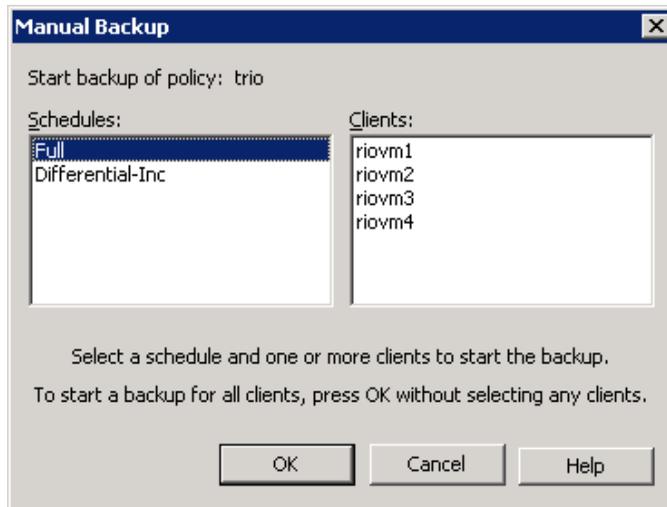
2   Select the type of schedule for the backup.

3   Select the clients (virtual machines) to back up.

If the policy was configured for automatic selection of virtual machines, the **Clients** pane shows the VMware backup host rather than the virtual machines.

4   Click **OK** to start the backup.

5   To see the job progress, click **Activity Monitor** in the NetBackup Administration Console.

It may take a few moments for the job to appear in the Activity Monitor. Do not start another backup if a job does not immediately appear. If the job does not show up after a few moments, close and restart the NetBackup Administration Console.

Note that your VMware backup request launches more than one job. The first job automatically creates and deletes snapshots. This job has a dash (-) in the Schedule column. The second job backs up the virtual machine files from the snapshot.

Using the Activity Monitor to monitor virtual machine backups

You can use the NetBackup Activity Monitor to keep track of the VMware virtual machines that a policy backs up.

To monitor virtual machine backups

1   Click **Activity Monitor** in the left pane of the Administration Console.

2   Note each job as it appears by row.

If the policy selects virtual machines automatically (based on a query), the backup consists of three generations of jobs:

■   The first job discovers the virtual machines. This job is labeled **Backup**. (This job is unique to policies that use a query to select virtual machines.)

■   The discovery (**Backup**) job starts a child job to take a VMware snapshot of the virtual machine. A snapshot job is started for each virtual machine. Each of these jobs is labeled **Snapshot**.

■   Each snapshot job starts a child job to back up the virtual machine. A backup job is started for each virtual machine. Each of these jobs is labeled **Backup**. The job flow is as follows:

```
discovery job --> snapshot job --> backup job
```

3   To trace the discovery job to the virtual machine backup jobs, note the Job ID and the Parent Job ID columns.

Job ID	Parent Job ID	Type	Job State	State Details	Status	Job Policy	Job S...	Client
134	132	Snapshot	Active			VMware-dd	-	pambl...
132	132	Backup	Active			VMware-dd	-	olydd....
137	134	Backup	Active			VMware-dd	full	pambl...
133	132	Snapshot	Done		0	VMware-dd	-	pambl...
135	133	Backup	Done		0	VMware-dd	full	pambl...
136		Image Cleanup	Done		1			

In this sample screen, the discovery job is 132. Job 132 started two snapshot jobs: 133 and 134, each for a separate virtual machine. Snapshot jobs 133 and 134 each started a backup job: 135 and 137.

4   Right-click on the job row and click **Details**.

On the Job Details screen, click the **Detailed Status** tab for more information on the job.

5   If the Job ID or the Parent Job ID column is not displayed in the Activity Monitor, display them as follows:

- Right click anywhere in the column header row and click **Columns > Layout**.

- Click the row for the heading that you want to display (such as Job ID).

Set Column Layout

Heading	Justification	State
Job ID	Right	Show
Parent Job ID	Left	Show
Type	Left	Show
Job State	Left	Show
State Details	Left	Show
Status	Right	Show
Policy	Left	Show
Schedule	Left	Show
Client	Left	Show
Media Server	Left	Show
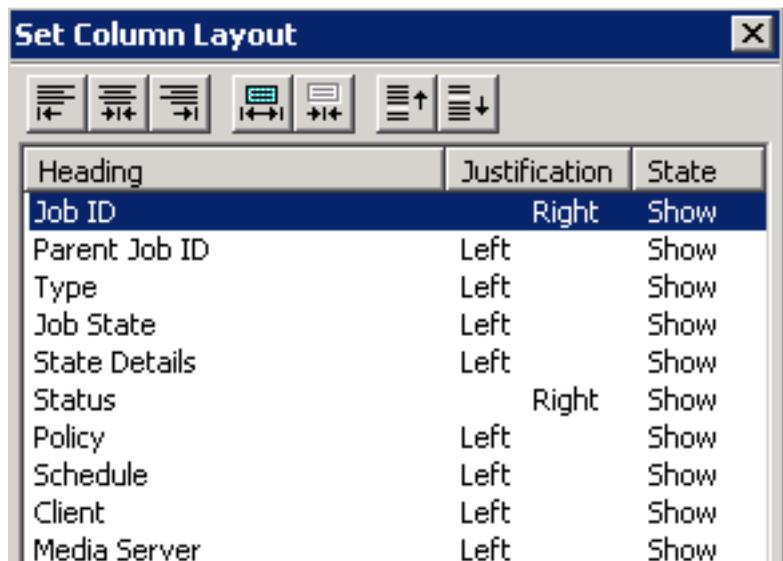
■ Use the following icons at the top of the screen to show the heading:

🔲	Sets the **State** to **Show**.
≡↑ ≡↓	Moves the row up or down in the list (farther to the left or right in the Activity Monitor).

■ Click **OK**. The Job ID and Parent Job ID columns should now be visible in the Activity Monitor.

See "Limit jobs per policy on the Attributes tab (for VMware)" on page 56.

Restarting jobs individually in the Activity Monitor

If the policy automatically selects virtual machines for backup, you can restart the virtual machine jobs individually. This feature is handy if the policy backs up a large number of virtual machines: you can restart one or more of the jobs individually rather than re-running the entire policy.

To restart jobs individually in the Activity Monitor

◆ In the Activity Monitor, right-click on the job and select **Restart Job**.

In some cases, to restart a child job you may have to restart its parent job.

Viewing NetBackup activity in vSphere Client

NetBackup can record backup activity for virtual machines in VMware vCenter. You can view the events in vSphere Client at the level of any parent object (such as folder, datacenter, cluster, or host). You can also view the events for the entire virtual machine.

Make sure that the policy's **Post events to vCenter** option is enabled:

See "VMware - Advanced Attributes dialog" on page 62.

To view backup events and the last backup time in vSphere Client

1 Open vSphere Client and connect to the VMware server.

2 Go to **Home > Inventory > Hosts and Clusters**.

3 Select the object (such as datacenter, host, or virtual machine) and click the **Tasks & Events** tab.

4 Click the **Events** view.

5 In the **Description, Type or Target contains** field, enter NetBackup.

If some NetBackup events do not appear, the events display limit may have been reached in vSphere Client. The maximum number of events that vSphere Client can display is 1000 (the default is 100).

See "To change the events display limit in vSphere Client" on page 128.
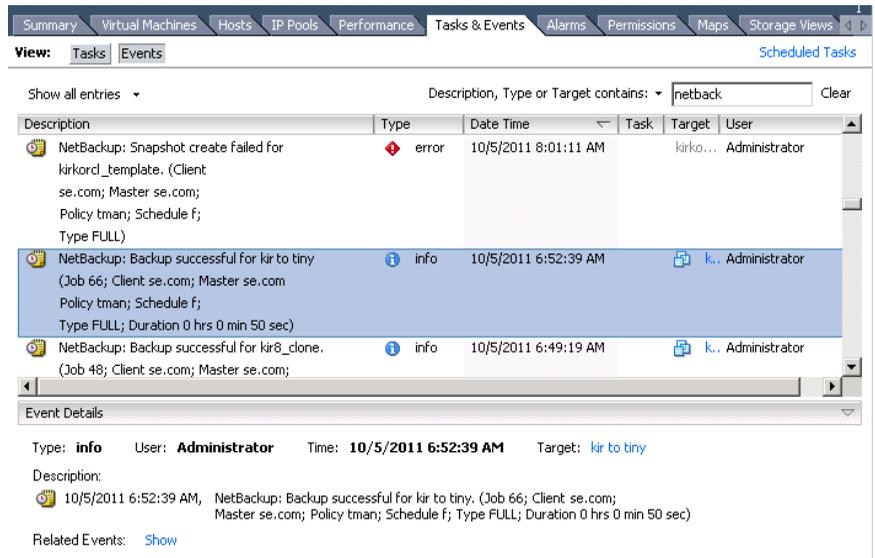
Each NetBackup event includes the following details:

Description	Shows the NetBackup operation that succeeded or failed, and includes policy details and duration. When you click on the row of the event, the **Event Details** pane shows the same information.
Type	The types are **info** for a successful operation, and **error** for a failed operation.
Date Time	The date and time of the event.
Task	Not used.
Target	The virtual machine that was backed up.
User	The user that ran the backup.

6 To see the date and time of the last backup for a particular virtual machine, select the virtual machine and click the **Summary** tab.

The timestamp of the last backup is listed for the NB_LAST_BACKUP attribute, under Annotations:

7 To see the date and time of the last backup for all virtual machines, click the **Virtual Machines** tab.

To change the events display limit in vSphere Client

◆ In vSphere Client, click the **Edit > Client Settings > Lists** tab.

Use the **Page size** field to change the size.

Using OpsCenter to report on virtual machine backups

To use OpsCenter to obtain a backup report on VMware virtual machines

1 Start the OpsCenter console in a web browser.

On a system that has a network connection to the OpsCenter server, enter the following in a browser:

```
http://host.domain/opscenter
```

where `host.domain` is the fully qualified domain name or IP address of the OpsCenter server.

2 Click the **Reports** tab.

3 Click **Client Reports > Virtual Client Summary**.

The **Virtual Client Summary** report is described in the *Symantec OpsCenter Administrator's Guide*.

Virtual machine backups using the Accelerator

This chapter includes the following topics:

- About the NetBackup Accelerator for virtual machines

- Accelerator: full vs. incremental schedules

- How the NetBackup Accelerator works with virtual machines

- Accelerator notes and requirements for virtual machines

- Accelerator forced rescan for virtual machines (schedule attribute)

- Accelerator requires the OptimizedImage attribute

- Accelerator backups and the NetBackup catalog

- Accelerator messages in the backup job details log

- NetBackup logs for Accelerator with virtual machines

About the NetBackup Accelerator for virtual machines

NetBackup Accelerator reduces the backup time for VMware backups. NetBackup uses VMware Changed Block Tracking (CBT) to identify the changes that were made within a virtual machine. Only the changed data blocks are sent to the NetBackup media server, to significantly reduce the I/O and backup time. The media server combines the new data with previous backup data and produces a traditional full NetBackup image that includes the complete virtual machine files.

> **Note:** Accelerator is most appropriate for virtual machine data that does not experience a high rate of change.

Accelerator has the following benefits:

- Performs the full backups faster than traditional backup. Creates a compact backup stream that uses less network bandwidth between the backup host and the server.
  Accelerator sends only changed data blocks for the backup. NetBackup then creates a full traditional NetBackup image that includes the changed block data.

- Accelerator backups support Granular Recovery Technology (GRT) for restoring Exchange, SQL, and SharePoint applications (using a full schedule only).

- Accelerator backups (full and incremental) support instant recovery of virtual machines.

- If the **Enable file recovery from VM backup** option on the policy **VMware** tab is enabled, you can restore individual files from the backup (full or incremental).

- Reduces the I/O on the backup host.

- Reduces the CPU load on the backup host.

Accelerator: full vs. incremental schedules

NetBackup Accelerator supports full and incremental backups.

Note: After an initial full backup, Accelerator backups with a full schedule have about the same effect on I/O and performance as traditional incremental backups. The NetBackup catalog however includes all catalog references that would be made if the backup was a traditional (non-Accelerator) full.

For virtual machine restore, note the following about full vs. incremental backups with Accelerator:

- For applications (Exchange, SQL, and SharePoint), NetBackup Accelerator supports Granular Recovery Technology (GRT) restores from full backups only.

- For any other kind of virtual machine restore, the Accelerator supports full backups and incremental backups.

How the NetBackup Accelerator works with virtual machines

To enable acceleration of virtual machine backups, click **Use Accelerator** on the policy **Attributes** tab.

See "Configuring a VMware policy from the Policies utility" on page 52.

The NetBackup Accelerator creates the backup stream and backup image for each virtual machine as follows:

- If the virtual machine has no previous backup, NetBackup performs a full backup and uses VMware Changed Block Tracking to track the data in use for each VMDK.

- At the next backup, NetBackup identifies data that has changed since the previous backup. Only changed blocks and the header information are included in the backup, to create a full virtual disk backup.

- The backup host sends to the media server a tar backup stream that consists of the following: The virtual machine's changed blocks, and the previous backup ID and data extents (block offset and size) of the unchanged blocks.

- The media server reads the virtual machine's changed blocks, the backup ID, and information about the data extents of the unchanged blocks. From the backup ID and data extents, the media server locates the rest of the virtual machine's data in existing backups.

- The media server directs the storage server to create a new full image that consists of the following: The newly changed blocks, and the existing unchanged blocks that reside on the storage server. The storage server may not write the existing blocks but rather link them to the image.

Accelerator notes and requirements for virtual machines

Note the following about Accelerator for virtual machines:

- Requires the Data Protection Optimization Option license. For the latest information on licensing, contact your Symantec sales or partner representative.

- Accelerator for virtual machines uses VMware Changed Block Tracking (CBT) to identify changes that were made within a virtual machine.
  VMware CBT may occasionally reset tracking of file changes, such as after a power failure or hard shutdown. In that case, for the next backup NetBackup

reads all the data from the vmdk files and the backup takes longer than expected.
If deduplication is enabled, the deduplication rate is lower than expected.
For more information on CBT, see the following VMware article:
Changed Block Tracking (CBT) on virtual machines (1020128)

- Supports the disk storage units that have the following storage destinations:

  - Cloud storage. Storage that is provided by a supported cloud storage vendor.

  - NetBackup Media Server Deduplication Pool. In addition to NetBackup media servers, NetBackup 5200 series appliances support Media Server Deduplication Pool storage.

  - PureDisk Deduplication Option.

  - Qualified third-party OpenStorage devices.

  To verify that your storage unit supports Accelerator, refer to the NetBackup hardware compatibility list for the currently supported OST vendors:
  "NetBackup 7.x Hardware"
  http://www.symantec.com/docs/TECH76495

- Symantec recommends that you not enable **Expire after copy** retention for any storage units that are used with storage lifecycle policies (SLP) in combination with Accelerator. The **Expire after copy** retention can cause images to expire while the backup runs. To synthesize a new full backup, the SLP backup needs the previous backup image. If the previous image expires during the backup, the backup fails.

- Granular Recovery Technology (GRT) is not supported for third-party OST storage. See the following tech note:
  Disk Storage Types supported for Granular Recovery Technology (GRT)
  http://www.symantec.com/docs/TECH187917

- Update the NetBackup device mapping files if needed.
  The NetBackup device mapping files contain all storage device types that NetBackup can use. To add support for the new devices or upgraded devices that support Accelerator, download the current device mapping files from the Symantec support site.
  See the *NetBackup Administrator's Guide Volume I* for information on the device mapping files and how to download them.

- Storage unit groups are supported only if the storage unit selection in the group is Failover.

- Supports the full backups and incremental backups. Every Accelerator backup (from a full schedule or incremental schedule) results in a complete image of the virtual machine.

- You can use incremental backups (cumulative or differential) as follows: To reduce the file-mapping overhead and to reduce the number of files that are recorded in the NetBackup catalog. Cumulative backups may involve more file-mapping because they do not use the random indexing method to determine which files have changed. In some cases, differential backups may be faster than cumulative backups.

- If a backup of the virtual machine does not exist, NetBackup performs a full backup. On the backup host it also accesses the VMware CBT information. This initial backup occurs at the speed of a normal (non-accelerated) full backup. Subsequent Accelerator backups of the virtual machine use VMware Changed Block Tracking to accelerate the backup.

Note: When you first enable a VMware policy to use Accelerator, the next backup (whether full or incremental) is in effect a full backup: It backs up all the virtual machine files that are selected in the policy. If that backup is an incremental, it may not complete within the backup window. When you upgrade policies to 7.6 and enable Accelerator, make sure that the next full backup completes in the time that is required.

- If the storage unit that is associated with the policy cannot be validated when you create the policy, note: The storage unit is validated later when the backup job begins. If Accelerator does not support the storage unit, the backup fails. In the `bpbrm` log, a message appears that is similar to one of the following:

```
Storage server %s, type %s, doesn't support image include.

Storage server type %s, doesn't support accelerator backup.
```

- Accelerator requires the storage to have the `OptimizedImage` attribute enabled. See "Accelerator requires the `OptimizedImage` attribute" on page 135.

Accelerator forced rescan for virtual machines (schedule attribute)

Accelerator for virtual machines uses Changed Block Tracking (CBT) technology from VMware to identify changed blocks. NetBackup requires the changed blocks when it creates a full virtual machine (synthesized) image. NetBackup is therefore dependent on VMware CBT for correctly identifying changed blocks. To protect against any potential omissions by underlying VMware CBT, the **Accelerator forced rescan** option conducts the backup without using CBT.

This option provides a safety net by establishing a new baseline for the next Accelerator backup.

When **Accelerator forced rescan** is used, all the data on the virtual machine is backed up. This backup is similar to the first VMware Accelerator backup for a policy. For the forced rescan job, the optimization percentage for Accelerator is 0. The duration of the backup is similar to a non-Accelerator full backup.

As an example: You can set up a weekly full-backup schedule with the **Use Accelerator** option. You can supplement that policy with a second schedule that enables the **Accelerator forced rescan** option, to run every six months.

Note: Accelerator forced rescan is unavailable if the **Use Accelerator** option on the **Attributes** tab is not selected.

Accelerator requires the `OptimizedImage` **attribute**

Accelerator requires that the storage has the `OptimizedImage` attribute enabled.

To ensure that your storage is configured properly, see the documentation for your storage option:

- NetBackup Media Server Deduplication Pool.
  The `OptimizedImage` attribute is enabled by default beginning with the NetBackup 7.1 release. If you created the storage servers and pools in an earlier release, you must configure them for `OptimizedImage`.
  See the *NetBackup Deduplication Guide*.

- Backups to a third-party disk appliance.
  The storage device must support the `OptimizedImage` attribute.
  See the *NetBackup OpenStorage Solutions Guide for Disk*.

- Cloud storage that NetBackup supports.
  See the *NetBackup Cloud Administrator's Guide*.

- PureDisk storage pool.
  By default, PureDisk supports the `OptimizedImage` attribute.

Accelerator backups and the NetBackup catalog

Use of Accelerator does not affect the size of the NetBackup catalog. A full backup with Accelerator generates the same catalog size as a full backup of the same data without Accelerator. The same is true of incremental backups: use of Accelerator does not require more catalog space than the same backup without Accelerator.

A potential catalog effect does exist, depending on how often you use Accelerator with full backups. A full backup with Accelerator completes faster than a normal full. It may therefore be tempting to replace your incremental backups with Accelerator full backups. Note: Since a full backup requires more catalog space than an incremental, replacing incrementals with fulls increases the catalog size. When changing your incrementals to fulls, you must weigh the advantage of Accelerator fulls against the greater catalog space that fulls require compared to incrementals.

Accelerator messages in the backup job details log

When a virtual machine is first backed up, Accelerator is not used for that backup. The following messages appear in the job details log:

```
7/25/2012 4:45:35 PM - Info bpbrm(pid=6192) There is no complete
 backup image match with track journal, a regular full backup will
 be performed

...

7/25/2012 4:53:22 PM - Info bpbkar32(pid=5624) accelerator sent
5844728320 bytes out of 5844726784 bytes to server, optimization 0.0%
```

When subsequent backups of the virtual machine use Accelerator, the following messages appear in the job details log:

```
7/27/2012 4:40:01 AM - Info bpbrm(pid=412) accelerator enabled

...

7/27/2012 4:43:07 AM - Info bpbkar32(pid=4636) accelerator sent
74764288 bytes out of 5953504256 bytes to server, optimization 98.7%
```

This message is a key trace for Accelerator. In this example Accelerator was successful at reducing the backup data by 98.7%.

NetBackup logs for Accelerator with virtual machines

Accelerator does not require its own log directory. For log messages about Accelerator, see the following standard NetBackup log directories.

Table 9-1 NetBackup logs that may contain Accelerator information

Log directory	Resides on
UNIX: `/usr/openv/netbackup/logs/bpbrm` Windows: `install_path\NetBackup\logs\bpbrm`	NetBackup master or media server
UNIX: `/usr/openv/netbackup/logs/bptm` Windows: `install_path\NetBackup\logs\bptm`	NetBackup media server
`/usr/openv/netbackup/logs/bpbkar` Windows: `install_path\NetBackup\logs\bpbkar`	Backup host
`/usr/openv/netbackup/logs/bpfis` Windows: `install_path\NetBackup\logs\bpfis`	Backup host
VxMS logs	See "NetBackup logging for VMware" on page 210.

To create the log directories, run the following command on the NetBackup servers and backup host:

On Windows:

`install_path\NetBackup\logs\mklogdir.bat`

On UNIX/Linux:

`/usr/openv/netbackup/logs/mklogdir`

Restore virtual machines

This chapter includes the following topics:

Restore notes and restrictions

Before you begin the restore, note the following:

- Cross-platform restore of individual files is not supported. You can restore Windows files to Windows guest operating systems but not to Linux. You can restore Linux files to supported Linux guest operating systems but not to Windows. In other words, the restore host must be the same platform as the files that you want to restore.
  See "About restore of individual files" on page 157.

- Unless a NetBackup client is installed on the virtual machine, you must do the restore from the NetBackup master server.

- To restore files to the original virtual machine location, the destination must be specified as the virtual machine's host name (not display name or UUID).

- To restore directly to an ESX server, the name that is specified for the restore must match the ESX server's official host name. The name must be in the same format in which it is registered in DNS and in the VMware server (whether short or fully-qualified).
  See "Adding NetBackup credentials for VMware" on page 42.

- The restore fails if ESX servers are configured with short host names and the backup and restore are done through a vCenter server.
  See "The restore fails if ESX servers use short host names and backups and restores use a vCenter server" on page 226.

- A virtual machine template cannot be restored to a standalone ESX server. Because templates are a feature of vCenter servers, you must restore the template through vCenter. If you restore a template to a standalone ESX server, the template is converted to a normal virtual machine and is no longer a template.

- If the virtual machine was backed up by its display name or UUID, and the display name differs from the host name, note: You must specify the correct destination client for the restore. Use the **Specify NetBackup Machines and Policy Type** dialog in the NetBackup Backup, Archive, and Restore interface.
  See "Invalid client error when you restore files using NetBackup BAR interface installed on the virtual machine" on page 230.

- Restore of individual files from a backup of the full virtual machine is not supported if the virtual machine contains Storage Foundation Volume Manager volumes.

- To restore Windows NTFS-encrypted files individually, you must install a NetBackup client on the virtual machine.
  See "NetBackup for VMware best practices" on page 204.

- For virtual machine restores, VMware supports the NBDSSL transport mode only for backups of vSphere 4.1 and later environments. Backups of the VMware systems that are earlier than vSphere 4.1 cannot be restored using the NBDSSL transport mode.

- If the attempt to restore a full virtual machine fails while using the SAN transport type, try the NBD transport type instead.

- VMware does not support the restore of virtual machines directly to an ESX 5.x server that vCenter manages. To restore the virtual machine, select the vCenter server as the destination.
  As an alternative, you can set up an independent ESX server to be used for restores. You must add NetBackup restore credentials for that ESX server by means of the **VMware restore ESX server** server type.
  See "Adding NetBackup credentials for VMware" on page 42.

- For the SAN transport mode, the job may be slow when you restore to a vCenter Server. For greater speed, designate a VMware restore ESX server as the destination for the restore.
  See "Adding NetBackup credentials for VMware" on page 42.

- For the SAN transport mode and a restore host on Windows 2008R2, the restore fails if the datastore's lun is offline. The detailed status log contains messages similar to the following:

  ```
  5/22/2013 4:10:12 AM - Info tar32(pid=5832) done. status: 24:
  socket write failed
  5/22/2013 4:10:12 AM - Error bpbrm(pid=5792) client restore EXIT STATUS 24
  socket write failed
  ```

  Make sure the status of the SAN disk on the restore host is online (not offline). Disk status can be checked or changed using the Windows diskpart.exe utility or the Disk Management utility (diskmgmt.msc). When the disk status reads online, retry the restore.

- A restore by means of the SAN transport mode may be slow in other circumstances. The following VMware article provides details:
  Best practices when using SAN transport for backup and restore

- The APIs in VMware's Virtual Disk Development Kit (VDDK) contain the following limitation: The maximum write speed during virtual machine restore is roughly one third of the hardware's maximum speed. The following Symantec tech note contains further information:
  Two causes of slow NetBackup for VMware restore performance
  http://www.symantec.com/docs/TECH169860

- When restoring large files, make sure that no snapshots are active on the destination virtual machine. Otherwise, the files are restored to the VMware configuration datastore, which may be too small to contain the files you want to restore. In that case, the restore fails.
  The configuration datastore (sometimes called the vmx directory) contains the configuration files that describe the virtual machine, such as `*.vmx` files. Note that active snapshots of vmdk files are also stored on the configuration datastore.

- If you cancel the virtual machine restore before it completes, the not-fully-restored virtual machine remains at the target location. NetBackup does not delete the incomplete virtual machine when the restore job is canceled. You must manually remove the incomplete virtual machine.

- If the virtual machine display name contains non-ASCII characters, the backup may succeed but the restore fails. To restore the virtual machine, you must change the display name to contain ASCII characters only and retry the restore.

- Granular Recovery Technology (GRT) is not supported for third-party OST storage. See the following tech note:
  Disk Storage Types supported for Granular Recovery Technology (GRT)
  http://www.symantec.com/docs/TECH187917

- NetBackup for VMware does not support individual file restore by means of ClientDirect Restore.

- On a restore, NetBackup recreates the linking between a hard link and its original file only in this case: If the link file and its target file are restored in the same job. If each file is restored individually in separate restore jobs, they are restored as separate files and the link is not re-established.

- If you restore a VM in vCloud to an expired vApp, the vApp is automatically renewed and added back into the vCloud organization. If the expired vApp contained other VMs, all those VMs are also removed from the expired list and added to the organization.
  Note that in vCloud Director, an expired vApp must be renewed before you can import a VM into that vApp.

- With a remote connection from a Windows Java GUI that uses the English locale, the restore of files that have non-ASCII characters may fail.
  See the following tech note for further information on how to restore the files:
  http://www.symantec.com/docs/TECH75745

- See "NetBackup for VMware: notes and restrictions" on page 33.

Restore notes and restrictions on Linux

Before you begin the restore, note the following:

- Cross-platform restore of individual files is not supported. You can restore Linux files to supported Linux guest operating systems but not to Windows.

- If the Linux file system was not quiesced before the snapshot, some files may be inconsistent. Such files can be recovered from the NetBackup.lost+found directory.
  See "About the NetBackup.lost+found directory on Linux" on page 164.
  See "About the SYMCquiesce utility" on page 292.

- To migrate an ext2 or ext3 file system to ext4, note: Make sure to follow the instructions under "Converting an ext3 file system to ext4" on the following page of the Ext4 wiki:
  https://ext4.wiki.kernel.org/index.php/Ext4_Howto#Converting_an_ext3_filesystem_to_ext4
  If you do not follow these instructions, data in a newly created ext4 file is not promptly flushed from memory to disk. As a result, NetBackup cannot back up

the data of recently created files in the ext4 file system. (The NetBackup snapshot captures the file as zero length.)

As a workaround for the file systems that were not correctly migrated, do one of the following:

- Run the Linux sync command on the ext4 file system before starting each backup.

- Install the NetBackup SYMCquiesce utility for VMware. This utility is described in the "SYMCquiesce utility for Linux virtual machines" appendix. The SYMCquiesce utility quiesces the Linux file system, to guarantee that all data has been flushed from memory to disk.

- For Linux virtual machines, NetBackup cannot restore individual files from software RAID volumes. The files are restored when you restore the entire virtual machine.

- The Linux ext4 file system includes a persistent pre-allocation feature, to guarantee disk space for files without padding the allocated space with zeros. When NetBackup restores a pre-allocated file (to any supported ext file system), the file loses its preallocation and is restored as a sparse file. The restored sparse file is only as large as the last byte that was written to the original file. Note also that subsequent writes to the sparse file may be non-contiguous.

- NetBackup supports backup and restore of Linux LVM2 volumes, including individual file restore from an LVM2 volume. Note however that NetBackup does not support individual file restore from a snapshot that was created by means of the snapshot feature in LVM2. If an LVM2 snapshot exists at the time of the backup, the data in the snapshot is captured in the backup. The data can be restored along with the rest of the virtual machine data when you recover the entire virtual machine.

- NetBackup supports backup of Linux FIFO files and socket files. NetBackup does not support restoring FIFO files and socket files individually. FIFO files and socket files can be restored along with the rest of the virtual machine data when you recover the entire virtual machine.

- For Linux virtual machines, the ext2, ext3, and ext4 file systems are supported for individual file restore. If a partition uses some other file system, the backup succeeds but files in that partition cannot be individually restored. To allow NetBackup to present mount points for restore in the Backup, Archive, and Restore interface, note: The "/" (root) partition must be formatted with ext2, ext3, or ext4.

- When you restore Linux files individually to an NFS-shared device on a Linux virtual machine, NetBackup can only restore the file data and attributes. The extended attributes cannot be restored to NFS-shared devices.

- For a virtual machine that is running a Linux guest operating system: When you restore a virtual machine, the ESX server may assign the virtual machine a new (virtual) MAC address. After you restart the virtual machine, you may have to configure its MAC address. For instance, the original MAC address of the virtual machine may be in a configuration file that has to be updated.
Refer to your VMware documentation for more details.

- For Linux, additional notes apply.
See "NetBackup for VMware: notes on Linux virtual machines" on page 36.

Restoring the full VMware virtual machine

To restore the full virtual machine

1   Start the NetBackup Backup, Archive, and Restore interface (BAR).

2   Specify the source client and destination client and type of policy:

In the Java interface, on the **Restore Files** tab, click the restore icon (hand symbol in the upper right).

In the Windows interface: Click **Files > Specify NetBackup Machines and Policy Type**.

3 Specify the following:

Server to use for backup and restores	The NetBackup master server that directed the backup
Source client for restores (or virtual client for backups)	The VMware virtual machine that was backed up.
	Click **Search VM Clients** to search or browse for a virtual machine. Use this option to locate a virtual machine in a large, multi-layered virtual environment.
	See "Browse and search virtual machines for restore" on page 160.
	Or enter the type of name that was selected for the **Primary VM identifier** option on the policy **VMware** tab. For example, if the **Primary VM identifier** option is set to VM host name, enter the virtual machine's host name.
Destination client for restores	This field is ignored. The destination for the restore is specified in a different screen as explained in a later procedure.
Policy type for restores	The type of policy that made the backup.
Date / time range	The date and time range within which to search for backups.

4 Select the type of restore:

In the Java interface, on the **Restore Files** tab, select **Restore type > Virtual Machine Backups**.

In the Windows interface, click the down arrow on the **Select for Restore** option. Select **Restore from Virtual Machine Backup**. A restore window displays the backups available for restore.

5 Select the virtual machine backup to restore.

In the Java interface, do the following:

- On the **Restore Files** tab, specify the **Start date** and **End date** within which to search for the backup. Click either of the calendar options.

- Specify root (/) in the **Browse directory** field and press Enter.

- Click on the root directory that is displayed under **Directory Structure**.
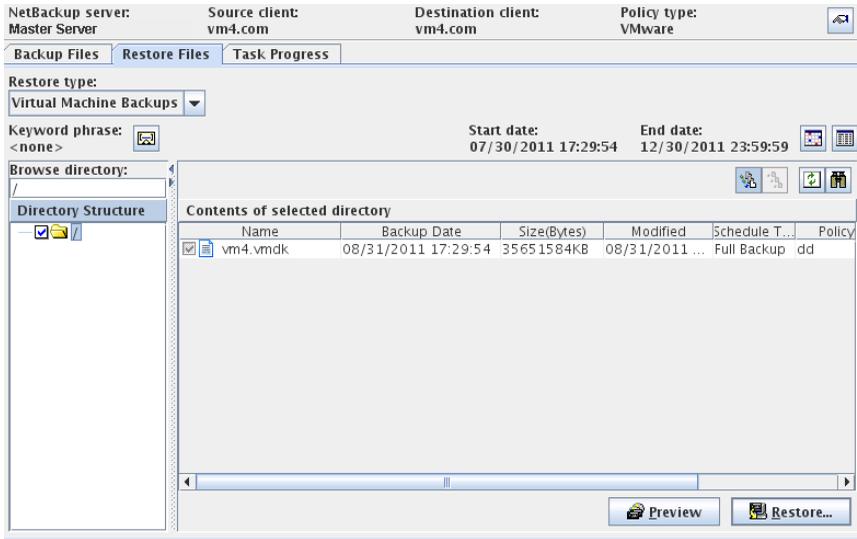
In the Windows interface, in the **NetBackup History** pane, click on the VMware backup. Then click on the item that is displayed under **All Folders**. You cannot select individual files. You must select the entire virtual machine.
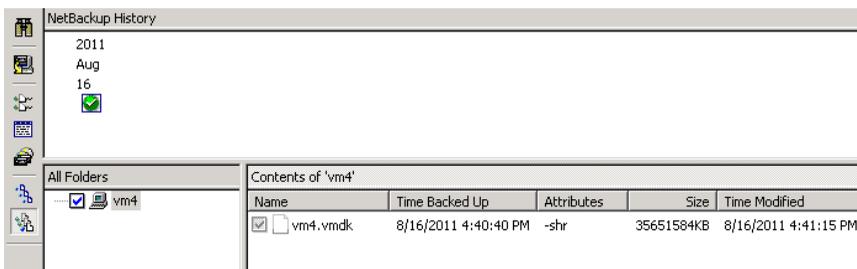
6 Select restore options.

In the Java interface, click **Restore**.

In the Windows interface, click **Actions > Restore**.

The type of dialog that appears depends on whether or not the backup was enabled for vCloud.

vSphere (not vCloud)   See "Virtual Machine Recovery dialog boxes (restore to original location)" on page 146.

                         See "Virtual Machine Recovery dialogs boxes (restore to alternate location)" on page 150.

vCloud   See "Virtual machine recovery dialog boxes for vCloud Director" on page 198.

Virtual Machine Recovery dialog boxes (restore to original location)

The following topics describe the Backup, Archive, and Restore screens for restoring a virtual machine to the original location. These screens do not apply to vCloud Director.

Recovery Destination dialog box

You can select the type of destination for the virtual machine recovery: the original location or alternate location.

This dialog includes the following:

- **Original settings of the virtual machine when it was backed up**
  Shows the configuration of the virtual machine at the time of the backup.
  When you restore the virtual machine to its original location, these configuration settings are used and cannot be changed.
  When you restore to an alternate location (not to the original location), you can change these settings after you click **Next**.

- **Recover virtual machine to**
  Select **Original location** or **Alternate location**.

Recovery Options dialog box

Select the recovery host and transport mode, as follows:

- **Destination setting**
  Shows the configuration of the virtual machine at the time of backup. These settings are applied to the virtual machine when it is restored.

  Note: This information is included for recovery to vSphere only (not for vCloud).

- **NetBackup Recovery Host**
  The host that performs the recovery. The default is the host that performed the backup (the backup host).
  In most cases, you can use the host that performed the backup. Selecting a different host as the recovery host can result in a slow restore or a failed restore, depending on the transport mode.

  For example, the restore fails if you select the SAN transport mode in the following case:

  - The host that performed the backup used a SAN connection to access the datastore.

- The host you select as recovery host does not have SAN access to the datastore.

- **Transport Modes**

  Determines how the restore data is sent from the recovery host to the VMware datastore. The appropriate option depends in part on the type of network that connects the VMware datastore to the recovery host.

  The default is the type that the backup used.

san	For unencrypted transfer over Fibre Channel (SAN) or iSCSI.
nbd	For unencrypted transfer over a local network that uses the Network Block Device (NBD) driver protocol. This mode of transfer is usually slower than Fibre Channel.
nbdssl	For encrypted transfer (SSL) over a local network that uses the Network Block Device (NBD) driver protocol. This mode of transfer is usually slower than Fibre Channel.
hotadd	Requires the recovery host in a virtual machine.
	For instructions on this transport mode and on installing the recovery host in a VMware virtual machine, refer to your VMware documentation.
Move Up, Move Down	Use these buttons to change the order in which NetBackup tries each selected mode. Highlight a mode and click Move Up or Move Down.
	For example: Assume that all four transport modes are selected, and the order is san, hotadd, nbd, and nbdssl. If one of the virtual disks cannot be accessed using san, the san transport mode is not used for any of the virtual machine's disks. NetBackup then tries to use the hotadd mode for all the disks. NetBackup continues to try each mode until it finds one that succeeds for all the disks.

Virtual Machine Options dialog box

Virtual Machine Options:

- **Restore BIOS UUID xxx instead of creating a new UUID**

Retains the UUID of the original virtual machine (note that the UUID is a globally unique identifier). The virtual machine is restored with the same UUID that it had before the restore.

Note the following:

- If a virtual machine with the same display name but with a different UUID exists at the target restore location, the restore fails. You must either delete the existing virtual machine and run the restore, or keep the existing virtual machine and abandon the restore.

- If you do not want to keep the existing virtual machine, you can do one of the following: Remove the existing virtual machine, or log into the ESX server and remove the directory where the virtual machine resides.

- **Overwrite the existing virtual machine**
  If a virtual machine with the same display name exists at the destination, that virtual machine must be deleted before the restore begins. Otherwise, the restore fails. Select this option to have the virtual machine deleted.

- **Remove backing information for devices like DVD/CD-ROM drives, serial or parallel ports**
  If a virtual machine had an ISO file that was mounted on a CD when the virtual machine was backed up, note: The ISO file must be available on the target ESX server when you restore the virtual machine. If the ISO file is not available on the ESX server, the restore fails.
  This option restores the virtual machine without restoring an ISO file that was mounted when the virtual machine was backed up.

- **Remove network interfaces**
  Removes any network interfaces from the restored virtual machine.

  Select this option if:

  - The network connections on the destination virtual machine have changed since the backup was made.

  - Or if the original virtual machine still exists and a duplicate may cause conflicts.

- **Power on virtual machine after recovery**
  Select this option to have the recovered virtual machine automatically turned on when the recovery is complete.

- **Override default job priority**
  Place a check mark in this box to override the default priority.

- **Job Priority**
  Use this field to set a higher priority.

- **Retain original hardware version**

   This option restores the virtual machine with its original hardware version (such as 4). It retains the original version even if the target ESX server by default uses a different hardware version (such as 7 or 8). If the target ESX server does not support the virtual machine's hardware version, the restore may fail.

   If this option is disabled, the restored virtual machine is converted to the default hardware version that the ESX server uses.

Format of restored virtual disks:

- **Original provisioning**

   Restores the virtual machine's virtual disks with their original provisioning.

Note: Regarding restore into vCloud Director: For **Original provisioning**, NetBackup restores the virtual machine's virtual disks with the format they had when the virtual machine was backed up. That format may be different from either of the following: The default format of the vCloud organization when the virtual machine was originally created, or the format for the destination organization.

- **Thick Provision Lazy Zeroed**

   Configures the restored virtual disks in the thick format. The virtual disk space is allocated when the disk is created. This option restores the populated blocks, but initializes vacant blocks with zeros later, on demand.

- **Thick Provision Eager Zeroed**

   Configures the restored virtual disks in the thick format. Restores the populated blocks and immediately initializes vacant blocks with zeros (eager zeroed). Creation of the virtual disks may take more time with this option. However, if the restore occurs over a SAN, the eager zeroed feature may speed up the restore by reducing network communication with the vCenter server.

- **Thin Provisioning**

   Configures the restored virtual disks in the thin format. Restores the populated blocks but does not initialize vacant blocks or commit them.

   Thin provisioning saves disk space through dynamic growth of the vmdk file. The vmdk files are no larger than the space that the data on the virtual machine requires. The virtual disks automatically increase in size as needed.

Note: If the vmdk is completely written, VMware automatically converts a thin disk to **Thick Provision Eager Zeroed**.

Refer to the following Symantec document for more support details on thin provisioned disks:

Support for NetBackup 7.x in virtual environments

For more information on virtual disk provisioning, refer to VMware's documentation.

Perform Recovery dialog box

Review the settings that are to be applied to the restored virtual machine.

- **Recovery settings**
  Lists several settings that are used for the recovery.

- **Run Pre-Recovery Check**
  Click this option to verify credentials, available space on the datastore, and other important requirements.

- **Start Recovery**
  Starts the recovery of the virtual machine.

Virtual Machine Recovery dialogs boxes (restore to alternate location)

The following topics describe the Backup, Archive, and Restore screens for restoring a virtual machine to an alternate location. These screens do not apply to vCloud Director.

Recovery Destination dialog box (restore to alternate location)

- **Original settings of the virtual machine when it was backed up**
  Shows the configuration of the virtual machine at the time of the backup. When restoring to an alternate location (not to the original location), you can change these settings after you click **Next**.

- **Recover virtual machine to**
  Select **Alternate location**.

Recovery Options dialog box (restore to alternate location)

The Recovery Options dialog initially displays the original virtual machine settings that were recorded in the NetBackup catalog when the virtual machine was backed up. Before accepting any default values, you may have to verify that the original hosts or servers are still available.

The dialog contains the following fields:

- **NetBackup Recovery Host**

  The recovery host transfers the virtual machine files to the VMware destination that is specified in other fields on this dialog. The default for the recovery host is the backup host that backed up the virtual machine.

  Consider the following when selecting a recovery host:

  - To use the original VMware backup host for the recovery, verify that the backup host still exists. The original backup host may have been removed or reconfigured after the backup occurred.

  - The current processing load on the host that you want to use may be a factor. The recovery host undergoes significant I/O activity when it restores a virtual machine.

  - The network connection between the recovery host and the destination datastore may limit the type and speed of data transmission. For example, to use the SAN transport mode, the recovery host must have access to the appropriate luns in the datastore.

- **Transport Modes**

  Determines how the data is sent from the recovery host to the VMware datastore. The appropriate mode depends on the type of connection between the NetBackup recovery host and the VMware datastore.

  More information is available about these options.

  See "Recovery Options dialog box" on page 146.

- **vCenter Server**

  Specifies the vCenter server for the restored virtual machine. To use the original vCenter Server (the default), verify that the original vCenter server still exists.

  To use a different vCenter Server, consider whether it is compatible with the virtual machine you want to restore. For example: If you attempt to restore a vmx-07 virtual machine to a vSphere server that is earlier than 4.0, note: VMware Tools converts the virtual machine to an earlier hardware version.

  In other cases, you can use the **Retain original hardware version** option on the **Virtual Machine Options** dialog.

  The restore may finish faster if you use the SAN transport mode with a restore ESX server (bypassing any vCenter servers).

  When choosing a target host for the restore, note the following:

  - If NetBackup has credentials to access a vCenter server (but does not have credentials to access a VMware restore ESX server), note: You can restore the virtual machine through the vCenter server. In this case, the data movement for the restore passes through the vCenter server. Passing the virtual machine data through the vCenter server may increase the amount of time that is needed to complete the restore.

The credentials must give NetBackup full access privileges to the vCenter server.

See "Adding NetBackup credentials for VMware" on page 42.

- If NetBackup has credentials to access a vCenter server as well as a VMware restore ESX server, the restore may complete faster. In this case, by default NetBackup passes the virtual machine data directly to the restore ESX server, bypassing the vCenter server. You can select a vCenter folder in which to place the restored virtual machine. The credentials must give NetBackup full access privileges to the restore ESX server.

  Select the vCenter Server, and click **Search** to select the VMware restore ESX server.

  Note: In vCenter 5.x environments, NetBackup uses the selected vCenter to create the virtual machine. NetBackup then writes the .vmdk files directly to the ESX server using the Restore ESX Server credentials to that server.

- If NetBackup has credentials to access an ESX server, you can designate that server as the target for the restore. The credentials must give NetBackup full access privileges to the ESX server.

  Select **None** for the vCenter Server, and click **Search** to select the ESX server.

  Note: To restore to an ESX 5 server, the ESX must be standalone, not managed by vCenter 5. To restore to an ESX 5 under vCenter 5, NetBackup must have VMware restore ESX server credentials for the ESX. Select the vCenter, and click **Search** to select the VMware restore ESX server.

- **ESX Server**

  Specifies the ESX server on which the restored virtual machine is to reside. To use the original ESX server (the default), verify that the original ESX server still exists.

  Click the **Search** option to browse for a different ESX server.

  See "Select ESX server dialog box (restore to alternate location)" on page 154.

- **Datacenter**

  Shows the VMware datacenter containing the selected ESX server.

- **Folder**

  A folder is a logical entity within the vCenter that contains VMware objects, such as datastores, networks, and virtual machines.

By default, this field shows the VMware folder that contained the virtual machine when the virtual machine was backed up. If you select a different ESX server to which to restore the virtual machine, this field changes to None. You must then click **Browse** to select a folder within the datacenter for the restored virtual machine.

See "Select Folder dialog box (restore to alternate location)" on page 154.

- **Display Name**

  Specifies the VMware display name for the restored virtual machine. The default is the display name that the virtual machine had when it was backed up.

  The display name must be unique for the vCenter Server where the virtual machine is restored.

  Note: If a virtual machine with this display name already exists at this location (or at the original location), you are prompted to click **Overwrite the existing virtual machine**. You cannot restore the virtual machine if the result is two virtual machines with the same display name on the same vCenter server.

- **Resource Pool/vApp**

  Use this option to have the restored virtual machine assigned to either a VMware resource pool or to a vApp. Resource pools manage the host's CPU and memory. vApps are logical containers for virtual machines, and also share some functionality with virtual machines.

- **Datastore/Datastore Cluster**

  Specifies the VMware datastore or datastore cluster that contains the virtual machine configuration files. Click **Change** to make a selection.

  This datastore (sometimes called the vmx directory) contains the configuration files that describe the virtual machine, such as `*.vmx` files. Active snapshots of vmdk files are also stored on this datastore.

  Note: The Datastore field shows the name of the datastore that contained the virtual machine data when the virtual machine was backed up. Even if the datastore was in a datastore cluster, the field shows the name of the datastore, not the datastore cluster. When the virtual machine is restored, NetBackup determines how the datastore is currently configured (in a cluster or not) and configures the virtual machine accordingly.

- **Use the same datastore/datastore cluster for all VMDKs**

  This option assigns all restored virtual machines to the datastore or datastore cluster that is selected in the **Datastore/Datastore Cluster** field.

If this option is not selected, you assign the VMDKs to specific datastores or datastore clusters in a later dialog (the Storage Destination dialog).

Select ESX server dialog box (restore to alternate location)

On the **Select ESX server** dialog, you can enter the name of the ESX server or drill down in the list to select a server.

- **Specify ESX server**
  Enter the name of the ESX server in this field. As you type a name, the list of available servers automatically expands and the nearest match is highlighted.

- **Search**
  If necessary, click **Search** to locate the server name that you typed.

Note: Some older ESX servers may not support the version of the virtual machine that you want to restore. Verify that the ESX server is compatible with the virtual machine.

Select Folder dialog box (restore to alternate location)

The Select Folder dialog shows the vCenter folders that exist on the datacenter that is shown in the **Datacenter** field.

Pick a folder from the list of available folders. The restored virtual machine is placed in this folder.

If two datacenters of the same name exist in the vCenter server, all folders for the identically named datacenters are displayed. After you select a folder and click OK, verify that the folder on the **Recovery Options** dialog contains the destination ESX server. If the selected folder is on the wrong datacenter, the restore fails.

Select Datastore or Datastore Cluster dialog box (restore to alternate location)

Use this screen to select a datastore or datastore cluster for the restored virtual machine. You can use the search field, or drill down manually into the list.

Note: Only datastores and clusters visible to the ESX server are displayed.

Search

As you type a name, the list of available datastores and datastore clusters automatically expands and the nearest match is highlighted.

Virtual Machine Options dialog box (restore to alternate location)

This dialog is described in a previous topic:

See "Virtual Machine Options dialog box" on page 147.

Storage Destination dialog box (restore to alternate location)

Select the datastores where the .vmdk files are to be restored.

- **Source VMDK File Name**
  Shows the names of the .vmdk files that were backed up.

- **Datastore/Datastore Cluster**
  Shows the VMware datastore or datastore cluster where the .vmdk files are to be restored. Click in this field to select another datastore.
  See "Select Datastore or Datastore Cluster dialog box (restore to alternate location)" on page 154.
  If the datastore is in a datastore cluster, NetBackup displays the name of the datastore (not the name of the cluster).

- **Datastore/Datastore Cluster Status**
  Indicates whether the datastore or datastore cluster has enough space to contain the selected .vmdk file.

OK	The datastore or datastore cluster has enough space to contain the selected .vmdk file.
Insufficient space	The datastore or datastore cluster does not have enough space to contain the selected .vmdk file.

Network Connections dialog box (restore to alternate location)

For restore into vSphere, this dialog displays all of the networks that the restored virtual machine can connect to.

For restore into vCloud Director, this dialog displays the networks that the virtual machine was connected to (if any) at the time of the backup.

For vCloud Director: If the virtual machine was not connected to any networks during backup, or if none of those networks are currently available, the dialog states: "No networks available for selected virtual machine." In that case, if a network connection is required, create it after the restore completes.

- **Retain original network configuration**

If possible, this option retains the original MAC address and other configuration settings of the virtual machine. Note that vCenter assigns a new MAC address if the original exists.

This option configures the virtual machine with its original network labels, even if those networks are not available at the restore location.

When you select this option, any network names that are shown in this dialog are ignored.

- **Network Names**

Select the networks that you want the restored virtual machine to be connected to. Note that virtual networks are displayed in addition to physical networks.

Note: Click the **Network Names** check box to select or unselect all the networks in the list.

When the virtual machine is backed up, its network connections (physical or virtual) are recorded in the NetBackup catalog.

For restores into vSphere, NetBackup determines what networks currently exist at the restore location and lists the network names as follows:

- If a network that was recorded in the backup catalog for the virtual machine still exists, it is listed on this screen and automatically selected.

- If a network is available that was not listed in the NetBackup catalog, it is listed on this screen but not selected.

- If a network was recorded in the backup catalog but is not currently available, it is not listed.

- This option discards previous network settings and creates new network adaptors for the selected networks.

Perform Recovery dialog box (restore to alternate location)

- **Recovery settings**

Lists the settings that are used for the recovery.

- **Run Pre-Recovery Check**

Verifies the credentials and appropriate paths and connectivity, determines whether the datastore or datastore cluster has available space, and reviews other requirements. You must run this check at least once. You can proceed with the restore even if the check fails.

- **Start Recovery**

Starts the recovery of the virtual machine.

About restore of individual files

You can use either of the following procedures to restore files individually.

One-stage process   Restore individual files to the virtual machine by restoring to the recovery host. The virtual machine drives that are the destination for the restore must be configured in one of the following ways:

- Windows only: The virtual machine drives must be shared through the guest operating system on the virtual machine.
  See "Setting up NetBackup Client Service for restore to a Windows shared virtual machine drive" on page 159.
- NetBackup client software must be installed on the VMware virtual machine.

Two-stage process   Restore individual files from the VMware recovery host to a NetBackup client (not to the virtual machine). See the *NetBackup Backup, Archive, and Restore Getting Started Guide* on how to restore to different locations.

Then manually copy the restored files to the virtual machine. (NetBackup does not perform this step.)

Note: Individual file recovery is supported from full backups and from incremental backups, as long as the **Enable file recovery from VM backup** policy option is enabled.

Restoring individual files

If the VMware backup was made with the **Enable file recovery from VM backup** option, you can restore individual files.

See "Optimizations options (VMware)" on page 57.

To restore individual files

1 In the NetBackup Backup, Archive, and Restore interface, specify the source client and destination client and the type of policy:

For UNIX systems, on the **Restore Files** tab, click the Restore icon:

For Windows systems, click **Files > Specify NetBackup Machines and Policy Type**.

2 Specify the following:

Server to use for backup and restores	The NetBackup master server that directed the backup.
Source client for restores	The VMware virtual machine that was backed up.
	Click **Search Virtual Clients** to search or browse for a virtual machine. This option helps to locate a virtual machine in a large, multi-layered virtual environment.
	See "Browse and search virtual machines for restore" on page 160.
	Or, enter the type of name that was selected for the **Primary VM identifier** option on the policy **VMware** tab. For example, if the **Primary VM identifier** option is set to VM host name, enter the virtual machine's host name.
Destination client for restores	Specify one of the following:
	■ The host name of the VMware virtual machine that was backed up, if NetBackup client software has been installed on the virtual machine.
	Specify the host name even if the policy identified the virtual machine by its VM display name, UUID, or DNS name. Do not enter the VM display name, UUID, or DNS name.
	■ The NetBackup recovery host.
	Note: The NetBackup Client Service must be logged on as Administrator.
	See "Setting up NetBackup Client Service for restore to a Windows shared virtual machine drive" on page 159.
Policy type for restores	The type of policy that made the backup.

3   Select the type of restore, as follows:

  ▪ For UNIX systems, on the **Restore Files** tab, select **Normal Backups**.

  ▪ For Windows systems, click **Files > Select Files and Folders to Restore > from Normal Backup**

4   For UNIX systems enter the **Browse directory** that contains the directories or files to restore.

  See "About restore of individual files" on page 157.

5   Click the files you want to restore.

6   Start the restore, as follows:

  ▪ On UNIX systems: Click **Restore**.

  ▪ On Windows systems: Click **Actions > Restore**....

7   For Windows systems, if NetBackup client software is not installed on the destination virtual machine, select one of the following:

  ▪ **Restore everything to a different location**

  ▪ **Restore individual folders and files to different locations**
    Destinations must be entered as UNC path names that refer to shared drives on the virtual machine.

  For example, to restore the file `E:\folder1\file1` on virtual machine `vm1`, enter the following destination:

  `\\vm1\e$\folder1\file1`

  The NetBackup Client Service must be logged on under an account that has Administrator privileges.

  See "Setting up NetBackup Client Service for restore to a Windows shared virtual machine drive" on page 159.

  See "About restore of individual files" on page 157.

Setting up NetBackup Client Service for restore to a Windows shared virtual machine drive

To restore individual files to a Windows virtual machine that has a shared drive, note: the NetBackup Client Service must be logged on under an account that has Administrator privileges (not as the Local System account). An account with Administrator privileges lets NetBackup write to the directories on the virtual machine to which the data is restored.

If you try to restore files while the NetBackup Client Service is logged on as the Local System account, the restore fails.

To log on the NetBackup Client Service as Administrator

1 In Windows Services on the VMware recovery host, double-click the NetBackup Client Service.

2 Check the **Log On** tab: if the service is not logged on under an account that has Administrator privileges, stop the service.

3 Change the logon to the Administrator account, or to an account that has Administrator privileges.

   The account must have Administrator privileges in the domain in which both the virtual machine and the VMware backup host reside.

4 Restart the service.

5 Retry the restore.

Browse and search virtual machines for restore

In the **Backup, Archive, and Restore** interface, under **File > Specify NetBackup Machines and Policy Type**: click **Search VM Clients**. This option makes it easier to locate a virtual machine in a large, multi-layered virtual environment.

The **Browse and Search Virtual Machines for Restore** dialog appears.

Use this dialog to find a virtual machine.

Note: This dialog finds the virtual machines that were backed up with the VMware policy type. It does not search for other types of backups (such as FlashBackup-Windows).

Note: If the backup was made by a version of NetBackup earlier than 7.6, the backup image must be imported and verified before it can be browsed or searched with this dialog.

Table 10-1   Browse and Search Virtual Machines for Restore dialog box

Dialog box item	Description
Search virtual machines	Search for virtual machines by name, IP address, UUID, or by other criteria.
	See "Search virtual machine clients by client name or query" on page 161.
Browse virtual machines	Browse for virtual machines by drilling down through the virtual objects.
	Select the type of view for browsing:
	■ **vCloud view** Shows the virtual objects as they appear in vCloud Director.
	■ **vSphere view** Shows the virtual objects as they appear in vSphere Client.
	See "Browse the vCloud or vSphere view for virtual machine clients" on page 163.

Note: Although VMware allows up to 128 characters for an object name, the NetBackup database restricts searches to the first 126 characters only.

Search virtual machine clients by client name or query

Use this screen to search for virtual machines by name or other identifier, or to enter rule-based search criteria (click **Advanced Search**).

Display name, host name, IP address, Instance UUID, BiosUUID, DNS name, or vCDvApp to search for:

Enter the name or number of the virtual machine to search for and click **Search**. Any matching virtual machines appear in the **Search results** screen.

See "Virtual machine search results" on page 163.

Advanced Search: Click to enter rule-based search criteria.

Table 10-2   Advanced search: Search virtual machine clients using a query

Search item	Description
join	Available only when you click the plus sign to add a rule to the search. AND: Limits or restricts the scope of the search. OR: Opens up the query to an additional possibility, expanding the scope of the search.
field	Select a parameter on which to search (scroll down). You can type the first character to speed up selection.
operator	Select an operator. You can type the first character to speed up selection. The available operators depend on the parameter that is selected for Field.
value	Enter a value for the field parameter.
✚	Click to refine or expand the search (add another rule).
✖	Click to remove the rule from the search.
Basic Search	Click to search by display name, host name, UUID, or DNS name.
Search	Click to run the search. The matching virtual machines appear in the **Search results** screen. See "Virtual machine search results" on page 163.

Note the following about the search behavior:

- Although VMware allows up to 128 characters for an object name, the NetBackup database restricts searches to the first 126 characters only.

- To search for a vSphere vApp by name without specifying its path: Use the search operator **Contains** or **EndsWith** (do not use **Equal**). To use **Equal**, you must specify the entire path of the vApp.

- To search by IP address: If the virtual machine has two or more IP addresses (such as virtual addresses), use **Contains** as the search operator instead of **Equal**.

- You must include a leading forward slash (/) when searching for a datacenter, VM folder, or resource pool. If you use the **Contains** operator, a leading slash is not required.

- Regarding wildcards: * and ? are not supported for Greater, GreaterEqual, Less, and LessEqual operators. The * and ? characters are treated as literals, not wildcards.
  For the rest of the operators, * matches everything, and ? matches any single character.
  Note: SQL has a limitation that wildcards *, ? (SQL equivalents are % and _) do not match null values. If a virtual machine does not have an IP address, the query "IPAddress Equal *" does not find the virtual machine.

Browse the vCloud or vSphere view for virtual machine clients

The **Browse the vCloud (or vSphere) view for virtual machine clients** screen shows your virtual environment starting with the vCenter server. The objects appear according to the view you chose (vCloud or vSphere).

To select a virtual machine, click on an ESX server or vApp. Highlight the virtual machine you want and then click **Select**.

To switch the view to vCloud or vSphere, click on the link in the upper right.

Note: Although VMware allows up to 128 characters for an object name, the NetBackup database restricts searches to the first 126 characters only.

See "Browse and search virtual machines for restore" on page 160.

Virtual machine search results

The virtual machines that match your search are listed in the **Search results** screen. The search criteria that were used are listed at the top.

Highlight the virtual machine that you want to restore and click **Select**.

If no virtual machines appear, click **Back** to revise your search criteria.

See "Browse and search virtual machines for restore" on page 160.

About the NetBackup.lost+found directory on Linux

Note: You can ignore this section if: you have installed the SYMCquiesce utility on your virtual machines, and your virtual machines meet the requirements for the SYMCquiesce utility.

See "About the SYMCquiesce utility" on page 292.

See "Installing the SYMCquiesce utility" on page 293.

Without the SYMCquiesce utility, a snapshot of a Linux virtual machine may be in an inconsistent state (sometimes called crash-consistent). In other words, the snapshot data is equivalent to the state of a file system after an abrupt, uncontrolled shutdown. When the virtual machine is restarted, a file system consistency check (`fsck`) reports the inconsistencies that need repair.

To handle inconsistent data from backups of crash-consistent Linux virtual machine snapshots, NetBackup creates a `NetBackup.lost+found` directory for each Linux volume. This directory is not a physical directory on the volume but a virtual directory in the NetBackup catalog. Any inconsistent directories or files are linked to the NetBackup.lost+found directory. The names of the inconsistent directories and files cannot be determined: the items in the NetBackup.lost+found directory are therefore assigned the names that represent the inode numbers of the original directories or files.

If a NetBackup.lost+found directory already exists on the virtual machine, NetBackup appends numbers to the new NetBackup.lost+found directory names, to keep them unique. The directories are named NetBackup.lost+found.1, NetBackup.lost+found.2, and so forth.
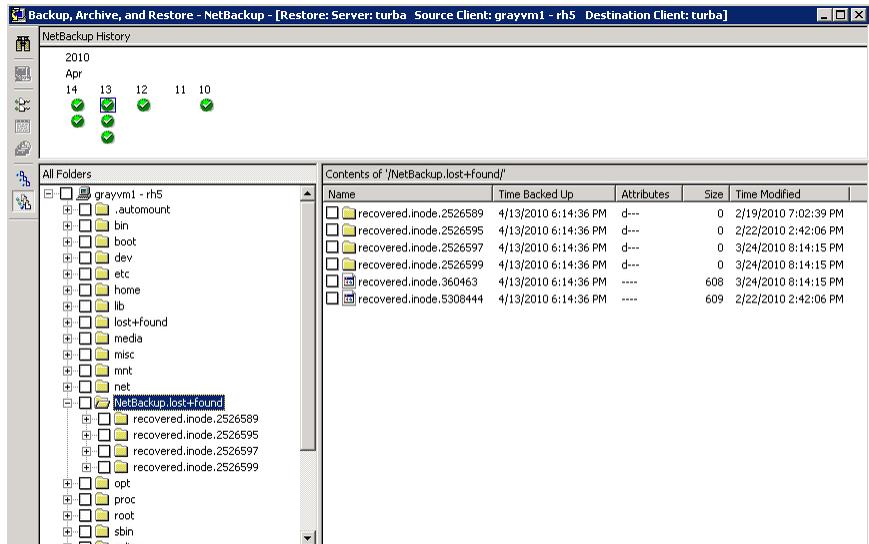
Note: The NetBackup.lost+found directory is not the same as the standard Linux lost+found directory that Linux maintains in case of an abnormal system shutdown.

The following Backup, Archive, and Restore screen shows examples of inconsistent directories and files in a NetBackup.lost+found directory. This example also shows the standard Linux lost+found.

In the NetBackup Backup, Archive, and Restore interface, you can search the NetBackup.lost+found directory for any inconsistent items and restore them. Symantec recommends that you restore them to an alternate location (not to the original virtual machine). You can then examine their contents to determine their original names. Any metadata that was captured at the time of the backup may be helpful in identifying the inconsistent files or directories. Examples of such metadata are file size, file owner, and file creation and modification dates.

If the recovery host is not at the same NetBackup release level as the backup host

Note the following about mixed-level backups and restores:

- To restore from a NetBackup 7.x backup
  To restore a virtual machine from a backup that a NetBackup 7.x backup host performed, a NetBackup 7.x recovery host is required. You cannot use a NetBackup 6.5.x recovery host to restore a virtual machine that was backed up by a NetBackup 7.x backup host.

- To restore from a NetBackup 6.5.x backup
  To restore a virtual machine (or selected files) from a NetBackup 6.5.x backup, the VMware Converter must be installed on the NetBackup recovery host. The recovery host can run NetBackup 6.5.x or 7.x. A staging area is required.

Restore virtual machines with Instant Recovery

This chapter includes the following topics:

About Instant Recovery for VMware

NetBackup can recover a virtual machine almost instantly, without waiting to transfer the virtual machine's data from the backup. NetBackup starts the virtual machine

directly from the backup image and makes it accessible to users on the target ESX host immediately. You can copy files (including vmdk files) without restoring the entire virtual machine. To restore the virtual machine, use VMware Storage vMotion to migrate the virtual machine data files from the backup image to the ESX host.

Some example uses for instant recovery:

- Access and restore individual files and folders from any type of OS and then delete the virtual machine. (Note for Windows or Linux: Instead of instant recovery, you can use the policy **Enable file recovery from VM backup** option and restore individual files with the Backup, Archive, and Restore interface.)

- Test a patch on a restored virtual machine before you apply the patch to production systems.

- Troubleshoot a virtual machine or host, such as when the production ESX host is down. You can start the virtual machine from its backup and use it until the production system is back online.

- Permanently recover the virtual machine by means of Storage vMotion.

- Verify the backup image.

- Copy a vmdk file and then delete the virtual machine.

- Verify an application.

In any case, the virtual machine is started directly from the backup image and is available in seconds or minutes. The startup time depends on the network speed and storage speed, not on the size of the virtual machine.

Table 11-1 describes the steps in a virtual machine instant recovery.

Table 11-1   How Instant Recovery for VMware works

Sequence	Actions
Step 1	Run the nbrestorevm command* to access the virtual machine from its backup image. The NetBackup File System Service (NBFSD) on the media server accesses the backup image file system and mounts the image as an NFS datastore. The datastore becomes accessible to the ESX host where the virtual machine is to be restored. On the same command, select a temporary datastore that is accessible to the ESX host.
Step 2	NetBackup creates a virtual machine on the ESX host and configures the virtual machine with write access to a temporary (local) datastore.
Step 3	NetBackup creates a snapshot of the virtual machine. Any new write requests in the virtual machine use the temporary datastore. The virtual machine uses the NFS datastore as read-only.

Table 11-1   How Instant Recovery for VMware works *(continued)*

Sequence	Actions
Step 4	NetBackup starts up the virtual machine on the ESX host.
Step 5	To keep the restored VM: Use Storage vMotion to copy the virtual machine data from the NFS datastore to the temporary datastore.
Step 6	When vMotion is complete, use nbrestorevm to unmount the NFS datastore.

*NetBackup 7.6 provides a command-line interface for instant recovery of virtual machines (nbrestorevm). A graphical interface will be available in a future release.

Task overview for Instant Recovery for VMware

Table 11-2 describes the tasks for Instant Recovery for VMware.

Table 11-2   Instant Recovery tasks

Step	Description	Reference topic
Step 1	Review the performance recommendations	See "Performance recommendations for Instant Recovery for VMware" on page 169.
Step 2	Review the notes and requirements	See "Requirements for Instant Recovery for VMware" on page 169. See "Notes on Instant Recovery for VMware" on page 171.
Step 3	Restart the Client for NFS service on the restore host	See "Restarting the Client for NFS service on the restore host" on page 172.
Step 4	Review the Instant Recovery options on the nbrestorevm command	See "Instant Recovery options on the nbrestorevm command" on page 172.
Step 5	Use the nbrestorevm command to perform Instant Recovery	See "Restoring a virtual machine with Instant Recovery for VMware" on page 177. See "Restoring individual files with Instant Recovery for VMware while the current virtual machine is running" on page 185.

Performance recommendations for Instant Recovery for VMware

High performance in virtual machine instant recovery depends on your physical storage and network infrastructure. You must have adequate network speed from the media server to the VMware ESX host. For good Storage vMotion performance with the least effect on the restored virtual machine in the production environment, SAN storage is recommended.

Symantec recommends the following:

- A SAN connection from the NetBackup media server and its disk storage unit to the ESX host.

- For Fibre Channel SAN, a minimum speed of 4 gigabits per second.

- For iSCSI SAN, a minimum speed of 1 gigabit per second.

- When you use Storage vMotion to migrate a restored virtual machine, migrate one virtual machine at a time per media server. The migration may be slow if you simultaneously migrate multiple virtual machines per media server.

- For disaster recovery testing, Symantec recommends that you restore no more than 3 or 4 virtual machines per media server. The number to restore depends on the I/O load on the media server. Symantec recommends restoring each VM one-by-one, not simultaneously.

Note: For large-scale recovery of multiple virtual machines, use the virtual machine restore feature in the Backup, Archive, and Restore interface. Do not use Instant Recovery for VMware.

Requirements for Instant Recovery for VMware

For virtual machine instant recovery, your environment must meet the following requirements:

- The virtual machine to restore must have been backed up from a VMware policy.

- The target ESX server for the restore must be at vSphere 5.0 or later.

- The restore host (NetBackup client) must be on Windows. The backup host that made the backup can be Windows or Linux.

- For a restore host that is separate from the NetBackup master server or media server: You must add the restore host to the list of servers that can access the master server. For example: If a NetBackup appliance was the backup host that made the backup, the restore host must run on a separate Windows host.

In the NetBackup Administration Console, click **Host Properties > Master Servers**, double-click the NetBackup master server, and click **Servers**. On the **Additional Servers** tab, click **Add** to add the restore host.

See "Allowing other servers or clients to restore virtual machines" on page 258.

- If the backup host was Linux, you must use the -vmproxy option on the nbrestorevm command to specify a Windows restore host. The nbrestorevm command is explained in the following topics:

  See "Instant Recovery options on the nbrestorevm command" on page 172.

  See "Restoring a virtual machine with Instant Recovery for VMware" on page 177.

- The NFS Client service must be enabled on the ESXi host.

- The Services for Network File System (NFS) must be installed on the Windows media server and restore host.

  See "About configuring services for NFS on Windows 2012 (NetBackup for VMware)" on page 260.

  See "About configuring services for NFS on Windows 2008 and 2008 R2 (NetBackup for VMware)" on page 267.

  See "About configuring Services for Network File System (NFS) on the Windows 2003 R2 SP2 NetBackup media server and NetBackup clients (NetBackup for VMware)" on page 275.

  The NetBackup media server platform must support Granular Recovery Technology. See the *NetBackup Enterprise Server and Server 7.x OS Software Compatibility List*:

  http://www.symantec.com/docs/TECH76648

- The Client for NFS service may have to be restarted on the NetBackup restore host.

  See "Restarting the Client for NFS service on the restore host" on page 172.

- The media server must use IPv4 (IPv6 is not supported).

  Note: If the media server is registered with IPv6 but is configured for both IPv4 and IPv6, use the following workaround:

  On the ESX server add an entry to the /etc/hosts file, to remap the media server host name to its IPv4 address. For example:

  ```
  10.84.65.60 mserver7.acme.com
  ```

  Where 10.84.65.60 is the IPv4 address of the media server mserver7.

- NetBackup requires login credentials for the vCenter server and the restore host.

  See "Adding NetBackup credentials for VMware" on page 42.

Notes on Instant Recovery for VMware

Note the following about instant recovery of VMware virtual machines:

- Supports the following storage unit types (disk only): BasicDisk, AdvancedDisk, Media Server Deduplication Pool (MSDP), PureDisk Deduplication Pool (PDDO). Note: Snapshot-only backups are not supported.

- Does not support a virtual machine that had disks that were excluded from the backup. The policy **Virtual disk selection** option must have been set to include all disks.

- Does not support a virtual machine that has a disk in raw device mapping mode (RDM) or that has a disk in Persistent mode.

- Supports the following policy schedule types: Full backups, and incremental backups that include the **Use Accelerator** option with a disk-based storage unit. Incrementals without the **Use Accelerator** policy option are not supported.

- Does not support virtual machine templates.

- If the virtual machine contains an IDE drive, the restored virtual machine may not start. This issue is not unique to instant recovery.
  See "VMware virtual machine does not restart after restore" on page 230.

- To avoid host name or IP address conflicts between the current virtual machine and the virtual machine version you want to restore: Shut down the virtual machine in your production environment before you start the recovery. Then change the display name of the current virtual machine, or use the `-R` option on nbrestorevm to rename the restored virtual machine.

- For a virtual machine that is running under a high load, migration of the virtual machine may take longer than expected. For this reason, NetBackup changes the virtual machine's `fsr.maxSwitchoverSeconds` property to 900.
  For example, this increase may be necessary when the virtual machine is restored from a deduplication storage unit.
  The following VMware knowledge base article contains more information on the `fsr.maxSwitchoverSeconds` property:
  Using Storage vMotion to migrate a virtual machine with many disks timeout

- Note the following about the virtual machine's datastore name:

  - If the name of the datastore includes spaces, the name should be enclosed in double quotes ("").

  - A virtual machine restore may fail if the name of the datastore (that was used at the time of the backup) ended with a period.
    The following tech note contains additional information.
    http://www.symantec.com/docs/TECH199771

■ Instant recovery cannot restore a vCloud virtual machine into vCloud. The virtual machine is restored into vSphere. You can copy or import the restored virtual machine into vCloud by means of the Copy option in vCloud.
Note that the vCloud Move option does not work with a virtual machine that runs from a NetBackup datastore.

■ Storage lifecycle policies (SLPs) can use Auto Image Replication to replicate a virtual machine backup image to another NetBackup domain. To restore the virtual machine from the replicated image, you must include the -vmproxy option on the nbrestorevm command. Use the -vmproxy option to specify the backup host (access host) that is in the domain where the virtual machine was replicated. Without the -vmproxy option, nbrestorevm defaults to the backup host in the original domain and the restore fails.

Restarting the Client for NFS service on the restore host

It may be necessary to stop and restart the NFS Client service. If you use the Microsoft services snap-in (`Services.msc`) to restart it, the service does not start until you restart the server.

To restart the Client for NFS service without a server restart

◆ From the Windows command prompt, run the following commands:

```
net stop nfsclnt
net stop nfsrdr
net start nfsrdr
net start nfsclnt
```

The Client for NFS service should restart without a restart of the server.

Instant Recovery options on the nbrestorevm command

NetBackup 7.6 provides a command-line interface for instant recovery of virtual machines: the nbrestorevm command.

The following is a list of the available nbrestorevm options for performing Instant Recovery of a VMware virtual machine. The options are listed in man page format.

Note: Although the nbrestorevm command has additional options, only the options that are described in this topic apply to Instant Recovery.

To initiate Instant Recovery (activate the virtual machine)

Options without brackets are required.

```
nbrestorevm -vmw -ir_activate -C vm_client
     -temp_location temp_location_for_writes
     [-S master_server] [-vmpo] [-vmsn] [-vmserver vm_server]
     [-vmproxy vm_proxy]
     [-s mm/dd/yyyy [HH:MM:SS]] [-e mm/dd/yyyy [HH:MM:SS]]
     [-R absolute_path_to_rename_file]
     [-disk_media_server media_server]
```

Note: Only -vmw, -ir_activate, -C, and-temp_location are required. If the other options are not specified, NetBackup automatically supplies values for those options from the backup. In most cases, if you do not restore the virtual machine to a different location, you can omit the bracketed options.

To list details about the activated virtual machine

```
nbrestorevm -ir_listvm
```

To deactivate or delete the virtual machine

```
nbrestorevm -ir_deactivate instant_recovery_identifier [-force]
```

To complete the VM instant recovery job after the data is migrated

```
nbrestorevm -ir_done instant_recovery_identifier
```

To reactivate a virtual machine that was interrupted during recovery

```
nbrestorevm  -ir_reactivate instant_recovery_identifier [-force]
nbrestorevm -ir_reactivate_all -vmhost vm_host -media_server
     media_server_activate_vm [-force]
```

Table 11-3 describes the nbrestorevm options for Instant Recovery of virtual machines. These options are also described in the NetBackup Commands Reference Guide, and in the man page for nbrestorevm.

Table 11-3   Options on the nbrestorevm command for Instant Recovery

Option	Description
-vmw	Indicates the type of virtual machine to restore (VMware).
-C *virtual_machine*	The name of the virtual machine as identified in the backup. For example, if the policy backed up the virtual machine by its host name, specify that host name. **Note:** If a virtual machine with the same name already exists on the target ESX host, the command fails. You can change the display name of the virtual machine in vCenter. As an alternative, use the -R option on nbrestorevm to change the display name or location of the restored virtual machine.
-ir_activate	Starts the restore by mounting the backup image of the virtual machine as an NFS datastore. The datastore becomes accessible to the ESX host where the virtual machine is to be restored. The following procedure has further details: See "To restore a virtual machine with instant recovery" on page 178.
-temp_location *temporary_datastore*	A temporary datastore on the ESX server where all writes occur until the virtual machine is restored. All writes occur on this datastore until Storage vMotion is complete or until you are finished with the virtual machine (such as for troubleshooting). **Note:** This datastore must exist before you run nbrestorevm.
-S *master_server*	Specifies a different master server, to restore a virtual machine from a backup that was made by that master.

Table 11-3	Options on the nbrestorevm command for Instant Recovery *(continued)*

Option	Description
-R *rename_file_path*	The absolute path to a file that contains directives for restore to a different location.
	The following are the entries that you can use in the file (each entry begins with `change`):
	``` change esxhost to new_ESX_host change resourcepool to new_resource_pool change vmname to new_virtual_machine_name change network to new_network ```
	Note: The `change` line should be entered exactly as it appears in this list, except for the variable at the end (such as *new_virtual_machine_name*). Replace that variable with the new name.
	For example:
	``` change esxhost to esx01.prod4.com change resourcepool to /Tech1/esx01.prod4.com/Res change vmname to T1vm5 ```
	Each `change` line must end with a carriage return.
	Note: If the file contains only one `change` line, (such as `change vmname to T1vm5`), that line must end with a carriage return.
	If you restore to a different ESX server, you may have to specify a different resource pool. (The original resource pool cannot be used to create a VM on a different ESX server.) You must specify a resource pool by including the following line in the rename file:
	``` change resourcepool to path_to_new_resource_pool ```
-vmserver *vCenter_server*	The name of the vCenter server that manages the target ESX host for the restore. To restore to the same vCenter where the virtual machine originally resided, omit this option.
-vmproxy *restore_host*	The host to perform the restore (a NetBackup client). The default is the host that performed the backup.
	Note: If the backup host was Linux, you must use the -vmproxy option to specify a Windows restore host.

Table 11-3   Options on the nbrestorevm command for Instant Recovery *(continued)*

Option	Description
-disk_media_server *media_server*	Specifies which media server performs the Instant Recovery. This option is useful if NetBackup storage is configured over several media servers, such as for load balancing. Without the -disk_media_server option, the Instant Recovery job may select any of the available media servers to do the restore. If only one of the media servers is configured for Instant Recovery, specify that server with the -disk_media_server option. See "Notes on Instant Recovery for VMware" on page 171.
-vmpo	Turns on the virtual machine after the restore.
-vmsn	Removes the virtual machine's network interface. See "Restoring individual files with Instant Recovery for VMware while the current virtual machine is running" on page 185.
-ir_deactivate *instant recovery ID*	Removes the virtual machine from the ESX host. If no other virtual machine uses the NetBackup NFS datastore, this option removes that datastore and releases its resources on the NetBackup media server. This option is for removing the virtual machine when you are finished copying its files and do not intend to keep it. **Note:** If the virtual machine has been migrated to a production datastore by means of vMotion, -ir_deactivate is the same as ir_done. **Note:** If vMotion is still in progress for this virtual machine, you should cancel the vMotion job before you use `-ir_deactivate`. See "To restore a virtual machine with instant recovery" on page 178.
-ir_done *instant recovery ID*	When vMotion migration of the virtual machine is finished, this option completes the virtual machine instant recovery job. It also removes the NetBackup NFS datastore if no other virtual machine uses it. When the datastore is removed, its resources are released on the media server. See "To restore a virtual machine with instant recovery" on page 178.

Table 11-3   Options on the nbrestorevm command for Instant Recovery
                        (continued)

Option	Description
-ir_reactivate *instant_recovery_identifier* -ir_reactivate_all	Reactivates a restored virtual machine: remounts the NetBackup NFS datastore, and from the temporary datastore on the ESX host it registers the restored virtual machines on the ESX host. *instant recovery ID* is the virtual machine's numeric identifier from the -ir_listvm output. If more than one virtual machine needs reactivation: -ir_reactivate_all remounts the NetBackup NFS datastores on the media server and reactivates the virtual machines. For example: If VM1, VM5, and VM6 were mounted on the specified ESX server (-vmhost), and their datastores were mounted on the specified media server (-media_server), those three VMs are reactivated.
-vmhost *vm_host*	When you reactivate virtual machines, this option specifies the ESX host on which the virtual machines were mounted.
-media_server *media_server_activate_vm*	When you reactivate virtual machines, this option specifies the media server on which the NFS datastores that contain the backup images were mounted.
-force	For the -ir_deactivate, –ir_reactivate, or –ir_reactivate_all option, -force suppresses confirmation prompts.
-s *start_time* -e *end_time*	By default NetBackup selects the latest full backup plus Accelerator-enabled incremental backups (if any). This option limits the selectable backup images to those with the timestamps that fall within the specified period. NetBackup selects the latest suitable backup image within the range.

Restoring a virtual machine with Instant Recovery for VMware

You can use this procedure to do either of the following:

- Copy files from a virtual machine backup.

- Restore the full virtual machine.

In either case, you can restore the virtual machine to its original location or to an alternate location.

Note: To avoid host name or IP address conflicts, shut down the current virtual machine in your production environment before you start instant recovery.

To copy files while the current virtual machine is running, use a different procedure:

Table 11-4   Basic steps for VMware instant recovery

Type of recovery	Steps
Copy files or troubleshoot an issue, then delete the restored virtual machine	Basic steps are these: ■ Restore the VM: Use nbrestorevm with the -ir_activate option. ■ Copy files from the VM; or use the VM as a stand-in until the production host is back online. ■ Delete the VM and release the media server resources: Use nbrestorevm with the -ir_deactivate option. See the following procedure for command details.
Restore and keep the virtual machine	Basics steps are these: ■ Restore the VM: Use nbrestorevm with the ir_activate option. ■ Transfer the virtual machine files to an ESX host: Use the **Migrate** option in vSphere Client. ■ Release the media server resources: Use nbrestorevm with the ir_done option. See the following procedure for command details.

The detailed procedure follows.

To restore a virtual machine with instant recovery

1   On the master server, media server, or restore host, enter the nbrestorevm command.

    This command is in the following location:

    UNIX, Linux: /usr/openv/netbackup/bin/

    Windows: *install_path*\NetBackup\bin\

    Enter the command as follows.

    To restore the VM to its original location:

    ```
    nbrestorevm -vmw -ir_activate -C virtual_machine -temp_location
    temporary_datastore [-vmproxy VMware_access_host] -vmpo
    ```

    To restore the VM to a different location:

    ```
    nbrestorevm -vmw -ir_activate -C virtual_machine -temp_location
    temporary_datastore [-vmserver vCenter_server] -R rename_file_path
    [-vmproxy VMware_access_host] -vmpo
    ```

-C *virtual_machine* identifies the virtual machine by the name or ID that was set in the policy's **Primary VM identifier** attribute for the backup. On the -C option, specify the same type of identifier that was used in the policy: VM host name, VM display name, VM BIOS UUID, VM DNS name, or VM instance UUID.

If the backup host was Linux, you must use the -vmproxy option to specify a Windows restore host.

The -R option provides the path to a file that contains directives for restore to a different location.

See "Restoring a virtual machine to a different location with Instant Recovery for VMware" on page 182.

See "Instant Recovery options on the nbrestorevm command" on page 172.

The nbrestorevm command mounts the virtual machine's backup image as an NFS datastore and makes the datastore accessible to the ESX host. It also creates the VM on the ESX host. It then creates a snapshot of the virtual machine.

Note: Storage lifecycle policies (SLPs) can use Auto Image Replication to replicate a virtual machine backup image to another NetBackup domain. To restore the virtual machine from the replicated image, you must include the -vmproxy option on the command. Use the -vmproxy option to specify the backup host (access host) that is in the domain where the virtual machine was replicated. Without the -vmproxy option, nbrestorevm defaults to the backup host in the original domain and the restore fails.

The following tasks appear in the vSphere Client interface. In this example, dbl1vm5 is the virtual machine to be restored.

Recent Tasks

Name	Target	Status	Details	Initiated by	Requested Start Time	Start Time	Completed Time
Create virtual machine snapshot	dbl1vm5	Completed		RM\sh	6/13/2012 5:12:14 PM	6/13/2012 5:12:14 PM	6/13/2012 5:12:17 PM
Reconfigure virtual machine	dbl1vm5	Completed		RM\sh	6/13/2012 5:12:13 PM	6/13/2012 5:12:13 PM	6/13/2012 5:12:14 PM
Create virtual machine	TOffice	Completed		RM\sh	6/13/2012 5:12:04 PM	6/13/2012 5:12:04 PM	6/13/2012 5:12:12 PM

Note the following:

■ The nbrestorevm command creates a NetBackup job of type "VM Instant Recovery."
See "Job types for Instant Recovery for VMware" on page 188.

- If you cancel the instant recovery job or stop all NetBackup services, the NetBackup NFS datastore is unmounted and its media server resources are released.

Caution: The virtual machine is deleted from the ESX host.

---

2 In vSphere Client, turn on the virtual machine.

If you included the -vmpo option on the nbrestorevm command, the virtual machine is already turned on.

3 Browse and copy the virtual machine files as needed.

To copy files while the current virtual machine is running, use a different procedure.

See "Restoring individual files with Instant Recovery for VMware while the current virtual machine is running" on page 185.

4   If you do not want to keep the restored virtual machine, enter the following:

`nbrestorevm -ir_listvm`

In the output, find the VM Instant Recovery ID for the restored VM.

To remove the VM from the ESX host:

`nbrestorevm -ir_deactivate` *instant recovery ID* `[-force]`

where *instant recovery ID* is the virtual machine's numeric identifier from the -ir_listvm output. -force is optional, to suppress confirmation prompts.

The VM is removed from the ESX host. If no other VM uses the NetBackup NFS datastore, NetBackup removes that datastore and releases its resources on the media server.

The following tasks appear in the vSphere Client interface. In this example, dbl1vm5 is the virtual machine to be removed and datastore_V is the temporary datastore that it used.

Recent Tasks							
Name	Target	Status	Details	Initiated by	Requested Start Time	Start Time	Completed Time
Unregister virtual machine	dbl1vm5	✔ Completed		RMNUS\sinh	6/13/2012 5:47:22 PM	6/13/2012 5:47:22 PM	6/13/2012 5:47:23 PM
Delete file	datastore_V	✔ Completed		RMNUS\sinh	6/13/2012 5:47:23 PM	6/13/2012 5:47:23 PM	6/13/2012 5:47:23 PM

This step completes the VM Instant Recovery job. Skip the rest of this procedure.

Step 5 uses Storage vMotion to move the virtual machine to a production datastore. If vMotion is already in progress for this virtual machine, you should cancel the vMotion job before you enter `-ir_deactivate`. Otherwise, vMotion moves the virtual machine to a production datastore where `-ir_deactivate` cannot remove it.

5   To keep the restored virtual machine:

In vSphere Client, right-click on the restored virtual machine and select **Migrate**. Select the migration type and the destination.

Note: For the destination, select a permanent (production) location for the virtual machine. Do not select the temporary datastore that was used for the instant restore.

Storage vMotion transfers the virtual machine data files from the NetBackup NFS datastore to the datastore that you selected.

Note: You should migrate no more than one restored virtual machine at a time per media server.

6   After the migration is complete, use vSphere Client to merge or consolidate the virtual machine's redo log (or snapshot) files manually. See your VMware documentation for details.

When the migration to the production datastore is complete, use the following steps to unmount the NFS datastore and release its resources.

7   Enter the following:

```
nbrestorevm –ir_listvm
```

In the -ir_listvm output, find the VM Instant Recovery ID for the restored VM.

8   When the data migration is complete, enter the following:

```
nbrestorevm –ir_done instant recovery ID
```

where *instant recovery ID* is the virtual machine's numeric identifier from the -ir_listvm output.

The -ir_done option completes the VM Instant Recovery job. It also removes the NetBackup NFS datastore if no other VM uses it. When the datastore is removed, its resources are released on the media server.

Restoring a virtual machine to a different location with Instant Recovery for VMware

This topic explains how to use the nbrestorevm command to restore a VM to a different location.

The overall instant recovery procedure is available in another topic:

To restore a VM to a different location

1 Find the path to a resource pool at the restore destination. (If you already know the full path, you can skip this step.)

Note: To restore to a different location, it is usually necessary to designate a different resource pool. Here is an example of a resource pool path:

```
/TechOffice/host/F2/pl9.acme.com/Resources
```

To find the path, enter the following on the master server, media server, or restore host:

UNIX , Linux:

```
/usr/openv/netbackup/bin/bpVMreq <restore_host> 11 0 <ESXi_server>
<VMserver_or_vCenter_server>
```

Windows:

```
<install_path>\NetBackup\bin\bpVMreq.exe <restore_host> 11 0
<ESXi_server> <VMserver_or_vCenter_server>
```

Note: The numeric value `11 0` is required and must be entered as shown.

For example:

```
bpVMreq battleship.acme.com 11 0 ESXi_pl9.acme.com
vC_p9vm3.acme.com
```

Where `battleship.acme.com` is the restore host, `ESXi_pl9.acme.com` is the destination ESXi server, and `vC_p9vm3.acme.com` is the destination vCenter server.

This command generates a path to an XML file in a temporary location. The XML file lists all the available resource pools.

Here is an example of an XML file that `bpVMreq` creates:

```xml
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<ResourcePoolList><ResourcePool Name="Resources"
Path="/TechOffice/host/F2/pl9.acme.com/Resources"
Type="ResourcePool"><ResourcePoolList/>
</ResourcePool></ResourcePoolList>
```

In this example, the path to the resource pool is `/TechOffice/host/F2/pl9.acme.com/Resources`. Make a note of the path for use in the next step.

2 Create a text file with the following `change` entries.

Note: Each `change` entry helps to define the location for the restore. Each `change` line must end with a carriage return.

```
change vmname to <new_virtual_machine_name>
```
(The `change vmname` entry is optional)

```
change esxhost to <new_ESXi_host>
```

```
change resourcepool to <path_to_new_resouce_pool>
```

```
change networkname to <new_network>
```
(The `change networkname` entry is optional)

Enter each `change` line exactly as it appears in this list, except for the variable at the end (such as *new_virtual_machine_name*). Replace the variable with the new name. For example:

```
change esxhost to ESXi01.prod4.com
```

For the *new_resouce_pool*, use the path that was obtained in the first step of this procedure. For example:

```
change resourcepool to /TechOffice/host/F2/pl9.acme.com/Resources
```

This text file is called the `-R` rename file, and is used with the nbrestorevm command in the next step.

3 To restore the VM using the `-R` rename file, enter the `nbrestorevm` command with the `-R` option as follows.

Note: The `-R` option specifies the path to the text file (rename file).

- To restore to the same vCenter server but to a different ESXi host, enter the following:
```
nbrestorevm -vmw -ir_activate -C <virtual_machine>
-temp_location <temporary_datastore> -R <rename_file_path>
```

- To restore to a different vCenter server and a different ESXi host, enter the following:
```
nbrestorevm -vmw -ir_activate -C <virtual_machine>
-temp_location <temporary_datastore> -R <rename_file_path>
-vmserver <vCenter_server>
```

To restore a VM after Auto Image Replication (AIR) to a disaster recovery (DR) site: you must also include the -vmproxy option on the nbrestorevm command to specify the restore host at the DR site.

Restoring individual files with Instant Recovery for VMware while the current virtual machine is running

You can use instant recovery to restore files individually from a virtual machine backup. You can restore the virtual machine from its backup image and mount it on a private network (such as a sandbox). This approach avoids the potential for network conflicts with the virtual machine in your production environment. Another virtual machine on a public network can be used as an intermediary, to copy the files from the virtual machine on the private network.

Note: This procedure lets you restore files into a running VM. You do not need to shut down the current virtual machine in your production environment before you start this procedure.

Before you start this procedure, you need an intermediary virtual machine that has a network connection to the public network or production network. In this procedure you connect the intermediary to the private network where the restored virtual machine is to be mounted.

At the end of the procedure, you can copy files from the restored virtual machine to the intermediary virtual machine. Then the virtual machines on the public network can access the files on the intermediary.

To restore individual files using instant recovery

1   Use vSphere Client to log in to the vCenter server.

    You must use a login that allows access to the files that you want to recover.

2   Create a vSphere standard switch.

    This switch is for access to the ESX host from the sandbox or private network where the VM is to be activated from its backup.

Note: The switch is for internal communication within the ESX host only.

For example, in vSphere Client 5:

■   Select the ESX host for communication between the restored virtual machine and the intermediary virtual machine.

■   On the **Configuration** tab, in the **Hardware** pane, click **Networking**.

■   Click **Add Networking**.

■   Select **Virtual Machine** as the connection type.

- Select **Create a vSphere standard switch**.

- For **Port Group Properties**, **Network Label**, enter a name for the internal switch (such as NB or NetBackup).

- Click **Finish**.

3 On the intermediary virtual machine, add a network card (NIC) to be connected to the vSphere standard switch.

Use this connection to retrieve files from the restored virtual machine that is to be mounted on the private network.

Note: This intermediary virtual machine must already have a network connection to the public network or production network.

For example, in vSphere Client 5:

- Select the intermediary virtual machine.

- On the **Summary** tab, click **Edit Settings**.

- Click **Add**.

- Select **Ethernet Adapter**.

- For the **Network label**, select the private network that is created in step 2.

- Click **Finish**.

4 If the intermediary's guest OS does not automatically assign an IP address for the private network after step 3, note: You must manually configure the IP address, default gateway, and subnet mask.

The intermediary should now be connected to both the public network and to the private network where the virtual machine is to be restored.

5   Use the nbrestorevm command to restore the virtual machine.

    ```
    nbrestorevm -vmw -ir_activate -C virtual_machine -temp_location
    temporary_datastore -R rename_file_path -vmsn
    ```

    -vmsn specifies that no network is enabled for the virtual machine when it is
    activated from the backup image. Without the -vmsn option, network conflicts
    with the production virtual machine may occur.

    The file that is designated by `-R rename_file_path` specifies a different display
    name or location for the restored virtual machine. You must change the virtual
    machine name or location to avoid conflicts with the current virtual machine in
    production. For example, to rename the virtual machine, the rename file can
    consist of the following entry (ending with a carriage return):

    ```
    change vmname to acme_vm5
    ```

    Note: The words `change vmname to` are literals, followed by the actual name
    to change to (such as `acme_vm5`).

    See "Instant Recovery options on the nbrestorevm command" on page 172.

    For other nbrestorevm options, see the man page or the *NetBackup Commands
    Reference Guide*.

6   Add a network card (NIC) to the restored virtual machine and connect the NIC
    to the vSphere standard switch from step 2.

7   Turn on the restored virtual machine.

8   If the guest OS does not automatically assign an IP address for the private
    network, configure the IP address, default gateway, and subnet mask.

9   Set up file sharing (such as through FTP, NFS, or CIFS) between the restored virtual machine and the intermediary virtual machine.

Then copy the files from the restored virtual machine to the intermediary virtual machine. The current virtual machine in production can access the files.

10 If you do not want to keep the restored virtual machine, enter the following:

```
nbrestorevm -ir_listvm
```

In the -ir_listvm output, find the VM Instant Recovery ID for the restored virtual machine.

To remove the restored virtual machine:

```
nbrestorevm -ir_deactivate instant recovery ID
```

where *instant recovery ID* is the virtual machine's numeric identifier from the -ir_listvm output.

Job types for Instant Recovery for VMware

Instant Recovery jobs appear as the following job types in the NetBackup Activity Monitor.

Table 11-5   VMware Instant Recovery job types in the Activity Monitor

Job type	Description
VM Instant Recovery	This job is the parent job for restoring a VM by means of Instant Recovery.
	To complete this job, you must enter one of the following:
	`nbrestorevm -ir_done instant recovery ID`
	`nbrestorevm -ir_deactivate instant recovery ID`
	For details on these commands:
	See "Restoring a virtual machine with Instant Recovery for VMware" on page 177.
Activate Instant Recovery	The parent VM Instant Recovery job starts an Activate Instant Recovery job to create the VM on the ESX host.
Stop Instant Recovery	This job runs when you use `nbrestorevm -ir_done` to remove the NetBackup NFS datastore and release its resources on the media server.
Deactivate Instant Recovery	This job runs when you use `nbrestorevm -ir_deactivate` to delete the restored VM from the ESX host.

Table 11-5   VMware Instant Recovery job types in the Activity Monitor
(continued)

Job type	Description
Reactivate Instant Recovery	This job runs when you use `nbrestorevm` with the ir_reconfigure option to restart an interrupted virtual machine recovery.

Reactivating a restored virtual machine with Instant Recovery for VMware

If an interruption occurs during an instant recovery (such as a restart of the host or media server), the ESX connection to the media server may fail. In that case, it may be possible to re-establish the connection and return the virtual machine to the state it was in before the outage. Any transactions that occurred in the virtual machine before the outage are retained.

To reactivate a restored virtual machine

1   If only one VM had been restored to the ESX host, enter the following:

    ```
    nbrestorevm –ir_listvm
    ```

    Find the VM Instant Recovery ID for the restored VM in the -ir_listvm output.
    Then enter the following:

    ```
    nbrestorevm –ir_reactivate Instant Recovery ID [-force]
    ```

    where *instant recovery ID* is the virtual machine's numeric identifier from the
    -ir_listvm output. -force is an optional parameter to suppress confirmation
    prompts.

    The ir_reactivate option remounts the NetBackup NFS datastore. From the
    temporary datastore on the ESX host it registers the restored virtual machines
    on the ESX host.

2   If more than one VM had been restored to the ESX host:

    ```
    nbrestorevm –ir_reactivate_all -vmhost vm_host –media_server
    media_server [-force]
    ```

    Note: For multiple virtual machines, do not use the –ir_reactivate option. Use
    –ir_reactivate_all.

    The -vmhost option specifies the ESX host on which the virtual machines were
    mounted. The -media_server option specifies the media server on which the
    NFS datastores that contain the backup images were mounted. -force is an
    optional parameter to suppress confirmation prompts.

    The nbrestorevm -ir_reactivate_all command remounts the NetBackup NFS
    datastores on the media server and reactivates the virtual machines.

3   When the virtual machine is reactivated, you can copy its files or migrate its
    data to the ESX host.

    See "To restore a virtual machine with instant recovery" on page 178.

4   If Storage vMotion was migrating the virtual machine files when the outage
    occurred, restart the migration.

    In vSphere Client, right-click on the restored virtual machine and select **Migrate**.

Use NetBackup for vCloud Director

This chapter includes the following topics:

- About NetBackup for vCloud Director
- Notes on creating a NetBackup policy for vCloud
- Notes on restoring virtual machines into vCloud Director
- Restoring virtual machines into vCloud Director
- Virtual machine recovery dialog boxes for vCloud Director

About NetBackup for vCloud Director

NetBackup can back up VMware vCloud Director environments and restore virtual machines into vCloud Director.

Table 12-1 describes the configuration requirements for backup of vCloud Director.

Table 12-1   Configuration for backup of vCloud Director virtual machines

Task	Description (NetBackup Administration Console)
Enter NetBackup credentials for the vCloud Director server and for its vCenter servers.	**Media and Device Management > Credentials > Virtual Machine Servers**. See "Adding NetBackup credentials for VMware" on page 42.

Table 12-1   Configuration for backup of vCloud Director virtual machines
                  (continued)

Task	Description (NetBackup Administration Console)
Configure the policy **Clients** tab	Select the following: ■ **Select automatically through query** ■ **Enable vCloud Director integration** With the Enable vCloud Director option, the policy selects only vCloud-managed virtual machines for backup: it skips the virtual machines that are not in vCloud. NetBackup collects information on the vCloud environment, such as its organizations, virtual datacenters, and vApps. NetBackup also retrieves information about a vApp for later restore of the vApp and its virtual machines. **Note: Enable vCloud Director integration** makes several vCloud keywords available in the policy Query Builder Field, for rule-based selection of virtual machines. If **Enable vCloud Director integration** is not selected, NetBackup cannot use the keywords to locate virtual machines in vCloud Director and the backup fails. **Note:** The browsing icon (next to the **Query Builder** drop-down fields) may list non-vCloud objects. If you select an object that is not in vCloud Director, it is excluded from the backup. See "Configuring a VMware policy from the Policies utility" on page 52. See "Notes on creating a NetBackup policy for vCloud" on page 192.

Note: VMware does not support non-ASCII characters in virtual machine display names or in other objects that are associated with the virtual machine. The same character restrictions also apply to vCloud Director objects.

The following topic includes a list of VMware articles that describe these restrictions:

See "NetBackup for VMware: notes and restrictions" on page 33.

Notes on creating a NetBackup policy for vCloud

When you create a backup policy for vCloud virtual machines, note the following:

■ To back up all the existing vApp templates, use the **vCDIsvAppTemplate** keyword in the query builder (**vCDIsvAppTemplate Equal TRUE**).

■ To back up specific vApp templates, use the **vCDvApp** keyword in the query builder with appropriate operator and values to select the particular templates.

Notes on restoring virtual machines into vCloud Director

To restore a virtual machine into vCloud Director, note the following:

- The Backup, Archive, and Restore interface allows the restore of one virtual machine at a time.
  You can use the nbrestorevm command to restore multiple virtual machines.
  See "Using the nbrestorevm command to restore virtual machines into vCloud Director" on page 246.

- When you back up a virtual machine in vCloud Director, Symantec recommends the **VMware display name** setting for **Primary VM identifier** on the **VMware** tab. Use of the **VM BIOS UUID** setting is not recommended.

- To restore a virtual machine into vCloud Director, the virtual machine must have been in vCloud Director when it was backed up.

- To restore a virtual machine into vCloud Director, the backup policy must have been configured as described in the following topic:
  See "About NetBackup for vCloud Director" on page 191.

- When a vApp is restored, vCloud Director resets the vApp's expiration date. For example: Assume the original vApp was created on the first day of the month and was set to expire in 30 days. If the vApp is restored 15 days before its expiration (on the 15th), vCloud resets the vApp to expire in 30 days from the 15th.
  The VM administrator can reset the expiration date to its original date.

- You cannot restore a virtual machine into an existing vApp template. VMware sets this restriction.

- After you restore a vApp template, the template cannot be changed and no further virtual machines can be added to it (a VMware restriction). To restore a vApp template that is to contain multiple VMs, you must restore all but one of the VMs separately into a non-template vApp. Then restore the last virtual machine by means of the **Capture vApp as a template in catalog** option.
  See "Restoring a vApp template that has multiple virtual machines" on page 197.

- You can restore the vCloud Director virtual machine into vSphere instead of vCloud Director. On the **Recovery Destination** screen, select **Alternate location in vSphere.**

- vCloud organization networks are not displayed on the **Network Connections** screen for restore; only vSphere networks are displayed.

- To restore into an existing vCloud Director vApp with the **Capture vApp as a template in catalog** option, the vApp must be turned off.

■ vSphere 5 provides storage profiles for managing the datastores on which virtual machines are created. When you restore into vCloud, the NetBackup restore interface lets you select a target datastore but not a storage profile. If the target datastore does not comply with the storage profile or if the datastore you select has been disabled, note: NetBackup automatically migrates the virtual machine to a compliant datastore if possible when you import to vCloud Director.

Note: At the end of a successful restore, NetBackup verifies that the virtual machine is on compliant storage (on a datastore with the defined storage profile).

Restoring virtual machines into vCloud Director

This topic includes two procedures:

■ Restoring virtual machines into a vApp, or restoring a single virtual machine into a vApp template.

■ Restoring a vApp template that has multiple virtual machines.

Note: You can also restore the virtual machine to an alternate location in vSphere.

See "Recovery Destination dialog box" on page 198.

Restoring a single virtual machine into a vApp or vApp template

1   Begin with the steps in the following procedure:

See "Restoring the full VMware virtual machine" on page 143.

After you click **Restore** or **Actions > Restore**, the **Recovery Destination** screen appears.

2   Select the recovery destination:

Original location in vCloud Director	You can restore a virtual machine into an existing vApp or into a new vApp that replaces the existing one. You can also restore a virtual machine that is in a vApp template.
	Note: The restored vApp template can only contain one virtual machine; no further virtual machines can be added.
Alternate location in vCloud Director	You can restore a virtual machine into an existing vApp or into a new vApp or vApp template.
	To restore multiple virtual machines into a vApp template:
	See "Restoring a vApp template that has multiple virtual machines" on page 197.

3 On the **Recovery Options** screen, select the NetBackup recovery host and transport mode for the restore.

See "Recovery Options dialog box" on page 146.

4 On the **Recovery vApp Options for vCloud Director** screen, set the vApp recovery options.

You can either restore the virtual machine into an existing vApp (if that vApp is not a template), or you can create a new vApp.

For restore to original location	Select **Restore into existing vApp**, or **Remove existing vApp and recreate the vApp**.
	Caution: If you remove the existing vApp, all virtual machines in the vApp are deleted. You must select the **Delete** option to acknowledge the deletion.
	See "Recovery vApp Options for vCloud Director dialog box (restore to original location)" on page 199.
	To restore a virtual machine in a vApp template, select **Remove existing vApp Template and recreate the vApp Template**. The restored vApp template can only contain one virtual machine; no further virtual machines can be added.
	To restore multiple virtual machines into a vApp template:
	See "Restoring a vApp template that has multiple virtual machines" on page 197.
For restore to alternate location	Select **Restore into existing vApp** or **Create new vApp**.
	You can enter details for the vApp to restore to.
	See "Recovery vApp Options for vCloud Director dialog box (restore to alternate location)" on page 200.
	Note: To restore the virtual machine into a vApp template that is to contain this virtual machine only, select **Create new vApp** and **Create vApp as a template in catalog**.
	To restore the virtual machine into a vApp template that is to contain multiple virtual machines:
	See "Restoring a vApp template that has multiple virtual machines" on page 197.

5   For restore to an alternate location: On the **Recovery Destination Options for vCloud Director** screen, select the ESX server, the virtual machine that you want to restore, and a datastore.

     See "Recovery Destination Options for vCloud Director dialog box (restore to alternate location)" on page 202.

6   On the **Virtual Machine Options** screen, select the appropriate options for the virtual machine and its disk provisioning.

     See "Virtual Machine Options dialog box" on page 147.

7   On the **Network Connections** screen, select the network for the restored virtual machine.

Note: If the virtual machine was not connected to any networks during backup, or if none of those networks are currently available, the dialog states: "No networks available for selected virtual machine." If a network connection is required, create it in vCloud Director after the restore completes.

Note: For restore to an alternate location (a different organization or vCloud server), no networks are displayed in the dialog. If a network connection is required, create it in vCloud Director after the restore completes.

     See "Network Connections dialog box (restore to alternate location)" on page 155.

8   On the **Perform Recovery** screen, run a pre-recovery check.

     To begin the restore click **Start Recovery**.

9   To restore additional virtual machines into the same vApp (not a vApp template), repeat this procedure.

     Note: On the **Recovery vApp Options for vCloud Director** screen, select **Restore into existing vApp**. Make sure to select the vApp into which you want to restore the additional virtual machines.

Restoring a vApp template that has multiple virtual machines

1   Use the Backup, Archive, and Restore interface to restore all but one of the virtual machines into a non-template vApp.

You can restore one virtual machine at a time. After you have restored the first virtual machine, restore the second virtual machine with **Restore into existing vApp** on the **Recovery vApp Options for vCloud Director** screen. Select the same vApp into which you restored the first virtual machine. Step through the restore screens to restore each virtual machine in this way, except for the last virtual machine.

Note: Use the following steps to restore the last virtual machine and to copy all the restored virtual machines into a vApp template.

2   On the **Recovery Destination** screen, select **Alternate location in vCloud Director**.

3   On the **Recovery vApp Options for vCloud Director** screen, do the following:

- Select **Restore into existing vApp**.

- Select the vCloud server and the organization that includes the vApp into which you have restored the other virtual machines.

- If necessary, browse for the vApp into which you have restored the other virtual machines.

- Select **Capture vApp as a template in catalog**.

- Select the catalog to contain the template vApp.
  Note: The organization determines the available catalogs.

- Enter a name for the vApp template.

- **Remove vApp after capture**: Deletes the non-template vApp into which you restored the other virtual machines at the beginning of this procedure. Use this option to free up space on the datastore after the restore is complete.
  See "Recovery vApp Options for vCloud Director dialog box (restore to alternate location)" on page 200.

4   On the **Recovery Destination Options for vCloud Director** screen, select the last virtual machine that you want to restore into the template vApp.

See "Recovery Destination Options for vCloud Director dialog box (restore to alternate location)" on page 202.

5   On the **Virtual Machine Options** screen, select the appropriate options for the virtual machine and its disk provisioning.

6   On the **Network Connections** screen, select the network for the restored virtual machine.

See "Network Connections dialog box (restore to alternate location)" on page 155.

7   On the **Perform Recovery** screen, run a pre-recovery check.

To begin the restore click **Start Recovery**.

NetBackup copies the current virtual machine and the previously restored virtual machines into a new vApp template. When the restore is complete, no further virtual machines can be added to the template vApp.

Virtual machine recovery dialog boxes for vCloud Director

The following topics describe the Backup, Archive, and Restore screens for restoring a virtual machine into vCloud Director.

You can restore a virtual machine into an existing vApp or into a new vApp.

See "Recovery Options dialog box" on page 146.

Recovery Destination dialog box

You can select the type of destination for the virtual machine recovery: the original location in vCloud, an alternate location in vCloud, or an alternate location in vSphere.

■   **Original settings of the virtual machine at backup**
Shows the configuration of the virtual machine at the time of the backup.
When you restore the virtual machine to its original location, these configuration settings are used and cannot be changed.
When you restore to an alternate location, you can change these settings after you click **Next**.

■   **vApp details**
Shows the information about the virtual machine's vApp at the time of the backup.

vApp Name	The name of the vApp that contained the virtual machine when it was backed up.

vApp Status	The status of the vApp (active or expired) at the time of the backup. When the virtual machine is restored, its vApp becomes active even if the current vApp in the restore location is expired.
vCloud Catalog	The name of the catalog that contains the vApp template. "..." means that the vApp is not a template.
Other virtual machines in vApp	A link to the names of the other virtual machines in the vApp, if any.

- **Select Recovery Destination**
  You can restore to the original location in vCloud, to an alternate location in vCloud, or to an alternate location in vSphere (not in vCloud).

Recovery Options dialog box (vCloud Director)

Select the recovery host and transport mode. For a description of these options, refer to the following topic:

Recovery vApp Options for vCloud Director dialog box (restore to original location)

You can choose whether to restore the virtual machine into an existing vApp or to remove the vApp and recreate it.

Restore into existing vApp	To restore the virtual machine into an existing vApp, select **Overwrite the existing virtual machine**.
	If the existing virtual machine is already turned on, this option fails.
	Note: If you restore a vApp template, this option is not available.
Remove existing vApp and recreate the vApp	For a vApp template, this option is labeled **Remove existing vApp Template and recreate the vApp Template**
	To remove the vApp (or vApp template) and recreate it, select **Delete all virtual machines to recreate this vApp**.
	Note: All virtual machines in the vApp are deleted.
	Click on the numeric link to see the names of the virtual machines that exist in the vApp.

Virtual Machine Options dialog box for vCloud Director

This dialog is described in a previous topic:

See "Virtual Machine Options dialog box" on page 147.

Perform Recovery dialog box for vCloud Director

- **Recovery settings**
  Lists your recovery selections, including the vCloud Director and vSphere settings.

- **Run Pre-Recovery Check**
  Verifies the credentials and appropriate paths and connectivity, determines whether the datastore or datastore cluster has available space, and reviews other important requirements. You must run this check at least once. You can proceed with the restore even if the check fails.

- **Start Recovery**
  Starts the recovery of the virtual machine

Recovery Options dialog box for vCloud Director (restore to alternate location)

Select the recovery host and transport mode. For a description of these options, refer to the following topic:

See "Recovery Options dialog box" on page 146.

Recovery vApp Options for vCloud Director dialog box (restore to alternate location)

You can restore the virtual machine into an existing vApp (**Restore into existing vApp**) or into a new vApp (**Create a new vApp**).

Table 12-2 describes the fields for specifying the vApp to restore to.

Note: The defaults are the server name, organization, and other details that were recorded in the backup.

Table 12-2 Details for the vApp to be restored to

Field	Description
vCloud Server	Select the vCloud Director server for the restore.
	The servers in the list are the ones for which NetBackup has credentials of type **VMware vCloud Director**.
	See "Adding NetBackup credentials for VMware" on page 42.
Organization	Select the vCloud Director organization for the restore.
Org vDC	Select the organization virtual datacenter.
vApp name	Select or enter the name of the vApp for the restore.
	If you restore into an existing vApp, click **Browse** to search for a vApp.
	See "Select a vApp dialog box" on page 202.
	This option defaults to the original vApp that was recorded in the backup.
Capture vApp as a template in catalog	This option is available when you restore to an existing vApp.
	This option copies the vApp that is specified in the **vApp Name** field into a new vApp template.
	It also copies all of the vApp's virtual machines into the same vApp template. Note that this operation may take a lot of time.
	By default, the source vApp for the copy is retained after the copy; you can have the source vApp removed after the copy. See the **Remove vApp after capture** option.
Create vApp as a template in catalog	This option is available when you create a new vApp for the restore.
	This option restores the virtual machine into a new vApp template. The name of the new template is the same as the vApp that was specified in the vApp Name field.
Catalog	Select the catalog in which to place the vApp template. The organization determines the available catalogs.
vApp template name	When you restore into an existing vApp and capture the vApp as a template:
	Enter the name for the new vApp template.

Table 12-2   Details for the vApp to be restored to *(continued)*

Field	Description
Remove vApp after capture	When you restore into an existing vApp and capture the vApp as a template:
	Select this option to remove the source vApp after the vApp copy to the new vApp template completes. At the end of the copy, the new template and its virtual machines are retained. The vApp that was the source for the copy is deleted.

Select a vApp dialog box

Use this dialog to search the organization for a vApp.

Specify vApp name	Enter the vApp name. As you type, the organization is expanded and the first name that contains the typed character(s) is highlighted.
	Wildcards are not allowed.
	Click **Search** to find further instances of the name.
vApps in Organization	You can drill into the organization and highlight a vApp.

Click **OK** to select the highlighted vApp.

Recovery Destination Options for vCloud Director dialog box (restore to alternate location)

Specify details about the virtual machine to restore.

The vCloud options that you selected in the **Recovery vApp Options for vCloud Director** dialog determine the vCenter server, resource pool, and datacenter.

ESX server	Select the ESX server in which to restore the virtual machine.
Virtual machine name	Enter the name for the restored virtual machine.
Datastore/ Datastore cluster	**Specify manually**: Select a datastore from the pull-down.
	Or click **Pick the datastore with the largest space available**.

Virtual Machine Options (restore to alternate location)

This dialog is described in a previous topic:

See "Virtual Machine Options dialog box" on page 147.

Network connections (restore to alternate location)

The following topic describes the network information that appears on this dialog:

See "Network Connections dialog box (restore to alternate location)" on page 155.

Perform Recovery dialog box for vCloud Director (restore to alternate location)

- **Recovery settings**
  Lists your recovery selections, including the vCloud Director and vSphere settings.

- **Run Pre-Recovery Check**
  Verifies the credentials and appropriate paths and connectivity, determines whether the datastore or datastore cluster has available space, and reviews other important requirements. You must run this check at least once. You can proceed with the restore even if the check fails.

- **Start Recovery**
  Starts the recovery of the virtual machine.

Best practices and more information

This chapter includes the following topics:

- NetBackup for VMware best practices

- More information on VMware

- Further assistance with NetBackup for VMware

NetBackup for VMware best practices

The following are best practices for NetBackup for VMware:

- For a more efficient backup, the NetBackup media server and the VMware backup host should be installed on the same host.

- When creating virtual machines, use the same name for both host name and display name. If the policy's **Primary VM identifier** option is changed, the existing entries on the policy **Clients** tab still work.

- VMware recommends that you run no more than four simultaneous backups of virtual machines that reside on the same datastore.

- Successful VMware snapshots depend on the following:

  - The amount of I/O that occurs on the virtual machine datastore. Backups should be scheduled when relatively little I/O activity is expected. Reducing the number of simultaneous backups can also help.
    Limit access to the datastore per policy: Use the **Limit jobs per policy** attribute in the NetBackup policy.
    Limit access to the datastore globally (across all policies): Use the Host Properties **Resource Limit** screen.

- The design of the I/O substructure that is associated with each virtual machine datastore. For correct I/O design and implementation, consult your VMware documentation.

- Make sure that the VMware backup host has enough memory to handle the number of simultaneous backups that occur.

- Include in a single NetBackup policy those virtual machines that use the same datastore. This practice lets you control the amount of backup-related I/O that occurs per datastore, to limit the backup effect on the target virtual machines.

- NetBackup supports multiple backup hosts. When a single backup host is saturated with a backup process, another backup host can be added to increase backup throughput.

- If a VM's disks are accessible to multiple ESX hosts, the disks can be accessed for backup or restore through any of the ESX hosts. The ESX host may or may not be the ESX host where the virtual machine is running or registered. All of the following must be accessible to each other and should have DNS configured:

  - The vCenter server.

  - All ESX hosts under the vCenter that have access to the VM's vmdk files.

  - The backup host.

- Upgrade to the latest version of VMware vSphere or Virtual Infrastructure.

- See the Symantec white paper titled *NetBackup for VMware Best Practices Guide*.

NetBackup for VMware with deduplication

For a VMware backup to a deduplication storage unit, select the **Enable file recovery from VM backup** option on the **VMware** policy tab. This option provides the best deduplication rates. Without the **Enable file recovery from VM backup** option, the result is a lower rate of deduplication.

More information is available on the VMware options.

More information on VMware

VMware Inc. provides an extensive set of manuals on VMware products.

```
http://www.vmware.com/support/pubs/
```

Further assistance with NetBackup for VMware

Table 13-1   Sources of information on NetBackup for VMware

Topic	Source
Performance benchmark testing	Symantec NetBackup, Cisco UCS, and VMware vSphere Joint Backup Performance Benchmark whitepaper
Snapshot Client configuration	Refer to the *NetBackup Snapshot Client Administrator's Guide*. The guide contains installation and configuration instructions on Snapshot Client.
List of all supported combinations of platforms and snapshot methods	Refer to the NetBackup 7 Snapshot Client Compatibility document: http://www.symantec.com/docs/TECH126901
Support information on NetBackup for VMware	Up-to-date information on NetBackup support in a virtual environment is available in the following tech note: Support for NetBackup 7.x in a virtual environment http://www.symantec.com/docs/TECH127089 This tech note provides a wide range of support information, such as a list of supported guest operating systems, file systems, and required VMware components.

Troubleshooting

This chapter includes the following topics:

- Notes on troubleshooting NetBackup for VMware

- Beware of unsupported equipment

- How to determine the ESX network that NetBackup used for the backup or restore

- NetBackup logging for VMware

- Configuring VxMS logging

- Preventing browsing delays caused by DNS problems

- Changing the browsing timeout for virtual machine discovery

- Changing timeout and logging values for vSphere

- Credentials for VMware server are not valid

- NetBackup status codes related to VMware

- Snapshot error encountered (status code 156)

- Conflict between NetBackup and VMware Storage vMotion with vSphere 5.0 or later

- The restore fails when you restore individual files to a virtual machine that has NetBackup client software

- The restore fails if ESX servers use short host names and backups and restores use a vCenter server

- Backup or restore job hangs

- Mount point missing on a restored Windows virtual machine

- Mount points not available when restoring files from a Linux virtual machine

- Remove the Consolidate Helper snapshot

- NetBackup catalog information for virtual machine backups made by 6.5.4 or earlier may prevent browsing the imported images for restore

- Invalid client error when you restore files using NetBackup BAR interface installed on the virtual machine

- VMware virtual machine does not restart after restore

- NetBackup job fails due to update tasks on the VMware server

Notes on troubleshooting NetBackup for VMware

Note the following:

- Make sure that the VMware Tools are installed on each virtual machine. Otherwise, communication problems and other issues can result. For example:

  - When you select virtual machines on the policy **Clients** tab, NetBackup cannot obtain the host name, IP address, or DNS name of the virtual machine. Policy validation may fail.

  - The virtual machine cannot be quiesced in preparation for the snapshot.

- You cannot restore individual VMware files onto the virtual machine itself, except under certain conditions.
  See "About restore of individual files" on page 157.

Beware of unsupported equipment

Unsupported equipment can cause many problems. Ensure that your VMware environment (including ESX servers, SAN devices, and backup host) conforms to all requirements and recommendations that are spelled out by VMware. For instance, if VMware does not support your HBAs, device drivers, or guest operating systems, NetBackup cannot work.

For support details, see VMware documentation at the VMware support site (for example, the VMware compatibility guides).

How to determine the ESX network that NetBackup used for the backup or restore

If a virtual machine's disks are accessible to multiple ESX hosts, the disks can be accessed through any of the ESX hosts. The ESX host that is used for the access may or may not be the ESX host where the virtual machine is running or registered. All of the following must be accessible to each other and should have DNS configured:

■ The vCenter server.

■ All ESX hosts under the vCenter that have access to the virtual machine's vmdk files.

■ The backup host.

If all hosts are not accessible to each other, the backup or restore may not succeed. In that case, you must determine which network NetBackup used for the backup or restore.

Note: For an NBD transport mode backup through vCenter, NetBackup uses the ESX network over which the ESX host was added or registered to the vCenter. For an NBD transport mode backup directly from the ESX host, NetBackup uses the ESX host's DNS/IP network.

The VxMS provider logs contain information on the network that NetBackup used.

See

Check the VxMS provider logs for messages similar to those in this example:

```
10:49:21.0926 : g_vixInterfaceLogger:libvix.cpp:1811 <INFO> : Opening file
[MYDATASTORE] TestVM/TestVM-000001.vmdk (vpxa-nfc://[MYDATASTORE]
TestVM/TestVM-000001.vmdk@MyESX.xxx.xxx.com:902)

   10:49:22.0301 : g_vixInterfaceLogger:libvix.cpp:1811 <INFO> : DISKLIB-LINK  :
Opened 'vpxa-nfc://[MYDATASTORE]
TestVM/TestVM-000001.vmdk@MyESX.xxx.xxx.com:902' (0x1e): custom, 41943040
sectors / 20 GB.

   10:49:22.0301 : g_vixInterfaceLogger:libvix.cpp:1811 <INFO> : DISKLIB-LIB   :
Opened "vpxa-nfc://[MYDATASTORE]
TestVM/TestVM-000001.vmdk@MyESX.xxx.xxx.com:902" (flags 0x1e, type custom).

   10:49:22.0301 : vdOpen:VixInterface.cpp:480 <DEBUG> : Done with
VixDiskLib_Open(): 200346144
   10:49:22.0301 : openLeafSnapshotDisks:VixGuest.cpp:475 <DEBUG> : vdOpen()
```

```
succeess
    10:49:22.0301 : openLeafSnapshotDisks:VixGuest.cpp:476 <INFO> : Transport
mode in effect = nbd
```

VMware logs the messages starting with `g_vixInterfaceLogger`. Such messages in the example indicate that TestVM-000001.vmdk is opened over the ESX host network `MyESX.xxx.xxx.com`.

The following articles contain related information:

- *When performing FullVM restores the VMware Backup Host connects to the wrong ESX host*
  http://www.symantec.com/docs/TECH203934

- *Best practices when using advanced transport for backup and restore*
  http://kb.vmware.com/kb/1035096

NetBackup logging for VMware

For log messages about VMware backup or VMware restore, see the following NetBackup log directories.

Table 14-1 NetBackup logs that pertain to VMware backup and restore

Log directory	Contains the messages on	Resides on
install_path\NetBackup\logs\bpbrm	Backup and restore	NetBackup master or media server
install_path\NetBackup\logs\bptm	Backup and restore	NetBackup media server
install_path\NetBackup\logs\bpfis	Snapshot creation and backup	VMware backup host
install_path\NetBackup\logs\bpcd	Snapshot creation and backup	VMware backup host
install_path\NetBackup\logs\bpbkar	Backup	VMware backup host
install_path\NetBackup\logs\bprd	Restore	NetBackup master server
install_path\NetBackup\logs\tar	Restore	VMware recovery host
install_path\NetBackup\logs\nbfsd	Instant recovery	NetBackup media server and VMware backup host
install_path\NetBackup\logs\bpVMutil	Policy configuration and on restore	VMware backup or recovery host

Table 14-1   NetBackup logs that pertain to VMware backup and restore
(continued)

Log directory	Contains the messages on	Resides on
install_path\NetBackup\logs\bpVMreq	Restore	The client where the Backup, Archive, and Restore interface is running.
install_path\NetBackup\logs\nbproxy	Policy configuration	VMware backup host
install_path\NetBackup\logs\ncfnbcs (originator ID 366) ncfnbcs uses unified logging. See the *NetBackup Troubleshooting Guide* for information on how to use unified logs.	Automatic virtual machine selection	VMware backup host
install_path\NetBackup\logs\ncfnbrestore (originator ID 357) ncfnbrestore uses unified logging. See the *NetBackup Troubleshooting Guide* for information on how to use unified logs.	Restore	VMware recovery host
Windows: *install_path*\NetBackup\logs\vxms Linux: /usr/openv/netbackup/logs/vxms	File mapping during backup	VMware backup host See "Configuring VxMS logging" on page 212. **Note:** The use of VxMS logging can reduce the performance of the backup host.

Note: Except for unified logging directories, these log directories must already exist in order for logging to occur. If these directories do not exist, create them.

To create most of these log directories, run the following command on the NetBackup servers and backup host:

Windows:

install_path\NetBackup\logs\mklogdir.bat

UNIX (on master or media servers):

/opt/openv/netbackup/logs/mklogdir

More detail is available on snapshot logs and logging levels. See the *NetBackup Snapshot Client Administrator's Guide*.

A broader discussion of NetBackup logging is available. See the *NetBackup Troubleshooting Guide*.

Configuring VxMS logging

The following procedures describe how to configure VxMS logging.

Except as noted in this topic, you can also use the Logging Assistant (in the NetBackup Administration Console) to configure VxMS logging. For details on the Logging Assistant, see the NetBackup Administrator's Guide, Volume I.

Note: VxMS logging may require significant resources on the VMware backup host.

To configure VxMS logging on a Windows backup host

1   Create the VxMS log directory:

    install_path\NetBackup\logs\vxms

Note: For logging to occur, the VxMS folder must exist.

---

2   In the Windows registry, create the DWORD registry entry VXMS_VERBOSE in the following location:

    HKEY_LOCAL_MACHINE > SOFTWARE > Veritas > NetBackup > CurrentVersion > Config

3   To configure the logging level, set the numeric value of `VXMS_VERBOSE` to 0 or greater. Larger numbers result in more verbose logs.

0   No logging.

1   Error logging.

2   Level 1 + warning messages.

3   Level 2 + informative messages.

4   Same as level 3.

5   Highly verbose (includes level 1) + auxiliary evidence files (`.mmf`, `.dump`, `VDDK logs`, `.xml`, `.rvpmem`).

6   VIX (VMware virtual machine metadata) dump only.

7   VHD (Hyper-V virtual machine metadata) dump only.

>7   Full verbose + level 5 + level 6 + level 7.

Note: Log levels higher than 5 cannot be set in the Logging Assistant.

Note: Log levels higher than 5 should be used in very unusual cases only. At that level, the log files and metadata dumps may place significant demands on disk space and host performance.

4   To change the log location:

- Open regedit and go to the following location:
  HKEY_LOCAL_MACHINE > SOFTWARE > Veritas > NetBackup > CurrentVersion

- Create the registry entry `vxmslogdir` with a string value `(REG_SZ)`. For the string value, specify the full path to an existing folder.

Note: You can use NTFS compression on VxMS log folders to compress the log size. The new logs are written in compressed form only.

Note: If the VxMS log location is changed, the Logging Assistant does not collect the logs.

To configure VxMS logging on a Linux backup host

1 Create the VxMS log directory:

`/usr/openv/netbackup/logs/vxms`

Note: For logging to occur, the VxMS directory must exist.

---

2 Add the following to the `/usr/openv/netbackup/bp.conf` file:

`VXMS_VERBOSE=`*numeric value of 0 or greater*

The following procedure contains a table of logging levels:

3 To change the log location, enter the following in the `bp.conf` file:

`vxmslogdir=`*path to new log location*

Note: If the VxMS log location is changed, the Logging Assistant does not collect the logs.

Preventing browsing delays caused by DNS problems

NetBackup may be unable to identify virtual machines when you use the **Browse for Virtual Machines** dialog. Virtual machine host names may not be properly configured in your Domain Name Server system (DNS), or the DNS system may be slow. A timeout message may appear, or messages similar to the following may appear in the NetBackup detailed status log:

```
17:25:37.319 [12452.10360] get_vSphere_VMs: Processing vm 002-wcms
17:25:37.319 [12452.10360] get_vSphere_VMs:    uuid
421a8b46-063d-f4bd-e674-9ad3707ee036
17:25:37.319 [12452.10360] get_vSphere_VMs:    vmxdir [san-05] 002-wcms/
17:25:37.319 [12452.10360] get_vSphere_VMs:    datastore san-05
17:25:37.319 [12452.10360] get_vSphere_VMs:    IpAddress 172.15.6.133
17:25:41.866 [12452.10360] get_vSphere_VMs: retry_gethostbyaddr for
172.15.6.133 failed with The requested name is valid, but no data of
the requested type was found.
```

Note: NetBackup may be unable to determine the host names of the virtual machines from their IP addresses (reverse lookup may fail).

To prevent browsing delays caused by DNS problems (Windows)

1   On the Windows desktop of the backup host, click **Start > Run** and enter
    `regedit`.

2   To be on the safe side, make a backup of the current registry (**File > Export**).

3   Go to **HKEY_LOCAL_MACHINE > SOFTWARE > Veritas > NetBackup >
    CurrentVersion > Config** and create a key that is called `BACKUP`.

4   Create a new DWORD under `BACKUP`, called `disableIPResolution`.

    This registry key causes NetBackup to use the virtual machine's IP address
    as the virtual machine's host name.

5   Use the NetBackup **Browse for Virtual Machines** screen to rediscover the
    virtual machines to show the host names set to the IP addresses.

    See "Browse for VMware Virtual Machines" on page 69.

To prevent browsing delays caused by DNS problems (Linux)

1   On the Linux backup host, create (or open) the following file:

    `/usr/openv/netbackup/virtualization.conf`

2   Add the following to the file:

    ```
    [BACKUP]
    "disableIPResolution"=dword:00000000
    ```

    This entry causes NetBackup to use the virtual machine's IP address as the
    virtual machine's host name.

    Note: If the file already contains a `[BACKUP]` line, do not add another `[BACKUP]`
    line. Any other lines that already exist under `[BACKUP]` should remain as they
    are.

3   Use the NetBackup **Browse for Virtual Machines** screen to rediscover the
    virtual machines to show the host names set to the IP addresses.

    See "Browse for VMware Virtual Machines" on page 69.

Changing the browsing timeout for virtual machine discovery

In the NetBackup Administration Console on Windows, you can adjust the time
available for browsing for virtual machines.

To change the browsing timeout value

1   In the NetBackup Administration Console on Windows, click on **Policies**.

2   From the main menu, click **View > Options**, then click the **Policies** tab.

3   Adjust the **VMware connect timeout** value.

4   Click **OK**.

Changing timeout and logging values for vSphere

Table 14-2 lists the vSphere keys and their default values for various timeouts. These values can be changed on the backup host (see the procedure in this topic).

Table 14-2   DWORD keys and defaults for vSphere timeouts

DWORD key name	Default value (in seconds)
`jobtimeout`	900
`poweroptimeout`	900
`snapshottimeout`	900
`registertimeout`	180
`browsetimeout`	180
`connecttimeout`	300

The key and default for the vSphere API logging level are the following.

Table 14-3   DWORD key and default for vSphere API log level

DWORD key name	Default value
`vmcloglevel`	0 (no logging)

Changes to the vSphere API logging level affect the following logs on the backup host:

■   For backups (snapshot creation): `bpfis` log

■   For restores: `bpVMutil` log

■   For virtual machine discovery: `ncfnbcs` log (originator ID 366)

The logs are in the following location on the backup host:

Windows: *install_path*\NetBackup\logs\

Linux: /usr/openv/netbackup/logs

To change vSphere timeouts and logging values on Windows

1   On the Windows desktop of the backup host, click **Start > Run** and enter
    `regedit`.

2   To be on the safe side, make a backup of the current registry (**File > Export**).

3   Go to **HKEY_LOCAL_MACHINE > SOFTWARE > Veritas > NetBackup >
    CurrentVersion > CONFIG** and create a key that is called `BACKUP`.

4   To change a timeout value, create a new DWORD under `BACKUP`, using the
    appropriate registry name (such as `jobtimeout` or `poweroptimeout`).

    Enter a value for the timeout.

5   To change the level of vSphere API logging, create a new DWORD called
    `vmcloglevel` and enter the new logging value.

    The allowed values are 0 through 6, where 0 is no logging and 6 is the highest
    log level.

To change vSphere timeouts and logging values on Linux

1   On the Linux backup host, create (or open) the following file:

    `/usr/openv/netbackup/virtualization.conf`

2   To change a timeout value, enter a new `dword` line under `[BACKUP]`, using the
    appropriate name (such as `jobtimeout` or `poweroptimeout`). Include a value
    for the timeout.

    For example:

    ```
    [BACKUP]
    "jobtimeout"=dword:60
    ```

    This example sets the job timeout to 60 seconds.

    Note: If the file already contains a `[BACKUP]` line, do not add another `[BACKUP]`
    line. Any other lines that already exist under `[BACKUP]` should remain as they
    are.

3   To change the level of vSphere API logging, enter a `dword` line for `vmcloglevel`
    with a logging value, under `[BACKUP]`. For example:

    ```
    "vmcloglevel"=dword:6
    ```

    The allowed values are 0 through 6, where 0 is no logging and 6 is the highest
    log level.

Credentials for VMware server are not valid

A number of issues can prevent NetBackup from gaining access to the ESX server or vCenter server. When you add credentials for a VMware server (**Add Virtual Machine Server** dialog), NetBackup validates the credentials when you click OK. If the credentials do not pass validation, a pop-up message appears.

Problems can result for a variety of reasons, including the following:

- An incorrect virtual machine server name. Make sure that the server name is entered correctly.
  More information is available about changing the server name that is stored in NetBackup.
  See "Changing the host name of a VMware server in NetBackup" on page 46.

- An invalid user name or password. Make sure that a valid user name and password were entered correctly.

- An incorrect port number. Make sure that the port number is correct on the NetBackup **Change Virtual Machine Server** dialog. If the VMware server uses the default port, no port specification is required. You can uncheck the **Connect using port number** box.

- You do not have enough privileges to perform backups or restores. (Note however that lack of sufficient privileges may not cause the credential validation to fail.)
  For general guidelines for permissions, see the following:
  http://www.symantec.com/docs/TECH128513
  For the minimum permissions needed to back up and restore with vStorage, see the following:
  http://www.symantec.com/docs/TECH130493

See "Adding NetBackup credentials for VMware" on page 42.

NetBackup status codes related to VMware

This topic provides assistance for NetBackup status codes relating to NetBackup for VMware.

Table 14-4   NetBackup status codes related to VMware

NetBackup status code	Explanation and recommended action
1, the requested operation was partially successful	This error may occur during restore, when the virtual machine cannot be imported into vCloud. In the Activity Monitor, the Detailed Status tab of the job details includes messages from vCloud Director that indicate the reason for the error. The restored virtual machine is present on the destination vCenter: you must manually import it into vCloud.
5, the restore failed to recover the requested files	For a virtual machine restore that uses Instant Recovery, this error can occur for the following reasons: ■ A name was specified incorrectly for the resource pool or temporary datastore. ■ The virtual machine cannot be mounted or activated in vSphere. Ensure that the names for the required parameters are specified correctly. Also, check for known issues in the vSphere tasks or events. For detailed debugging, consult the `bpVMutil` logs on the restore host: *install_path*\NetBackup\logs\bpVMutil

Table 14-4   NetBackup status codes related to VMware *(continued)*

NetBackup status code	Explanation and recommended action

6, the backup failed to back up the requested files	This error can occur for the following reasons:
	
	■ The virtual machine and the alternate client virtual machine may contain too many disks. If the total is too great for the alternate client SCSI controllers, a backup with the hotadd transport mode fails. The following appears in the job status log: `ERR - Error opening the snapshot disks using given transport mode: Status 23.`
	Add more SCSI controllers to the alternate client virtual machine.
	
	■ If the VMware backup host cannot access the datastore over the selected transport mode, the backup fails. The detailed status log on the backup host may contain the following:
	
	`12/4/2009 1:12:34 PM - Error bpbrm(pid=21376) from client vm4: ERR - Error opening the snapshot disks using given transport mode: Status 23.`
	
	Select a different transport mode and retry the backup.
	
	■ Storage vMotion migrated the virtual machine's files when NetBackup performed a backup of the virtual machine directly through the ESX server. To avoid conflicts with Storage vMotion in vSphere 5.0 or later, NetBackup should conduct backups through the vCenter server.
	See "Conflict between NetBackup and VMware Storage vMotion with vSphere 5.0 or later" on page 225.
	
	■ For the backups that use the hotadd transport mode: The backup host was unable to resolve the host name of the ESX server. This error may occur if DNS is not correctly configured on the virtual machine where the backup host is installed. On the virtual machine, you can enter the IP address of the ESX server into the hosts file: `\Windows\System32\drivers\etc\hosts`
	
	■ For the backups that use the hotadd transport mode: If the virtual machine to back up and the virtual machine that contains the hotadd backup host do not reside in the same datacenter: The backup fails. For a successful hotadd backup, the two virtual machines must be in the same VMware datacenter.
	
	■ A previous hotadd backup of the virtual machine may have failed. Certain mount directories or cloned disks must be manually removed to allow hotadd backups to succeed, as follows:
	
	  ■ During a hotadd backup, VMware creates a linked clone of the virtual machine's disks and attaches the cloned disks to the backup host. (The attached disks can be seen in the vSphere Client interface.) If a hotadd backup of the virtual machine fails, NetBackup may be unable to remove the cloned disks from the backup host. In the backup host, the presence of the cloned disks prevents subsequent backups from completing.
	  Remove the cloned disks from the VMware backup host and retry the backup.
	
	  ■ During a virtual machine backup, VMware creates mount directories in the C:\Windows\Temp folder on the backup host. After the backup, VMware automatically removes the mount directories. In some cases, such as when the backup uses the hotadd transport mode, NetBackup may be unable to remove the mount directories.
	  Remove the mount directories from the \Temp folder and retry the backup. The folder name contains a string such as `VMware-System`.

Table 14-4 NetBackup status codes related to VMware *(continued)*

NetBackup status code	Explanation and recommended action
16	For a virtual machine restore that uses Instant Recovery, the recovery host was not Windows. Virtual machine Instant Recovery currently requires a Windows recovery host. (Linux support is planned for a future release.)
20, invalid command parameter	For the **Backup Media Server** option, the storage unit that is specified in the policy must be unique to your media servers. If the storage unit is also available on another media server, the snapshot job cannot succeed.
21, socket open failed	The NetBackup media server may not have the Services for Network File System (NFS) installed. As a result, the media server cannot contact the Portmapper service. The attempt to manually start the NFS services fails because the Network File System is not installed. Install the Services for Network File System on the media server. See "About installing and configuring Network File System (NFS) for Granular Recovery Technology (GRT)" on page 259.
156, snapshot error encountered	A number of different issues can cause this error. See "Snapshot error encountered (status code 156)" on page 223.
227, no entity was found	To restore selected files (not the entire virtual machine) to the original location, you must specify the host name of the virtual machine. Do not specify the display name or UUID as the destination.

Table 14-4   NetBackup status codes related to VMware *(continued)*

NetBackup status code	Explanation and recommended action

2817, 2820	A virtual machine restore may fail in the following cases:
	
	■ If an .ISO file was presented to a virtual machine as a virtual CD or DVD during backup, note: The ISO file must be available on the destination host. If the ISO is not available on the host where you restore the virtual machine, the restore fails. The vCenter interface may include the message `Invalid configuration for Device '1'.`
	
	■ For a restore that uses the hotadd transport mode: If the virtual machine to restore and the virtual machine that contains the hotadd restore host do not reside in the same datacenter: The restore fails. For a successful hotadd restore, the two virtual machines must be in the same VMware datacenter.
	
	■ The restore host cannot access the VMware datastore over the selected transport mode. The job log on the restore host may contain messages such as the following:
	
	`FTL - Virtual machine restore: VxMS initialization failed`
	
	Select a different transport mode and retry the restore.
	
	■ You attempted to restore a file that has a path name longer than 1023 characters.
	Note that a backup of a Linux virtual machine backs up all files, including those with path names longer than 1023 characters. A restore of the entire Linux virtual machine recovers all files. But you cannot restore the long path-name files individually.
	
	■ If the ESX servers are configured with short host names (not fully qualified), NetBackup may not find the ESX server for the restore.
	See "The restore fails if ESX servers use short host names and backups and restores use a vCenter server" on page 226.
	
	■ For the restore, the virtual machine's hardware version (such as 7) is later than the hardware version that the target server supports. If VMware Tools cannot convert the virtual machine's hardware version to an earlier version, the restore fails. Messages similar to the following appear in the detailed status log:
	
	`Info bpVMutil(pid=6268) INF - vmwareLogger:`
	`WaitForTaskCompleteEx: The virtual machine version is not`
	`compatible with the version of the host <hostname>.`
	
	If possible, restore the virtual machine to a VMware server that supports the virtual machine's hardware version.

Table 14-4 NetBackup status codes related to VMware *(continued)*

NetBackup status code	Explanation and recommended action
2848	During the restore, NetBackup cannot create the virtual machine. This error can occur for a variety of reasons such as the following: ■ Credentials for the VMware server do not have sufficient permissions to create a virtual machine. ■ Insufficient space on a datastore. ■ Incompatible virtual machine or vmdk configurations. ■ Error or task cancellation on the VMware server. The Job Details tab should contain additional information. The VMware server logs may also have information on the error.

Snapshot error encountered (status code 156)

The following table describes the VMware issues that relate to NetBackup status code 156.

Table 14-5 Possible causes of status code 156

Causes of status code 156	Description and recommended action
NetBackup cannot obtain the volume ID of a drive	NetBackup may not be able to obtain the volume ID of a drive. In that case, none of the virtual machine drives are backed up. The backup fails with NetBackup status code 156. The drive may be down.
A backup of the virtual machine is already active	You cannot run more than one backup per virtual machine at a time. If you start a second backup of the virtual machine while the first backup is active, the second job fails with a status 156. Recommended action: Wait until the first job completes, then run the second one.

Table 14-5 Possible causes of status code 156 *(continued)*

Causes of status code 156	Description and recommended action

Cannot find virtual machine name	NetBackup cannot find the host name or VM display name of a virtual machine that is listed in the backup policy. The detailed status log may include the following error message:
	
	`Critical bpbrm (pid=<pid number>) from client <client name>:`
	`FTL - snapshot creation failed, status 156.)`
	
	If the virtual machines do not have static IP addresses, you can configure NetBackup to identify virtual machines by their VM display names or UUIDs. Examples of the environments that do not use static IP addresses are clusters, and the networks that assign IP addresses dynamically.
	
	Note that NetBackup may have been configured to identify virtual machines by their VM display names. In that case, make sure that the display names are unique and that they do not contain special characters.
	
	See "Primary VM identifier options (VMware)" on page 58.

The virtual machine is powered off	Through a vCenter server, NetBackup can back up the virtual machines that are turned off. You must provide credentials for NetBackup to access the vCenter server. See "Adding NetBackup credentials for VMware" on page 42. If NetBackup uses credentials for an ESX server instead of vCenter, it may not be able to identify a turned off virtual machine. Note the following: ■ If the policy uses VM host name or VM DNS name as the Primary VM identifier, NetBackup may not find the virtual machine. The backup fails. ■ If the policy uses VM display name or VM UUID as the Primary VM identifier, NetBackup can identify the virtual machine. The backup succeeds.
The virtual machine disk is in raw mode (RDM)	The RDM is ignored (not backed up) and any independent disk is recreated but empty. See "Configurations for backing up RDMs" on page 288.
The attempt to create a snapshot exceeded the VMware timeout	If the attempt to create a snapshot of the virtual machine exceeds the VMware timeout of 10 seconds, the snapshot fails with NetBackup status 156. This timeout may occur if the virtual machine is configured with a large number of volumes. Note that the timeout may be encountered even if the **Virtual machine quiesce** option was disabled. Do one of the following: ■ Reduce the number of volumes within the virtual machine. ■ Install a NetBackup client on the virtual machine and select another backup method for the policy (not the VMware snapshot method).

| | Table 14-5 | Possible causes of status code 156 *(continued)* |

Causes of status code 156	Description and recommended action
The virtual machine has no vmdk file assigned	The snapshot fails if the virtual machine has no vmdk file.
	Virtual machines without vmdk files can occur in a vCenter Site Recovery Manager (SRM) environment. If a replicated virtual machine has never been active, it is in passive mode and may have no vmdk file(s).
	You can enable the **Ignore diskless VMs** option on the **VMware Advanced Attributes** tab of the policy. If this option is enabled: NetBackup does not back up a replicated (passive) virtual machine in an SRM environment if that virtual machine has no vmdk files.
	More information is available on the **Ignore diskless VMs** option.
	See "VMware - Advanced Attributes dialog" on page 62.

Conflict between NetBackup and VMware Storage vMotion with vSphere 5.0 or later

To avoid conflicts with Storage vMotion in vSphere 5.0 or later, NetBackup should conduct backups through the vCenter server, not through the ESX host. A backup directly through the ESX server may fail if Storage vMotion simultaneously migrates the virtual machine's files. In addition, the virtual machine's snapshot files may be stranded or other problems with the virtual machine may result. VMware has acknowledged this issue.

If the backup fails, the NetBackup job details contain a message similar to the following:

```
Error opening the snapshot disks using given transport mode: Status 23.
```

To back up a virtual machine while its files are in the process of migration, NetBackup must conduct the backup through the vCenter server.

To back up a virtual machine while its files are in the process of migration

1   In the NetBackup Administration Console, under **Media and Device Management > Credentials > Virtual machine servers**, add NetBackup credentials for the vCenter server.

Select a server type of VMware VirtualCenter Server.

2   Delete the credentials that are currently defined under the server type VMware ESX server, and add those credentials as type VMware Restore ESX Server.

3   Rerun the backup.

The restore fails when you restore individual files to a virtual machine that has NetBackup client software

When you restore individual files to a virtual machine that has a NetBackup client, make sure that a firewall does not interfere with the restore. If a firewall stops the restore, turn off the firewall and retry the restore.

The restore fails if ESX servers use short host names and backups and restores use a vCenter server

In the following case, the attempt to restore the virtual machine fails:

■   The ESX servers in your VMware environment are configured with short host names (not fully qualified), and

■   The backup was performed through a vCenter server, not directly from an ESX server, and

■   The restore is directed through a vCenter server, not directly to an ESX server.

In this case, NetBackup cannot find the ESX server for the restore. Restore of the virtual machine fails, and the following message appears in the bpvmUtil log:

FAILED_TO_GET_MOR_BY_NAME

To restore virtual machines through a vCenter server in environments with short ESX host names (Windows)

1   On the Windows desktop of the backup host, click **Start > Run** and enter regedit.

2   To be on the safe side, make a backup of the current registry (**File > Export**).

3 Go to **HKEY_LOCAL_MACHINE > SOFTWARE > Veritas > NetBackup > CurrentVersion > Config** and create a key that is named `BACKUP`.

4 Right-click in the right pane and click **New > DWORD Value**. Enter `disableFQDN` as the name.

To restore virtual machines through a vCenter server in environments with short ESX host names (Linux)

1 On the Linux backup host, create (or open) the following file:

`/usr/openv/netbackup/virtualization.conf`

2 Add the following to the file:

```
[BACKUP]
"disableFQDN"=dword:00000000
```

Note: If the file already contains a `[BACKUP]` line, do not add another `[BACKUP]` line. Any other lines that already exist under `[BACKUP]` should remain as they are.

Backup or restore job hangs

NetBackup may have exceeded the maximum number of allowed VMware NFC connections to the ESX server when it used the transport modes `nbd` or `nbdssl`. Note that NetBackup uses one NFC connection per virtual disk on the ESX or ESXi server.

If NetBackup is configured to access the ESX server directly (not through a vCenter or VirtualCenter server), fewer connections are allowed. The following are the maximum connections as set by VMware:

Table 14-6   VMware NFC connection limits for `nbd` or `nbdssl` transfers

ESX version	Type of access to the ESX server	Maximum NFC connections allowed
ESX 4	Directly to ESX server	9
ESX 4	Through vCenter	27
ESXi 4	Directly to ESX server	11
ESXi 4	Through vCenter	23
ESXi 5	Directly to ESX server	The maximum total for all NFC connection buffers to an ESXi host is 32 MB

Table 14-6   VMware NFC connection limits for `nbd` or `nbdssl` transfers *(continued)*

ESX version	Type of access to the ESX server	Maximum NFC connections allowed
ESXi 5	Through vCenter	52

Try a different transport type (such as SAN or hotadd). If a different transport type is not available and NetBackup accesses the ESX servers directly, set up access through a vCenter (or VirtualCenter) server. Use of a server increases the maximum number of allowed connections. For example: With 27 connections, NetBackup can access a virtual machine that has up to 27 disks, if the ESX 4 server is behind a vCenter server.

Note that the connection limits are per-host (that is, per vCenter or ESX server).

For example, assume the following environment:

- An ESX 4.0 server with three virtual machines.

- Each virtual machine has 10 virtual disks.

- The virtual machines are behind a vCenter 4.0 server.

For a simultaneous backup of the three virtual machines, NetBackup requires 30 NFC connections. With a limit of 27 NFC connections per vCenter server, any of the three backup jobs may hang.

These limits are described in the *VMware Virtual Disk API Programming Guide*:

VMware Virtual Disk API Programming Guide

See also the following section of the *VMware vSphere 5 Documentation Center*:

Virtual Disk Transport Methods

Mount point missing on a restored Windows virtual machine

A Windows virtual machine may fail to write its mount point configuration to disk (the mount point configuration remains in RAM). In that case, the mount point information cannot be backed up. When the virtual machine is restored, the data from the mounted volume is restored, but the mount point is absent from the restored virtual machine.

Reassign the mount point on the restored virtual machine. To make sure the mount point is correctly configured, restart the virtual machine.

Mount points not available when restoring files from a Linux virtual machine

For Linux virtual machines, only the ext2, ext3, and ext4 file systems are supported for individual file restore. If a partition is formatted with some other file system, the backup succeeds but NetBackup cannot map the file system addresses of the files. As a result, NetBackup cannot restore individual files from that partition. Only the files that were on ext2, ext3, or ext4 partitions can be individually restored.

Note also: to restore individual files from their original mount points, the "/" (root) partition must be formatted as ext2, ext3, or ext4. If the "/" (root) partition is formatted with a different file system (such as ReiserFS), the mount points cannot be resolved. In that case, you can restore ext2, ext3, or ext4 files from the /dev level (such as /dev/sda1). You cannot restore the files from their original mount point level.

Remove the Consolidate Helper snapshot

If a datastore is out of space when you attempt to delete snapshots, VMware creates a snapshot named Consolidate Helper. You should manually delete this snapshot before the next backup. Otherwise, change files may accumulate on the datastore. The accumulation of such files can affect both the backup performance and the I/O performance of the virtual machine.

For more information, see the following VMware knowledge base article about deleting the Consolidate Helper snapshot:

http://kb.vmware.com/kb/1003302

NetBackup catalog information for virtual machine backups made by 6.5.4 or earlier may prevent browsing the imported images for restore

If you import a NetBackup 6.5.4 or earlier virtual machine backup image to a NetBackup 7.x system, note: the catalog header file of the imported image may have the wrong value for VM_TYPE. The value of the imported image may be incorrectly reported as 0 even for type 1 (Full VM) and type 2 (Mapped full VM) backups. As a result, you cannot use the Backup, Archive, and Restore interface to browse and restore the virtual machine image.

You must change the VM_TYPE value in the header file of the imported image to correct this problem. For the backups that were made with the Full VM backup

option, set VM_TYPE to 1. For the backups that were made with the Mapped full VM backup option, set VM_TYPE to 2.

For instructions, see the following tech note:

http://www.symantec.com/docs/TECH63525

Invalid client error when you restore files using NetBackup BAR interface installed on the virtual machine

If the virtual machine was backed up by display name or UUID, and the display name is not the same as the host name, note: You cannot restore individual files by means of the Backup, Archive, and Restore (BAR) interface if the interface is installed on the virtual machine itself. The files can be restored if BAR is installed on the master server or media server. In this case, BAR must not be installed on the virtual machine that you want to restore to.

To restore files, the **Destination client for restores** field in the BAR interface must have a valid host name or IP address.

VMware virtual machine does not restart after restore

The virtual machine may have had SCSI and IDE drives at the time of backup and the guest OS resided on a SCSI drive. In that case, the virtual machine when restored may attempt to boot from the IDE drive. The boot attempt fails with the message "Operating system not found."

VMware has identified this problem and will address it in a future release.

As a workaround, you can reconfigure the BIOS on the virtual machine to boot from the correct SCSI device.

NetBackup job fails due to update tasks on the VMware server

Certain virtual machine update tasks on the VMware server may cause a NetBackup job to fail. For example, a restore may fail when you use the nbrestorevm command to restore multiple VMs at the same time. If the failed restore job creates the VM, the VM is deleted.

On the backup or restore host, the bpVMutil log may contain a message similar to the following:

```
Detail: <ManagedObjectNotFoundFault xmlns="urn:vim25"
xsi:type="ManagedObjectNotFound"><obj type="VirtualMachine">
vm-14355</obj>
        </ManagedObjectNotFoundFault>
```

As a workaround, rerun the job for the operation that failed.

Note: If possible, avoid VMware maintenance activities during backup or restore operations.

NetBackup commands to back up and restore virtual machines

This appendix includes the following topics:

- Using NetBackup commands to create a VMware policy
- Using the nbdiscover command to search the virtual environment
- Using the nbrestorevm command to restore virtual machines into vSphere
- Using the nbrestorevm command to restore virtual machines into vCloud Director
- Using the nbrestorevm command to restore virtual machines with Instant Recovery
- The nbrestorevm -R rename file for restoring virtual machines
- Logs for troubleshooting virtual machine restores
- Query format and examples for searching virtual machine backups
- Allowing other servers or clients to restore virtual machines

Using NetBackup commands to create a VMware policy

This topic describes how to use NetBackup commands to create a policy to back up virtual machines.

The NetBackup commands for policy creation are in the following directory:

Windows:

`install_path`\Veritas\NetBackup\bin\admincmd

UNIX or Linux:

`usr/openv/netbackup/bin/admincmd`

Run these commands on the NetBackup master server.

To use NetBackup commands to create a VMware policy

1   Create a blank policy.

    `bppolicynew policyName -M masterServer`

    For example:

    `bppolicynew pol1 -M nbserver.acme.com`

2   Configure the VMware policy type and set the VMware snapshot options.

    This step requires running the initialize form of the bpplinfo command in two stages.

First stage:	`bpplinfo policyName -set -pt VMware`
	Example for the first stage of bpplinfo:
	`bpplinfo pol1 -set -active -pt VMware -residence stu1`

Second
stage:
```
bpplinfo policyName -modify -use_virtual_machine 1
-alt_client_name VMware_backup_host -snapshot_method
"VMware_v2" -snapshot_method_args
keyword=value,keyword=value,...
```

The -alt_client_name specifies the VMware backup host (NetBackup access host). You can specify a particular backup host on this option, or specify MEDIA_SERVER (a media server acts as the backup host).

The -use_virtual_machine, -alt_client_name, -snapshot_method "VMware_v2", and -snapshot_method_args must be specified with all parameters set. (Otherwise, the snapshot job fails.)

Note: -snapshot_method_args is a comma-delimited list of keywords that define the VMware snapshot and policy. The keywords are described in a separate topic:

See "VMware policy: bpplinfo options and keywords" on page 236.

Example for the second stage of bpplinfo (for a policy for vCloud Director):

```
bpplinfo pol1 -modify -use_virtual_machine 1 -alt_client_name
backuphost1.acme.com -application_discovery 1 -snapshot_method
"VMware_v2" -snapshot_method_args "file_system_optimization=1,
snapact=2,drive_selection=0,Virtual_machine_backup=2,
enable_vCloud=1,multi_org=0,disable_quiesce=0,nameuse=0,
exclude_swap=1,skipnodisk=0,post_events=1,ignore_irvm=0,
rLim=10,rTO=0,rHz=10,trantype=san:hotadd:nbd:nbdssl"
```

To back up virtual machines in vCloud Director, the bpplinfo command must include the following:

- -application_discovery 1

- The *snapshotMethodArgs* list must include enable_vCloud=1.

In addition, NetBackup credentials must be specified for a vCloud Director server.

3 Create a schedule for the policy.

```
bpplsched policyName -add scheduleLabel -st scheduleType
```

For example:

```
bpplsched pol1 -add Full -st FULL
```

4 Modify the schedule attributes.

```
bpplschedrep policyName scheduleLabel -(0..6) start duration
```

For example:

```
bpplschedrep pol1 Full -0 0 604800
```

5 Select the virtual machines to back up.

This step requires two commands: bpplclients and bpplinclude.

```
bpplclients policyName -add VM_to_back_up hardware operating_System
```

```
bpplinclude policyName -add ALL_LOCAL_DRIVES | filter_to_select_VMs
```

- To back up a virtual machine through manual selection (for example):

  ```
  bpplclients pol1 -add prvm1.acme.com Windows-x64 Windows2008
  bpplinclude example -add ALL_LOCAL_DRIVES
  ```

  In this example, `prvm1.acme.com` is the virtual machine to back up, including all of its local drives (`-add ALL_LOCAL_DRIVES`). `ALL_LOCAL_DRIVES` is the only file list option available for the VMware policy type.

- To automatically select virtual machines through a query rule (for example):

  ```
  bpplclients pol1 -add MEDIA_SERVER VMware VMware
  bpplinclude pol1 -add "vmware:/?filter= Displayname Contains
  'prvm'"
  ```

  MEDIA_SERVER allows NetBackup to use a media server to discover and select the virtual machines. As an alternative, you can use -add to specify a particular discovery host.

  In the bpplinclude example, the query rule `"vmware:/?filter= Displayname Contains 'prvm'"` selects the virtual machines with the display names that contain `prvm`. (Other characters can also appear in the display names.)

Note: To back up virtual machines in vCloud Director, the policy must use a query rule on the bpplinclude command to select virtual machines automatically. For vCloud, do not specify a virtual machine on the bpplclients command.

---

bpplinclude has options for modifying the query rules in an existing policy.

See "VMware policy: bpplinclude options for modifying query rules" on page 239.

To test the bpplinclude query rule (vmware:/?filter) before you run the backup

◆ Run the following:

Windows:

install_path\NetBackup\bin nbdiscover -noxmloutput -policy
policyName -noreason

UNIX, Linux:

/usr/openv/netbackup/bin nbdiscover -noxmloutput -policy
policyName -noreason

A + sign appears before the virtual machines that the query rule selects for the backup: these virtual machines are included in the backup when the policy runs.

The virtual machines to be excluded from the backup appear with a - sign.

The -noreason option omits explanations as to why the query excluded a virtual machine or why the query failed. For explanations, do not include -noreason.

For more details on most of the command options, see the man page or the *NetBackup Commands Reference Guide*.

Notes on creating a VMware policy for vCloud Director

Note the following when you create a policy for vCloud Director:

■ NetBackup credentials must be specified for a vCloud Director server.

■ The bpplinfo command must include the following option and value, to enable the policy for automatic selection of virtual machines: -application_discovery 1

■ On the bpplinfo command, the *snapshotMethodArgs* list must include the following attribute: enable_vCloud=1.

■ The policy must use a query rule, on the bpplinclude command, to select virtual machines automatically.

For the complete steps--including these points--use the following procedure:

VMware policy: bpplinfo options and keywords

Table A-1 describes the options that are available on the bpplinfo command that are not described in the man page. These options are set to default values if not specified.

Table A-1 bpplinfo options

Option	Values	Keyword label in policy GUI
-enable_meta_indexing	0 disabled, 1 enabled	The Attributes tab > Enable indexing for search
-ignore_client_direct	0 enables client deduplication, 1 disables client deduplication	The Attributes tab > Disable client side deduplication
-application_discovery	0 disabled, 1 enabled	Clients tab > Select automatically through query
-discovery_lifetime	seconds	Clients tab > Reuse VM selection query results for
-ASC_apps_attr	`exchange`, `mssql`, `sharepoint` truncatelogs=0 disabled, 1 enabled (for Exchange or SQL Server only) To enable Exchange file recovery: -ASC_apps_attr exchange: To enable Exchange, SQL, and SharePoint file recovery: -ASC_apps_attr exchange:,mssql:,sharepoint: To enable exchange recovery with truncate logs: -ASC_apps_attr exchange::truncatelogs=1 To enable exchange without truncate logs and mssql with truncate logs: -ASC_apps_attr exchange:,mssql::truncatelogs=1 To enable exchange with truncate logs and mssql without truncate logs (note the final colon): -ASC_apps_attr exchange::truncatelogs=1,mssql: To enable both exchange and mssql with truncate logs: -ASC_apps_attr exchange::truncatelogs=1,mssql::truncatelogs=1	Enables the file-level recovery of database data. VMware tab > Application Protection: Enable Exchange Recovery, Enable SQL Server Recovery, or Enable SharePoint Recovery
-snapshot_method_args	*keyword=value,keyword=value,* ... See Table A-2 on page 238.	

Table A-2 describes the keywords that must be included in -snapshot_method_args.

Table A-2   Keywords and values for -snapshot_method_args

Keyword	Value	Name of keyword in policy GUI
file_system_optimization=	0 disabled, 1 enabled	VMware tab > Exclude deleted blocks
snapact=	0 Ignore, 1 Abort, 2 Remove NetBackup	VMware tab > Orphaned snapshot handling
drive_selection=	0 Include all disks, 1 Exclude boot disk, 2 Exclude data disks	VMware tab > Advanced > Virtual disk selection
Virtual_machine_backup=	1 disabled, 2 enabled	VMware tab > Enable file recovery from VM backup
enable_vCloud=	0 disabled, 1 enabled	Clients tab > Enable vCloud Director integration (only available with automatic selection of client)
multi_org=	0 disabled, 1 enabled	VMware tab > Advanced > Multiple organizations per policy
disable_quiesce=	0 virtual machine quiesce is enabled, 1 virtual machine quiesce is disabled	VMware tab > Advanced > Virtual machine quiesce
nameuse=	0 VM host name, 1 VM display name, 2 VM BIOS UUID, 3 VM DNS Name, 4 VM instance UUID	VMware tab > Primary VM identifier
exclude_swap=	0 disabled, 1 enabled	VMware tab > Exclude swap and paging files
skipnodisk=	0 disabled, 1 enabled	VMware tab > Advanced -> Ignore diskless VMs
post_events=	0 No Events, 1 All Events, 2 Error Events	VMware tab > Advanced > Post events to vCenter
ignore_irvm=	0 disabled, 1 enabled	VMware tab > Advanced > Ignore Instant Recovery VMs
rLim=	0 - 100	VMware tab > Advanced > Snapshot retry
rTO=	0 - 1440	VMware tab > Advanced > Snapshot timeout (minutes)
rHz=	0 - 3600	VMware tab > Advanced > Snapshot creation interval (seconds)

	Table A-2	Keywords and values for -snapshot_method_args *(continued)*

Keyword	Value	Name of keyword in policy GUI
trantype=	san, hotadd, nbd, or nbdssl If more than one, separate each with a colon. Order of modes indicates priority. Example: trantype=nbd:hotadd This example selects these two modes and tries nbd first.	VMware tab > Transport modes
serverlist=	VMware server names. Use a colon to separate the names. For example: `serverlist=vc1.acme.com:vc2.acme.com` To specify no server list, enter `serverlist=`	VMware tab > Advanced > VMware server list

VMware policy: bpplinclude options for modifying query rules

The bpplinclude command has options for modifying the query rules in an existing policy.

	Table A-3	bpplinclude options for modifying query rules

Option	Description

-addtoquery *query_string* ...	Adds the specified query string to the end of the policy query rules, or creates a query if none exists.
	
	Quotes (") must be escaped (\).
	
	Examples:
	
	To add `vm17` to the list of values in the query rules of policy1:
	
	`bpplinclude policy1 -addtoquery ,\"vm17\"`
	
	To create a query in a policy that does not have a query:
	
	`bpplinclude policy1 -addtoquery vmware:/?filter=DisplayName AnyOf \"grayfox7\",\"grayfox9\"`
	
	Note: Each quote (") is escaped with a backslash (\).

Table A-3 bpplinclude options for modifying query rules *(continued)*

Option	Description
-addtoquery -f *file_name*	Adds the entries to the query rules from the specified file, or creates a query if none exists.
	In the file, quotes (") do not need to be escaped.
	Example:
	To create a query in a policy that does not have a query:
	`bpplinclude policy1 -addtoquery -f qfile1`
	where the contents of `qfile`1 are:
	`vmware:/?filter=vCenter Contains "ROS" AND ESXserver Equal "VM_test1" AND Powerstate Equal poweredOn`
	Note: The values "ROS" and "VM_test1" are not escaped.
	Note: You can place entries on multiple lines in the file. All entries are added to the end of the query (if a query already exists).
-deletefromquery *query_string* ...	Deletes the specified query string from the policy query rules.
	Examples:
	To delete `vm27` from the list of values in the query rule of policy1:
	`bpplinclude policy1 -deletefromquery \"vm27\"`
	This example also deletes the comma preceding vm27 if such a comma exists in the query rules.
	Note: The -deletefromquery option deletes a comma if: the phrase in the query_string does not begin or end with a comma and the character preceding the deleted string is a comma.
	To delete an entire query from the policy:
	`bpplinclude policy1 -deletefromquery vmware:/?filter=DisplayName AnyOf "grayfox7","grayfox9"`

| Table A-3 | bpplinclude options for modifying query rules *(continued)* |

Option	Description
-deletefromquery -f *file_name*	Deletes the file entries from the query rules.
	Example:
	To delete a query from a policy:
	`bpplinclude policy1 -deletefromquery -f qfile1`
	where the contents of `qfile`1 are:
	`vmware:/?filter=vCenter Contains "ROS" AND ESXserver Equal "VM_test1" AND Powerstate Equal poweredOn`
	Note: The values "ROS" and "VM_test1" are not escaped.

Note: paths that contain wildcards must be enclosed in quotes.

Using the nbdiscover command to search the virtual environment

To search for VMs, run nbdiscover on the master server.

UNIX and Linux:

`/usr/openv/netbackup/bin/nbdiscover -noxmloutput "query"`

Windows:

`install_path\NetBackup\bin\nbdiscover.exe -noxmloutput "query"`

where -noxmloutput displays one VM per line. The *query* specifies either a filter-based search rule or a browse operation.

For example, to search for the backups of virtual machines that have "prod1" in their display names:

`nbdiscover -noxmloutput`
`"vmsearch:/;reqType=search?filter=VMDisplayName Contains 'prod1'"`

For further descriptions of the command options, see the command's man page or the *NetBackup Commands Reference Guide*.

Using the nbrestorevm command to restore virtual machines into vSphere

To restore VMs, run the nbrestorevm command on the master server or recovery host. The command is located in the following directory:

UNIX and Linux:

```
/usr/openv/netbackup/bin/nbrestorevm
```

Windows:

```
install_path\NetBackup\bin\nbrestorevm.exe
```

The following nbrestorevm options are used in these examples:

- `-vmw`

  Required for all VMware virtual machine restores.

- `-C virtual_machine_to_restore`

  The VM name must match the type of name that was selected in the **Primary VM identifier** option of the backup policy. For example, if the VM was backed up by its VM display name, specify the display name on the `-C` option.

- `-R absolute_path_to_rename_file`

  Restores to a different location. The required entries in the rename file depend on the destination for the restore. See each example in this topic. Further notes are available on the rename file.
  See "The nbrestorevm -R rename file for restoring virtual machines" on page 251.

- `-O`

  Overwrites the VMs and associated resources if they already exist.

- `-S master_server`

  Specifies the master server that made the backup (if different from the current master).

- `-vmserver vCenter_server`

  Specifies a different vCenter server for the restore destination.

- `-vmproxy VMware_recovery_host`

  Specifies a different VMware recovery host (overrides the default backup host that backed up the VMs).

> **Note:** Storage lifecycle policies (SLPs) can use Auto Image Replication to replicate a virtual machine backup image to another NetBackup domain. To restore the virtual machine from the replicated image, you must include the `-vmproxy` option. Use `-vmproxy` to specify the backup host (access host) that is in the domain where the virtual machine was replicated.

- `-vmkeephv`

  Retains the hardware version upon recovery.

- `-vmsn`

  Removes the network from the restored VM.

- `-vmvmxd`

  Restores the .vmdk files to the vmx datastore (the configuration datastore).

- `-vmpo`

  Turns on the VM after the restore.

Following are examples of nbrestorevm, for various restore destinations and options.

A. Restore to the original location and overwrite the VM.

```
nbrestorevm -vmw -C VM_to_restore -O
```

B. Restore to the original location, overwrite the VM, and remove the network.

```
nbrestorevm -vmw -C VM_to_restore -O -vmsn
```

C: Restore to the original location from a VM backup that a different master server made, and overwrite the VM.

```
nbrestorevm -vmw -C VM_to_restore -S master_server -O
```

D: Restore to the original vCenter and ESX, but to a different datastore that also contains the VM configuration files.

```
nbrestorevm -vmw -C VM_to_restore -R absolute_path_to_rename_file
-vmvmxd
```

For the `-R` rename file, create a text file with the following entry:

```
change datastore to new_vmx_datastore
```

where *new_vmx_datastore* specifies the path to the vmx datastore (configuration datastore) for the restored VM. After the restore, this datastore contains the .vmdk files of the restored VM.

Note: In the rename file, the change line must end with a carriage return.

E: Restore to a different vCenter server.

```
nbrestorevm -vmw -C VM_to_restore -R absolute_path_to_rename_file
-vmserver vCenter_server
```

For the -R rename file, create a text file with the following entries. Replace the italicized values with the actual name for the restored VM and for the other vSphere objects in this list:

```
change vmname to new_display_name
change esxhost to new_ESX_host
change datacenter to /new_datacenter
change folder to /new_datacenter/new_folder
change resourcepool to new_datacenter/host/new_ESX_host/resources
/new_resource_pool
change datastore to new_vmx_datastore
change /original_vmdk_path to /new_vmdk_path
```

Note: In the rename file, each change line must end with a carriage return.

The last change entry in this list (change */original_vmdk_path* to */new_vmdk_path*) designates the following: the original path to the .vmdk file, and the new path to the .vmdk file of the restored VM. This change entry is required when you restore to a different datastore (unless you use the nbrestorevm –vmvmxd option). Depending on your VMware environment, this change entry may take the following form:

```
change /original_datastore/original_VM_folder/original_vmdk.vmdk to
/new_datastore/new_VM_folder/new_vmdk.vmdk
```

Note: If the change vmdk directive specifies a different path for some of the VM's vmdk files, the other vmdk files are restored to their original datastore.

See "The nbrestorevm -R rename file for restoring virtual machines" on page 251.

F: Restore to a different vCenter server that has multiple networks.

```
nbrestorevm -vmw -C VM_to_restore -R absolute_path_to_rename_file
-vmserver vCenter_server
```

Create a rename file with the change entries listed for example E. Add the following change entry:

```
change network to new_network, new_network(n)
```

Note: In the rename file, each change line must end with a carriage return.

G: Restore by means of a different recovery host, to a different ESX server under the same vCenter Server. After recovery, turn on the VM.

```
nbrestorevm -vmw -C VM_to_restore -R absolute_path_to_rename_file
-vmproxy VMware_recovery_host -vmpo
```

The –vmpo option turns on the restored VM.

Include the following in the rename file:

```
change esxhost to new_ESX_host
```

To restore the .vmdk files to a different datastore, include the following entry in the rename file:

```
change /original_vmdk_path to /new_vmdk_path
```

Note: In the rename file, each change line must end with a carriage return, even if the file contains only one line.

Note: The rename file may require other change entries, depending on your vSphere environment. See the available entries under example E.

Note: Configure the recovery host as a VMware Access Host on the master server. Communication between the master server and the backup host or recovery host (client) should be established before the restore.

H. Restore to a different location, to a standalone ESX server

```
nbrestorevm -vmw -C VM_to_restore -R absolute_path_to_rename_file
```

Include the following in the rename file:

```
change esxhost to new_ESX_host
change datacenter to None
change folder to None
change resourcepool to /ha_datacenter//host/new_ESX_host/resources
change datastore to new_datastore
change /original_vmdk_path to /new_vmdk_path
change network to new_network
```

Note: For restore to a standalone ESX server, the resource pool entry must include the literal string ha-datacenter in the pool path.

Note: The rename file may require other change entries, depending on your vSphere environment. See the available entries under example E.

I. Restore to a different location in a vSphere cluster, retaining the VM hardware version

```
nbrestorevm -vmw -C VM_to_restore -R absolute_path_to_rename_file
-vmkeephv
```

Include the following in the rename file:

```
change resourcepool to
/new_datacenter/host/cluster/resources/new_resource_pool
```

Note: The rename file may require other change entries, depending on your vSphere environment. See the available entries under example E.

For further descriptions of the nbrestorevm options, see the command's man page or the *NetBackup Commands Reference Guide*.

The following topics contain additional information:

See "Logs for troubleshooting virtual machine restores" on page 254.

See "The nbrestorevm -R rename file for restoring virtual machines" on page 251.

Using the nbrestorevm command to restore virtual machines into vCloud Director

To search the virtual environment for VMs, use the nbdiscover command.

See "Using the nbdiscover command to search the virtual environment" on page 241.

To restore the virtual machines, run nbrestorevm on the master server or backup host. The nbrestorevm command is located in the following directory:

UNIX and Linux:

```
/usr/openv/netbackup/bin/nbrestorevm
```

Windows:

```
install_path\NetBackup\bin\nbrestorevm.exe
```

The following command options are used in these examples:

- `-vmw`

  Required for all VMware virtual machine restores.

- `-vcd`

  Required for all virtual machine restores into vCloud.

- `-C` *virtual_machine_to_restore*

  The VM name must match the type of name that was selected in the **Primary VM identifier** option of the backup policy. For example, if the VM was backed up by its VM display name, specify the display name on the `-C` option.

- `-R` *absolute_path_to_rename_file*

  Restores to a different location. The entries that are required in the rename file depend on the destination for the restore. See each example in this topic. Further notes are available on the rename file:

- `-vcdovw`

  Overwrites an existing vApp.

- `-vcdrte`

  Restores to an existing vApp. (If this option is set but the vApp does not exist, the restore fails.)

- `-vcdtemplate`

  Restores a vApp as a template.

- `-vcdlfree`

  Restores to the datastore that has the most free space.

- `-vcdremv`

  Removes a vApp after capture to a template.

A: Restore to the original vApp in vCloud and overwrite the VM.

```
nbrestorevm -vmw -vcd -C VM_to_restore -vcdrte -O
```

The -O option overwrites the VM.

B: Restore to the original vCloud location to an existing vApp. Remove the existing vApp and create a new vApp.

```
nbrestorevm –vmw –vcd –C VM_to_restore –vcdovw
```

The –vcdovw option deletes the vApp and the VMs inside it, and creates a new vApp.

Note: For restore to the original location, you must use either the –vcdovw option or the –O option.

C: Restore to the original vCloud location in a vApp template.

```
nbrestorevm –vmw –vcd –C VM_to_restore –vcdovw
```

Note: To restore a VM that resides in a vApp template to its original location, use the –vcdovw option. If you use –O option, the restore fails with status 2820.

D: Restore to a different vCloud vApp but to the same vCloud organization.

```
nbrestorevm –vmw –vcd –C VM_to_restore –R absolute_path_to_rename_file
–vcdrte
```

For the -R rename file, create a text file with the following entries. These entries describe the restore location. Replace the italicized values with the actual values:

```
change vcdvapp to new_vcdvapp
change orgvdc to new_organization_VDC
```

Note: In the rename file, each change line must end with a carriage return.

Note: If you want to associate the restored VM with a different organization VDC, use the change orgvdc entry to specify the organization VDC.

E: Restore to a different vCloud organization.

```
nbrestorevm –vmw –vcd –C VM_to_restore –R absolute_path_to_rename_file
–vcdrte
```

Include the following in the rename file:

```
change organization to new_organization
change orgvdc to new_organization_VDC
change vcdvapp to new_vcdvapp
change resourcepool to /new_datacenter/host/new_ESX_host/resources
/new_resource_pool
change datastore to new_vmx_datastore
```

Note: To create the organization on a different vCenter, include the `-vmserver` *vCenter_server* option on the command. You must also include other change directives, such as for datacenter and ESX server.

F: Restore to a different vCloud Director.

```
nbrestorevm -vmw -vcd -C VM_to_restore -R absolute_path_to_rename_file
-vcdrte -vmserver vCenter_server
```

Include the following in the rename file:

```
change vcdserver to new_vcdserver
change organization to new_organization
change orgvdc to new_organization_VDC
change vcdvapp to new_vcdvapp
change vcdvmname to new_vcdvmname
change esxhost to new_ESX_host
change datacenter to /new_datacenter
change resourcepool to /new_datacenter/host/new_ESX_host/resources
/new_resource_pool
change datastore to new_vmx_datastore
```

G: Restore to a different vCloud vApp and capture it as a template in a catalog.

```
nbrestorevm -vmw -vcd -C VM_to_restore -R absolute_path_to_rename_file
-vcdtemplate
```

Include the following in the rename file:

```
change vcdvapp to new_vcdvapp
change vcdcatalog to new_vcdcatalog
```

The vApp is restored to the original organization and organization VDC. To associate the vApp with a different organization VDC, include this directive:

```
change orgvdc to new_organization_VDC
```

Note: After the template is created, no other VMs can be added to the template.

H: Restore to a different vCloud vApp, capture the vApp as a template, and remove the vApp.

```
nbrestorevm -vmw -vcd -C VM_to_restore -R absolute_path_to_rename_file
-vcdtemplate -vcdremv
```

Include the following in the rename file:

```
change vcdvapp to new_vcdvapp
change vcdcatalog to new_vcdcatalog
```

The -vcdremv option removes the non-template vApp; the new vApp template is retained.

Note: After the template is created, no other VMs can be added to the template.

I: Restore a vCloud vApp template that has multiple virtual machines.

First, restore a virtual machine to a non-template vApp:

```
nbrestorevm -vmw -vcd -C VM_to_restore -vcdrte
```

Run this command for each VM but do not restore the last VM.

Next, restore the last VM, create a vApp template, and copy all the restored VMs into that template:

```
nbrestorevm -vmw -vcd -C VM_to_restore -R absolute_path_to_rename_file
-vcdtemplate -vcdremv -vcdlfree
```

Include the following in the rename file:

```
change vcdvapp to vApp_template
```

The change directive provides the name for the new vApp template into which the VMs are to be restored.

The -vcdremv option removes the non-template vApp into which you initially restored the virtual machines. The -vcdlfree option selects the datastore that has the largest available space.

Note: After the template is created, no other VMs can be added to the template.

Using the nbrestorevm command to restore virtual machines with Instant Recovery

Instant Recovery for VMware is described in the "Restore virtual machines with Instant Recovery" chapter of this guide.

See "About Instant Recovery for VMware" on page 166.

See "Notes on Instant Recovery for VMware" on page 171.

See "Instant Recovery options on the nbrestorevm command" on page 172.

See "Restoring a virtual machine with Instant Recovery for VMware" on page 177.

The nbrestorevm -R rename file for restoring virtual machines

The -R option on the nbrestorevm command is for restoring a VM to a different location. It identifies a text file that is called the rename file. This file describes the restore location by means of change directives. Each change directive provides information about a VMware attribute or object that defines the VM when it is restored. For example: the change directives can set the display name for the restored VM, the name of the datastore, and the name of the ESX server.

Note the following about the -R rename file:

■ The -R option must specify the absolute path to the rename file.

■ The -R option and rename file are not required when you restore the VM to its original location with all its original settings.

■ Each change directive in the -R rename file must end with a carriage return. If the file contains only one change directive, that line must end with a carriage return.

■ The change directives to include in the rename file depend on the VMware environment.
Unlike the Backup, Archive, and Restore interface, the nbrestorevm command does not have its own validation checks. When you use the nbrestorevm -R option, you must include all the change entries that the VMware environment requires. Otherwise, the restore does not succeed or the VM does not function correctly.

■ The change directives can be placed in any order in the file.

- The change directive should be entered exactly as shown in Table A-4, except for the variable at the end (such as *new_display_name*). Replace that variable with the new name.

- If a vSphere object does not apply to the restore destination, enter `None` as its value. For example: For restore to a standalone ESX, enter `change datacenter to None`.

- The rename file overrides the nbrestorevm -vmsn and -vmvmxd options:

  - If the rename file includes a change directive for a .vmdk path and nbrestorevm includes the –vmvmxd option, the –vmvmxd option is ignored. The change directive determines the .vmdk path of the restored VM.

  - If the rename file includes a change directive to designate a network for the restored VM and nbrestorevm includes the –vmsn option, –vmsn is ignored.

Table A-4   `-R` rename file change directives

-R rename file directives	Description and notes
`change vmname to ` *`new_display_name`*	Sets the display name for the restored VM. If this entry is omitted, the original display name is used.
`change esxhost to ` *`new_ESX_host`*	Designates the ESX server to restore to. This entry is required when you restore to a different ESX server.
`change datacenter to ` *`/new_datacenter`*	Designates the datacenter in which to restore the VM. If the destination does not have a datacenter, enter None as the value: `change datacenter to None`
`change folder to` *`/new_datacenter/new_folder`*	Designates the folder in which to restore the VM. If the destination does not have a folder, enter None as the value: `change folder to None`
`change resourcepool to` *`/new_datacenter/host/new_ESX host/resources`* *`/new_resource_pool`*	For restore to a different ESX server, specify a different resource pool. (The original resource pool cannot be used to create a VM on a different ESX server.) You must specify a resource pool by including the following line in the rename file: For restore to a standalone ESX server, the `change resourcepool` entry must include the literal string `ha-datacenter` in the path: `change resourcepool to /ha_datacenter//host/new_ESX_host/resources`

Table A-4   −R rename file change directives *(continued)*

-R rename file directives	Description and notes
`change datastore to `*`new_vmx_datastore`*	Designates the vmx datastore (configuration datastore) of the restored VM. The vmx datastore contains the configuration files that describe the virtual machine.
	This change entry is required when you use the –vmvmxd option on the nbrestorevm command. The -vmvmxd option allows the vmdk files to be restored to the same datastore where the VMX file is specified.
	Note: See the change */original_vmdk_path* to */new_vmdk_path* directive in this table.
`change `*`/original_vmdk_path`*` to `*`/new_vmdk_path`*	Designates the original path to the .vmdk file, and the new path to the .vmdk file of the restored VM. As a rule, this change entry is required when you restore to a different datastore. Depending on your VMware environment, this change entry may take the following form:
	change */original_datastore/original_VM_folder/original_vmdk.vmdk* to */new_datastore/new_VM_folder/new_vmdk.vmdk*
	Note: If you use the -vmvmxd option on nbrestorevm to restore the .vmdk files to the vmx datastore, do not use this change directive. By specifying the datastore for the vmdk files, this change directive overrides the -vmvmxd option.
	Note: If the change vmdk directive specifies a different path for some of the VM's vmdk files, the other vmdk files are restored to their original datastore.
	To restore more than one vmdk file to a specified datastore:
	`change `*`/first_vmdk_path`*` to `*`/new_first_vmdk_path`*`
change `*`/second_vmdk_path`*` to `*`/new_second_vmdk_path`*`
change `*`/nth_vmdk_path`*` to `*`/new_nth_vmdk_path`*
`change network to `*`new_network`*	Designates the new network for the restored VM. To designate multiple networks, enter the following:
	`change network to `*`new_network, new_network(n)`*
`change organization to `*`new_organization`*	Designates the vCloud Director organization to restore to.
`change orgvdc to `*`new_organization_virtual_datacenter`*	Designates the virtual datacenter in the vCloud Director organization to restore to.

Table A-4	$-R$ rename file change directives *(continued)*

-R rename file directives	Description and notes
`change vcdserver to` *`new_vcdserver`*	Designates the vCloud Director server to restore to.
`change vcdvapp to` *`new_vcdvapp`*	Designates the vCloud Director vApp to restore to.
`change vcdvapptemplate to` *`new_vcdvapptemplate`*	Designates the vCloud Director vApp template to restore to.
`change vcdvmname to` *`new_vcdvmname`*	Sets the display name for the restored VM in vCloud Director.
`change vcdcatalog to` *`new_vcdcatalog`*	Designates the vCloud Director catalog to restore to.

Logs for troubleshooting virtual machine restores

If the nbrestorevm job fails, it usually reports status code 2820. The following logs may contain the messages that indicate the problem.

Table A-5	Logs with messages on nbrestorevm

Log directory	Resides on
Windows *install_path*\NetBackup\logs\bprd Linux, UNIX /usr/openv/netbackup/logs/bprd	Master server
Windows *install_path*\NetBackup\logs\bpVMutil Linux, UNIX /usr/openv/netbackup/logs/bpVMutil	Recovery host

If the restore job reaches the point of creating the virtual machine, the job's detailed status should contain a specific error message. vSphere Client shows an attempt to create the virtual machine and displays an associated failure message.

Query format and examples for searching virtual machine backups

From the master server, the nbdiscover command can search virtual machine backups based on a query rule. Compose the query manually and enclose it in double quotes.

For example: Search for backups of the virtual machines that have "vm1" as their display names:

```
nbdiscover "vmsearch:/;reqType=search?filter=VMDisplayName Equal
'vm1'"
```

Table A-6   Query format with examples

Element	Description
vmsearch:/	Specifies that the query searches virtual machine backups.
reqType	The request type. The following request types are supported: ■ search Specifies that the query is used for search. Requires a query rule ■ browse Displays the hierarchy of the virtual machines that were backed up. Requires the viewType. ■ listFields Lists the supported field names and their attributes. ■ listOps Lists the operations that a field supports. Requires the fieldName option.

viewType	Specifies the type of hierarchical view (vcloud or vsphere). Used with the browse option.
	
	Example - Show the hierarchy of vCloud:
	`nbdiscover "vmsearch:/;reqType=browse;viewType=vcloud"`
	Example - Show the hierarchy of vSphere:
	`nbdiscover "vmsearch:/;reqType=browse;viewType=vsphere"`

fieldName	Specifies the name of the field for which supported operators are to be listed. Used with the listOps. Example - List supported operators for VMDisplayName `nbdiscover "vmsearch:/;reqType=listOps;fieldName=VMDisplayName"`

Table A-6	Query format with examples *(continued)*

Element	Description
`filter`	The query rule. nbdiscover searches virtual machine backups based on the rule.
	Example:
	`nbdiscover -noxmloutput "vmsearch:/;reqType=search?filter=ScheduleType Equal '0'"`

See the following examples with sample output.

Example 1: Search for the virtual machines that have full backups.

```
nbdiscover -noxmloutput "vmsearch:/;reqType=search?filter=ScheduleType
Equal '0'"
```

```
+ "demovm%20(8c879391-2917-4416-9373-bea7ec727717)"
+ "smallvm2%20(10a16222-8532-46ff-bd6a-9661240392f4)"
```

Example 2: Search backups of the virtual machines that have the display names that contain "vm".

```
nbdiscover -noxmloutput
"vmsearch:/;reqType=search?filter=VMDisplayName Contains 'vm'"
```

```
+ "demovm%20(8c879791-2917-4428-9373-bea7ec727717)"
+ "small_vm%20(33e85579-7279-411f-b2f9-9fb570583911)"
+ "small_vm_percent_%25%20(33e85579-7279-411f-b2f9-9fb570583911)"
```

Example 3: Search for backups of the vCloud virtual machines that have "test" in their vApp names.

```
nbdiscover -noxmloutput "vmsearch:/;reqType=search?filter= vCDvApp
Contains 'test'"
```

```
+ "demovm%20(8c879791-2917-4428-8213-bea7ec727717)"
+ "small_vm%20(61e83479-7246-411f-b1f9-9fb570546755)"
+ "small_vm_percent_%25%20(61e83479-7246-411f-b1f9-9fb570546755)"
```

Example 4: Search the virtual machine backups that occurred before 08/24/2012 11:05:56 AM. Specify the backup time in UTC.

```
nbdiscover -noxmloutput "vmsearch:/;reqType=search?filter=BackupTime
Less '1345871512'"
```

```
+ "demovm%20(8c846791-2917-4428-9373-bea7ec727437)"
+ "small_vm%20(22e85813-7246-433f-b2f9-9fb570585387)"
+ "small_vm_percent_%25%20(22e85579-7246-433f-b2f9-9fb570585387)"
```

Example 5: Search backups for virtual machines where the vCloud organization is named "QA" and the vApp name contains "demo".

```
nbdiscover -noxmloutput "vmsearch:/;reqType=search?filter=vCDOrg
Equal 'QA' AND vCDvApp Contains 'demo'"

+ "demovm%20(8c879791-2917-4428-9373-bea7ec727717)"
```

Example 6: Show the hierarchy of a vCloud environment. The output is in XML.

```
nbdiscover "vmsearch:/;reqType=browse;viewType=vcloud"

<Start Iteration="vmsearch:/;reqType=browse;viewType=vcloud">
<VCDSERVER>
     <NBU>
     <NAME>hypervm1.acme.com</NAME>
     </NBU>
     <VCDORG>
          <NBU>
          <NAME>Test Cloud</NAME>
          </NBU>
          <VCDORGVDC>
               <NBU>
               <NAME>Test Org</NAME>
               </NBU>
               <VCDVAPP>
                    <NBU>
                    <NAME>TestvApp</NAME>
                    </NBU>
               </VCDVAPP>
          </VCDORGVDC>
     </VCDORG>
</VCDSERVER>
<StatusMsg NBUStatus="0" Severity="0"></StatusMsg>
</START>
```

This search found the following:

- A vCloud Director server: `hypervm1.acme.com`

- An organization: `Test Cloud`

- A virtual datacenter: `Test Org`

- A vApp: `TestvApp`

Allowing other servers or clients to restore virtual machines

You can configure NetBackup to allow nbrestorevm to run from another host (such as another server, client, or virtual machine). The enabled host can use nbrestorevm to restore the virtual machine. The host must be configured as a peer of the NetBackup master server that performed the backup.

You can configure the peer in either of the following ways:

- In the NetBackup Administration Console, click **Host Properties > Master Servers > *double click the master server* > Servers**. Add the peer on the **Additional servers** tab.

- Add an empty *peer_name* file in the following location:
  UNIX, Linux

  `/usr/openv/netbackup/db/altnames/peer_name`

  Windows

  `install_path\NetBackup\db\altnames\peer_name`

  The name of the file is the name of the server or client to be granted restore privileges.

  For instructions, see the topics on allowing clients to perform redirected restores, in the *NetBackup Administrator's Guide, Vol I*.

Configuring services for NFS on Windows

This appendix includes the following topics:

About installing and configuring Network File System (NFS) for Granular Recovery Technology (GRT)

NetBackup Granular Recovery leverages Network File System, or NFS, to read individual objects from a database backup image. Specifically, the NetBackup client uses NFS to extract data from the backup image on the NetBackup media server. The NetBackup client uses "Client for NFS" to mount and access a mapped drive

that is connected to the NetBackup media server. The NetBackup media server handles the I/O requests from the client through NBFSD.

NBFSD is the NetBackup File System (NBFS) service that runs on the media server. NBFSD makes a NetBackup backup image appear as a file system folder to the NetBackup client over a secure connection.

About configuring services for NFS on Windows 2012 (NetBackup for VMware)

For instant recovery of virtual machines, the Services for Network File System (NFS) must be installed on Windows media servers.

Table B-1   Configuring NFS in a Windows 2012 environment

Action	Description
Configure NFS on the media server.	On the media server do the following: ■ Stop and disable the ONC/RPC Portmapper service, if it exists. ■ Enable NFS. See "Enabling Services for Network File System (NFS) on a Windows 2012 media server (NetBackup for VMware)" on page 260. ■ Stop the Server for NFS service. See "Disabling the Server for NFS (NetBackup for VMware)" on page 272. ■ Configure the portmap service to start automatically at server restart. Issue the following from the command prompt: `sc config portmap start= auto` This command should return the status `[SC] ChangeServiceConfig SUCCESS`.
Configure NFS on the restore host.	On the restore host, do the following: ■ Enable NFS. See "Enabling Services for Network File System (NFS) on a Windows 2012 restore host (NetBackup for VMware)" on page 264. ■ Stop the Server for NFS service. See "Disabling the Server for NFS (NetBackup for VMware)" on page 272.

Enabling Services for Network File System (NFS) on a Windows 2012 media server (NetBackup for VMware)

To perform VM instant recovery with a Windows 2012 media server, you must enable Services for Network File System. When this configuration is completed, you can disable any unnecessary NFS services.

To enable Services for Network File System (NFS) on a Windows 2012 media server

1   Open the Server Manager.
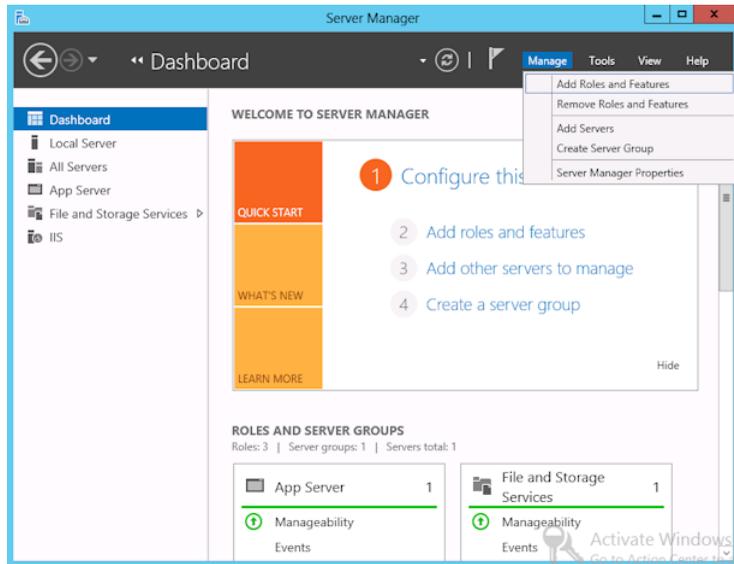
2   From the **Manage** menu, click **Add Roles and Features**.

3   In the Add Roles and Features Wizard, on the **Before You Begin** page, click **Next**.

4   On the **Select installation type** page, select **Role-based or feature-based installation**.
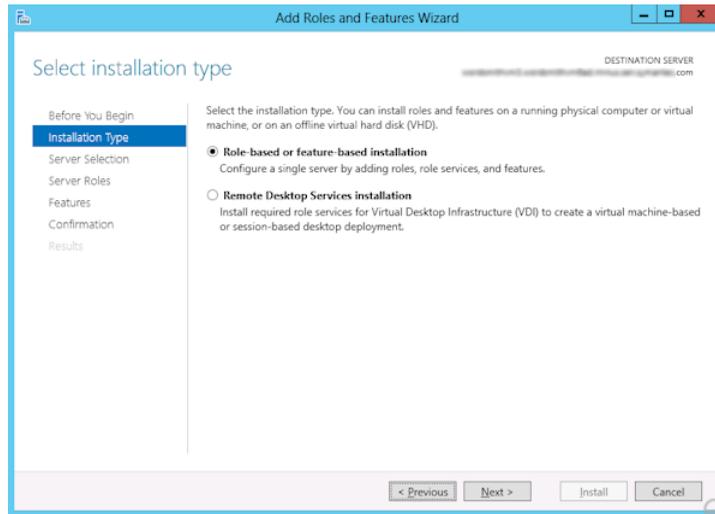
5   Click **Next**.

6   On the **Sever Selection** page, click **Select a server from the server pool** and select the server. Click **Next**.
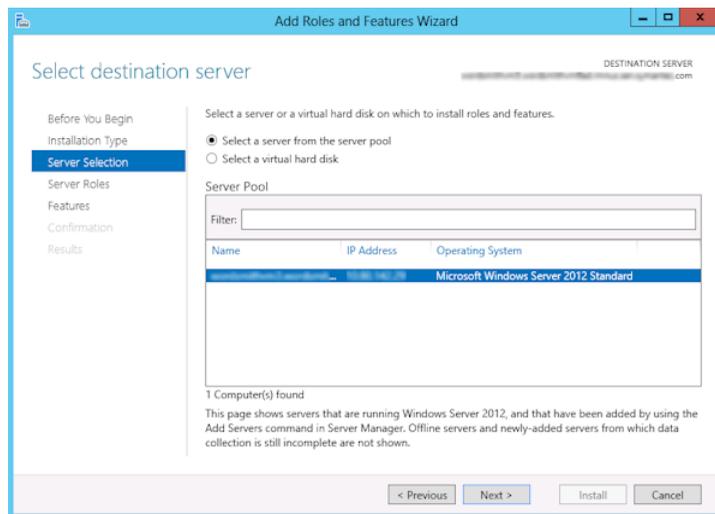
7   On the **Server Roles** page, expand **File and Storage Services** and **File and iSCSI Services**.

8   Click **File Server** and **Server for NFS**. When you are prompted, click **Add Features**. Click **Next**.
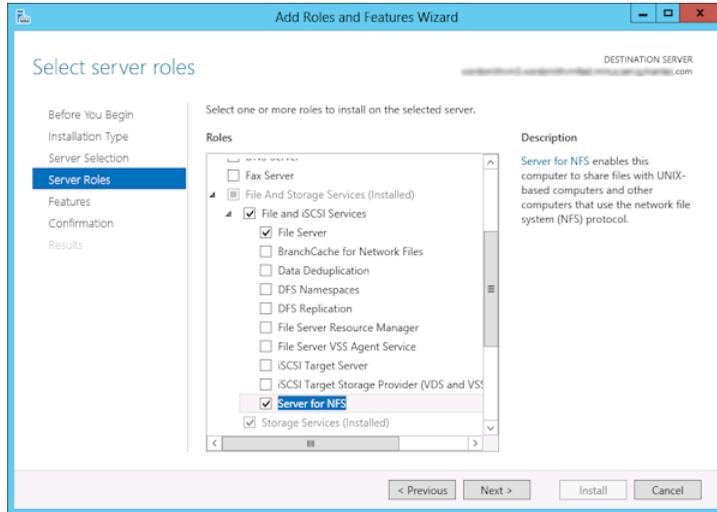
9 If the media server is also a restore host, on the **Features** page, click **Client for NFS**. Click **Next**.
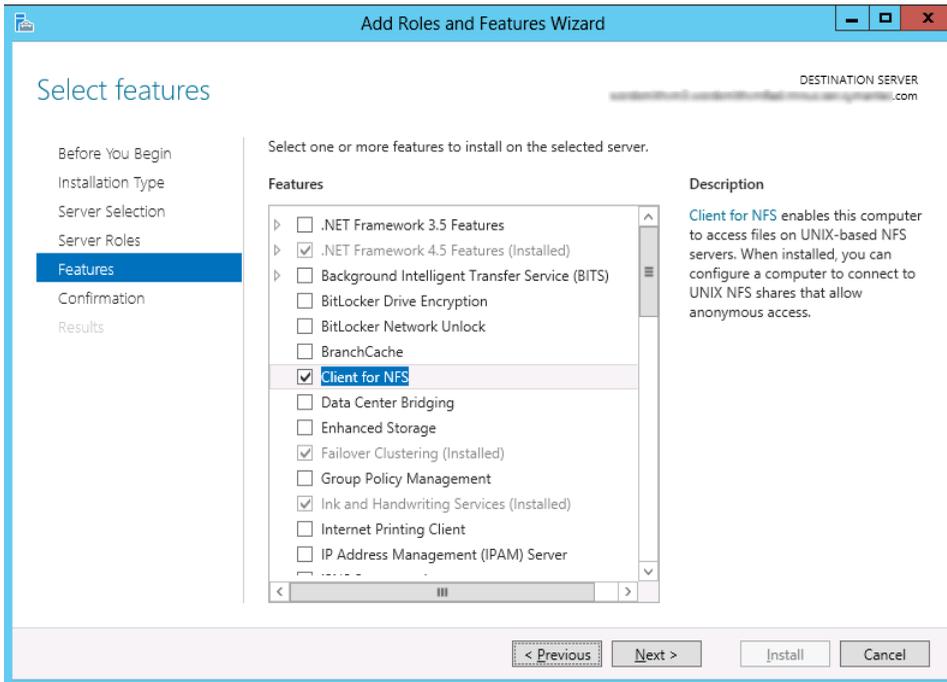
10 On the **Confirmation** page, click **Install**.

11 Disable any unnecessary services, as follows:

- If you have a single host that functions as both the media server and the restore host, you can disable the Server for NFS.

- For a host that is only the NetBackup media server, you can disable the Server for NFS and the Client for NFS.

12 Make sure that the portmap service is started and that its startup mode is set to auto.

Enabling Services for Network File System (NFS) on a Windows 2012 restore host (NetBackup for VMware)

To perform VM instant recovery with a Windows restore host, you must enable Services for Network File System. When this configuration is complete, you can disable any unnecessary NFS services.

To enable Services for Network File System (NFS) on a Windows 2012 restore host

1 Open the Server Manager.
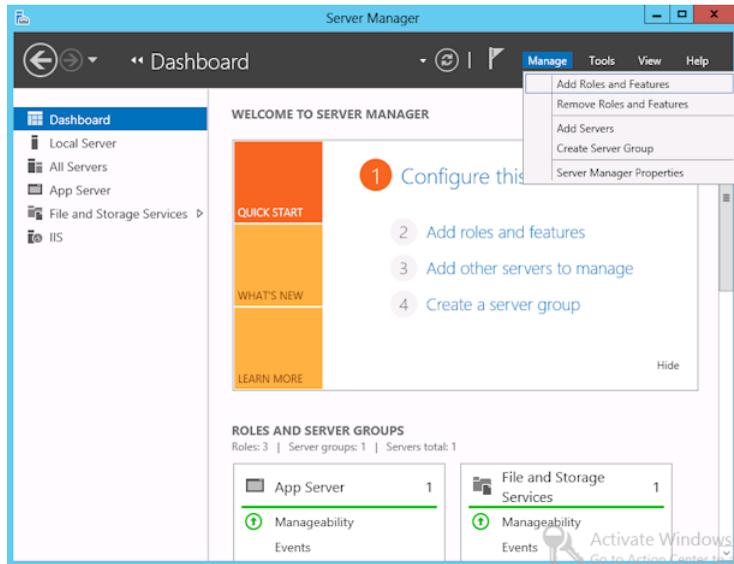
2 From the **Manage** menu, click **Add Roles and Features**.

3 In the Add Roles and Features Wizard, on the **Before You Begin** page, click **Next**.

4   On the **Select installation type** page, select **Role-based or feature-based installation**.
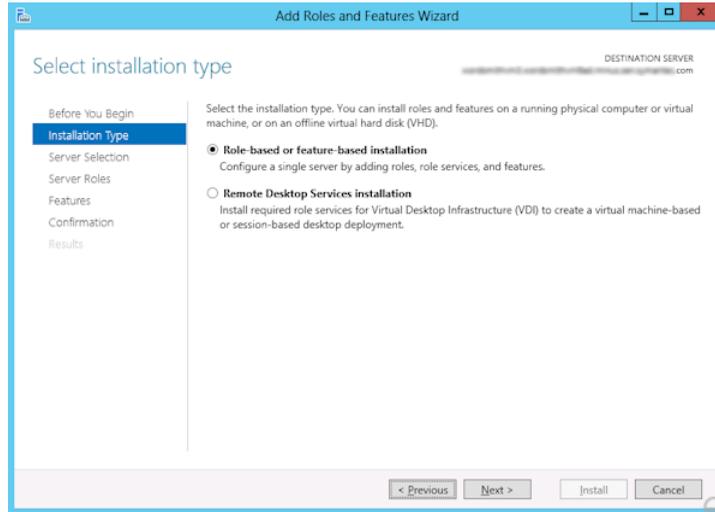
5   Click **Next**.

6   On the **Sever Selection** page, click **Select a server from the server pool** and select the server. Click **Next**.
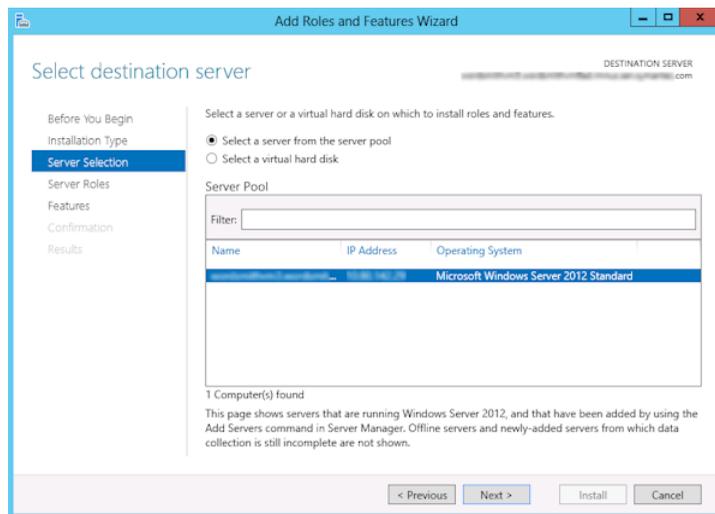
7   On the **Server Roles** page, click **Next**.

8   On the **Features** page, click **Client for NFS**. Click **Next**.
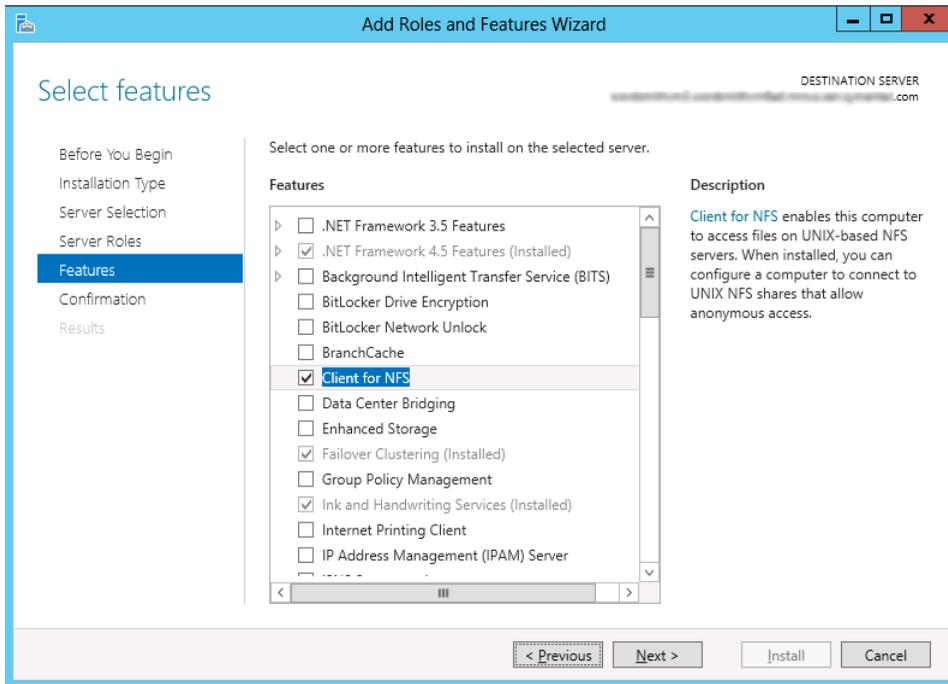
9   On the **Confirmation** page, click **Install**.

About configuring services for NFS on Windows 2008 and 2008 R2 (NetBackup for VMware)

For instant recovery of virtual machines, the Services for Network File System (NFS) must be installed on the Windows restore host and media servers.

Note: Before you configure NFS on the media server or restore host, look for the ONC/RPC Portmapper service. If it exists, stop it and disable it. Otherwise, the configuration of NFS Services for Windows fails.

Table B-2   Configuring NFS in a Windows 2008 or 2008 R2 environment

Action	Description
Configure NFS on the media server.	On the media server do the following: ■ Stop and disable the ONC/RPC Portmapper service. ■ Use the Windows Server Manager to enable NFS. See "Enabling Services for Network File System (NFS) on Windows 2008 or 2008 R2 (NetBackup for VMware)" on page 268. ■ Stop the Server for NFS service. See "Disabling the Server for NFS (NetBackup for VMware)" on page 272. ■ Stop the Client for NFS service. See "Disabling the Client for NFS on the media server (NetBackup for VMware)" on page 273. **Note:** If the media server is also a restore host, do not disable the Client for NFS. ■ Configure the portmap service to start automatically at server restart. Enter the following from the command prompt: `sc config portmap start= auto` This command should return the status `[SC] ChangeServiceConfig SUCCESS`.
Configure NFS on the restore host.	On the restore host, do the following: ■ Enable NFS. See "Enabling Services for Network File System (NFS) on Windows 2008 or 2008 R2 (NetBackup for VMware)" on page 268. ■ Stop the Server for NFS service. See "Disabling the Server for NFS (NetBackup for VMware)" on page 272.
On the restore host, install the hot fix for Client for NFS.	The hot fix is available at the following location: http://support.microsoft.com/kb/955012 **Note:** Important Windows Vista hot fixes and Windows Server 2008 hot fixes are included in the same packages. However, the hot fix Request page lists only **Windows Vista**. For the hot fix package for either operating system, select the hot fix that is listed under **Windows Vista** on the page. Always refer to the **Applies To** section in articles to determine the actual operating system for each hot fix.

Enabling Services for Network File System (NFS) on Windows 2008 or 2008 R2 (NetBackup for VMware)

To perform VM instant recovery with a Windows restore host, you must enable Services for Network File System. When this configuration is completed on the media server and the restore host, you can disable any unnecessary NFS services.

See "About configuring services for NFS on Windows 2008 and 2008 R2 (NetBackup for VMware)" on page 267.

To enable Services for Network File System (NFS) on Windows 2008 or 2008 R2

1   Open the **Server Manager**.

2   In the left pane, click **Roles** and, in the right pane, click **Add Roles**.
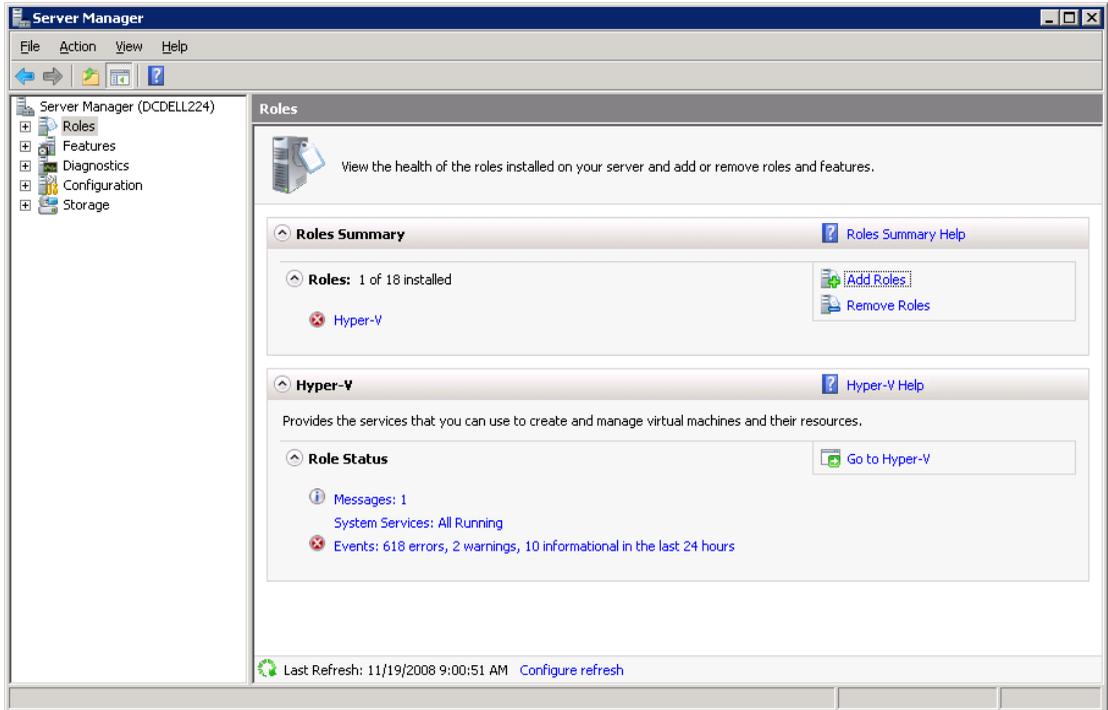
3   In the **Add Roles Wizard**, on the **Before You Begin** page, click **Next**.

4 On the **Select Server Roles** page, under **Roles**, check the **File Services** check box.
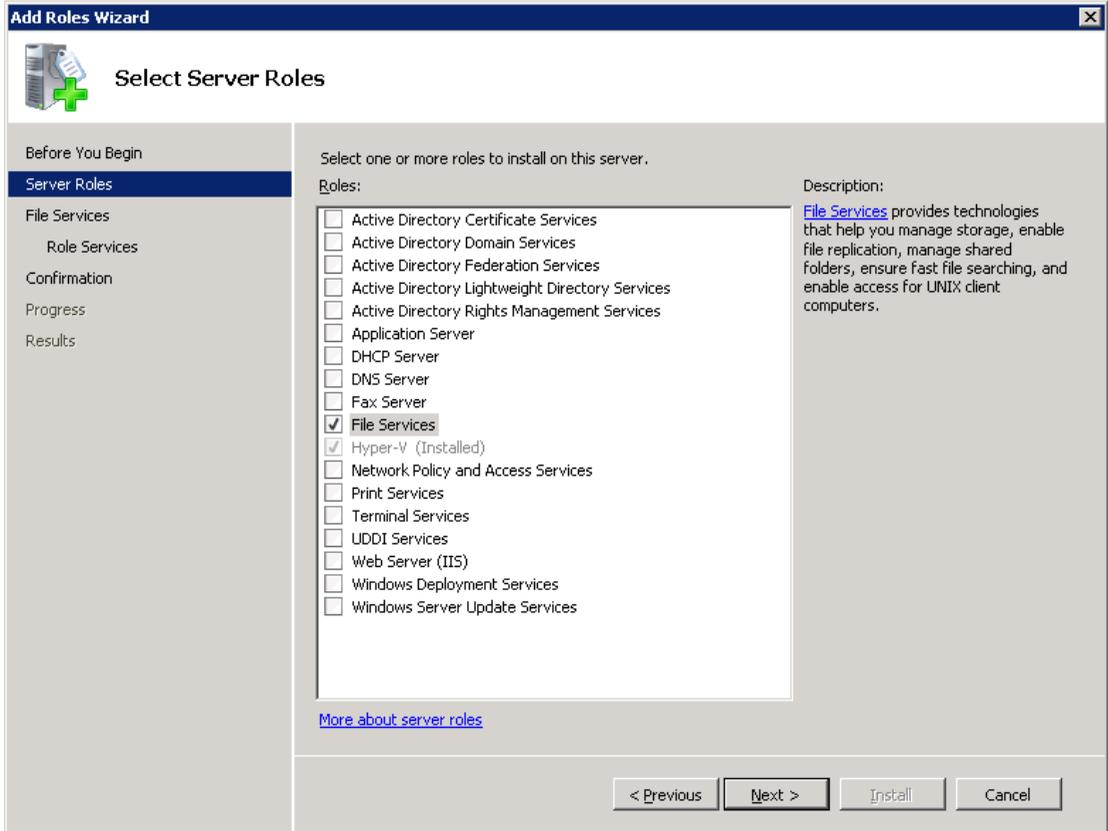
5 Click **Next**.

6 On the **Files Services** page, click **Next**.

7 On the **Select Role Services** page, uncheck **File Server**.

8 Check **Services for Network File System**.

9 Click **Next** and complete the wizard.

10 For each host in your configuration, do one of the following.

- If you have a single host that functions as both the media server and the restore host, you can disable the Server for NFS.

- For a host that is only the NetBackup media server, you can disable the Server for NFS and the Client for NFS.

Note: Make sure that the portmap service is started and that its startup mode is set to auto.

See "About configuring services for NFS on Windows 2008 and 2008 R2 (NetBackup for VMware)" on page 267.

■ For a host that is only a restore host, you can disable the Server for NFS.

Disabling the Server for NFS (NetBackup for VMware)

To disable the Server for NFS

1 Open the Server Manager.

2 In the left pane, expand **Configuration**.

3 Click **Services**.
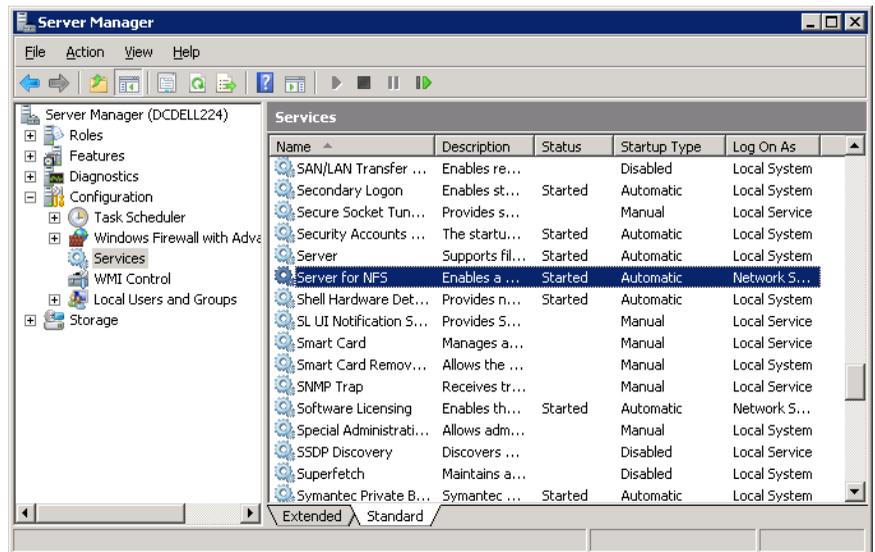
4 In the right pane, right-click on **Server for NFS** and click **Stop**.

5 In the right pane, right-click on **Server for NFS** and click **Properties**.

6   From the **Startup type** list in the **Server for NFS Properties** dialog box, click
     Disabled.
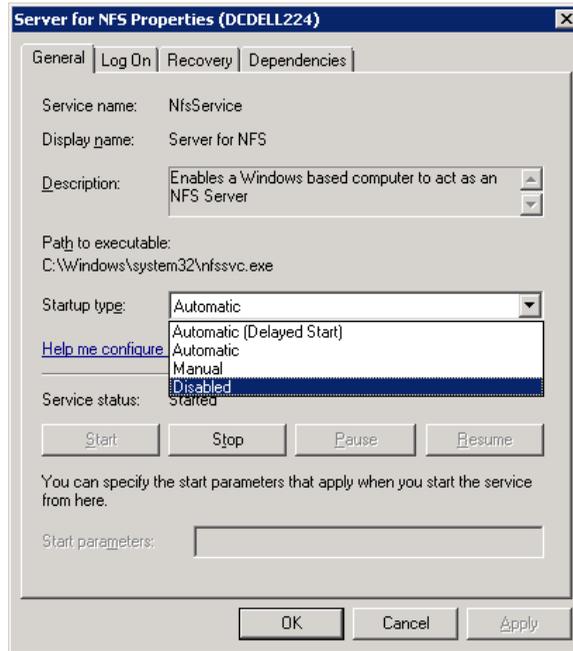
7   Click **OK**.

8   Do this procedure for each media server and for the restore host.

Disabling the Client for NFS on the media server (NetBackup for VMware)

After you enable Services for Network File System (NFS) on a host that is only a
NetBackup media server, disable the Client for NFS.

To disable the Client for NFS on the NetBackup media server

1   Open the Server Manager.

2   In the left pane, expand **Configuration**.

3   Click **Services**.

4   In the right pane, right-click on **Client for NFS** and click **Stop**.

5   In the right pane, right-click on **Client for NFS** and click **Properties**.

Configuring services for NFS on Windows | 275
About configuring Services for Network File System (NFS) on the Windows 2003 R2 SP2 NetBackup media server and
NetBackup clients (NetBackup for VMware)
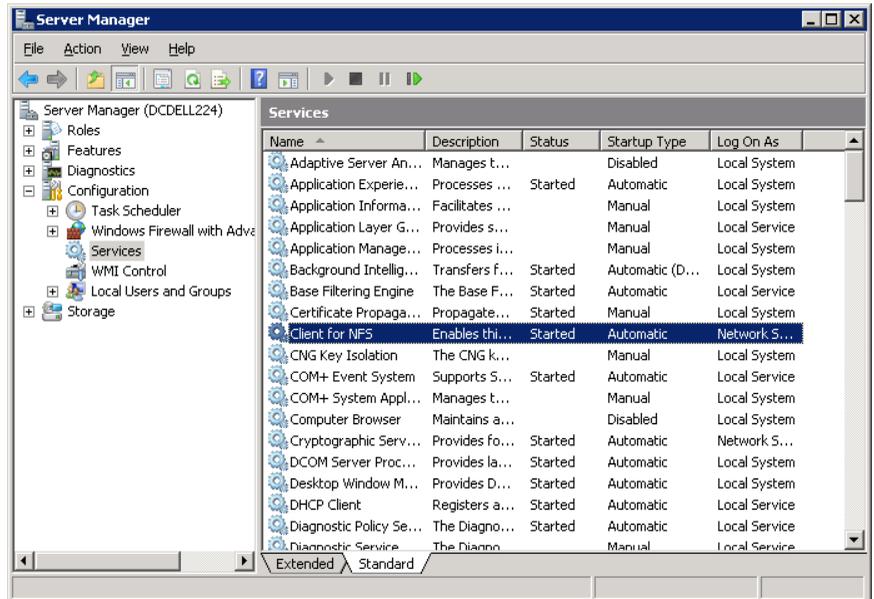
6 From the **Startup type** list in the **Client for NFS Properties** dialog box, click **Disabled**.
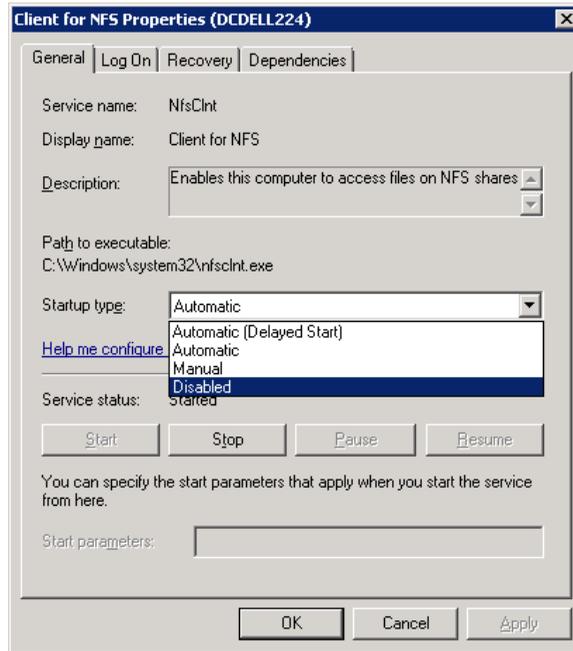
7 Click **OK**.

About configuring Services for Network File System (NFS) on the Windows 2003 R2 SP2 NetBackup media server and NetBackup clients (NetBackup for VMware)

Note: NetBackup does not support Granular Recovery Technology (GRT) with Windows Server 2003 R1 or earlier versions.

Configuring services for NFS on Windows | 276
About configuring Services for Network File System (NFS) on the Windows 2003 R2 SP2 NetBackup media server and
NetBackup clients (NetBackup for VMware)

Table B-3   Configuring NFS in a Windows 2003 R2 SP2 environment

Action	Description
Install the necessary NFS components on the NetBackup media server.	On the media server do the following: ■ Stop and disable the ONC/RPC Portmapper service. ■ Install the following NFS components: ■ The RPC External Data Representation ■ RPC Port Mapper ■ If the media server is also the restore host, install the following components: ■ Client for NFS ■ Microsoft Services for NFS Administration ■ Configure the portmap service to start automatically at server restart. Issue the following from the command prompt: `sc config portmap start= auto` This command should return the status `[SC] ChangeServiceConfig SUCCESS`. See Table B-4 on page 277. See "Installing Services for NFS on the Windows 2003 R2 SP2 media server (NetBackup for VMware)" on page 277.
Configure the Client for NFS service on the media server.	Depending on configuration of the host, verify that Client for NFS is configured correctly: ■ For a single host that is both the media server and the restore host, ensure Client for NFS is running. ■ For a host that is only a NetBackup media server, Client for NFS can be stopped and disabled.
Install the necessary NFS components on the restore host.	■ On the restore host, install the following NFS components: ■ The RPC External Data Representation ■ RPC Port Mapper ■ Client for NFS ■ Microsoft Services for NFS Administration ■ After the installation completes, ensure that the Client for NFS service is running. See Table B-4 on page 277. See "Installing Services for NFS on the Windows 2003 R2 SP2 media server (NetBackup for VMware)" on page 277. See "Installing Services for NFS on the restore host on Windows 2003 R2 SP2 (NetBackup for VMware)" on page 279.
Install the hot fix for Client for NFS on the restore host.	Hot fix http://support.microsoft.com/kb/955012 applies to 2008 and to 2003 R2. The hot fix is available at the following location: http://support.microsoft.com/kb/947186

Configuring services for NFS on Windows | 277

About configuring Services for Network File System (NFS) on the Windows 2003 R2 SP2 NetBackup media server and
NetBackup clients (NetBackup for VMware)

Table B-4   NFS components required for Windows 2003 R2 SP2

NFS component	Restore host	NetBackup media server
Client for NFS	X	
Microsoft Services for NFS Administration	X	
RPC External Data Representation	X	X
RPC Port Mapper		X

Installing Services for NFS on the Windows 2003 R2 SP2 media server (NetBackup for VMware)

To install Services for NFS on the Windows 2003 R2 SP2 media server

1   Click **Start** > **Control Panel** > **Add or Remove Programs**.

2   Click **Add/Remove Windows Components**.

3   Check **Other Network File and Print Services** and click **Details**.

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About configuring Services for Network File System (NFS) on the Windows 2003 R2 SP2 NetBackup media server and
NetBackup clients (NetBackup for VMware)
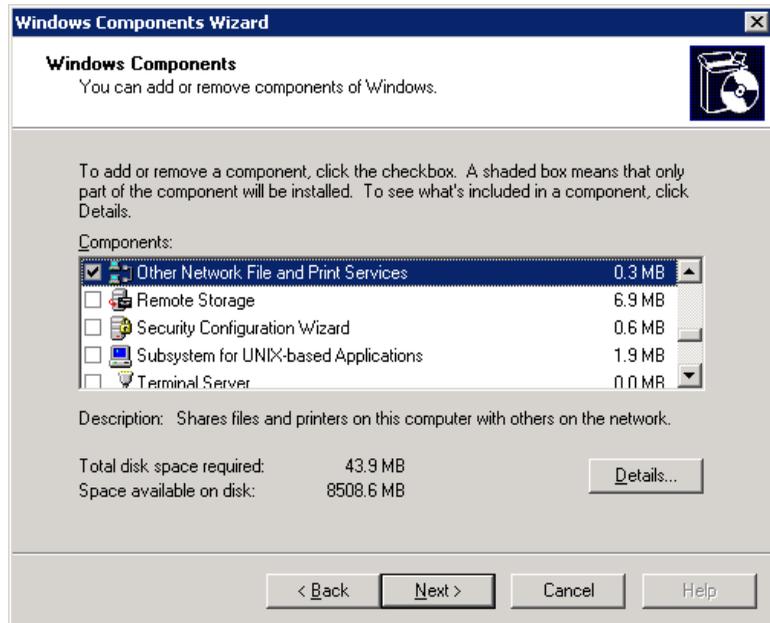
4   Check **Microsoft Service for NFS** and click **Details**.
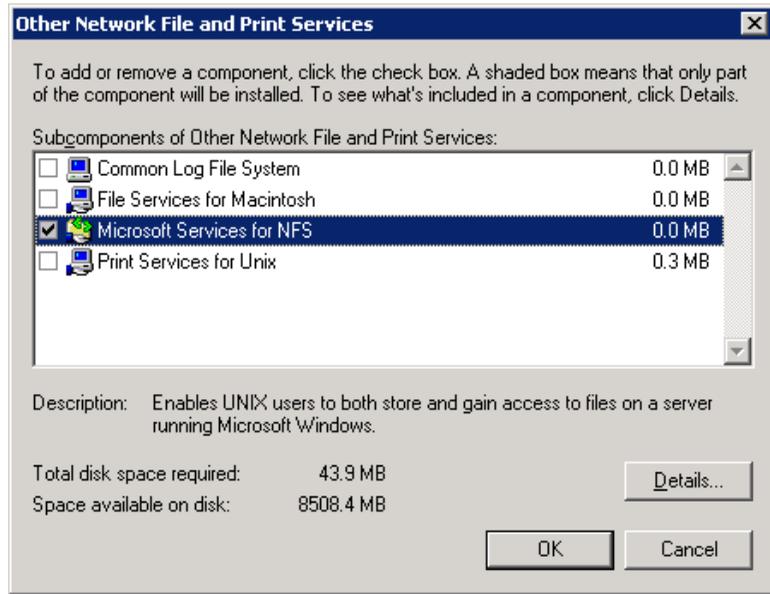
5   Install the components that apply to your configuration.

- If the host is only a NetBackup media server, check the following components:

    - RPC External Data Representation

    - RPC Port Mapper

- If you have a single host that functions as both the media server and the restore host, check the following components:

    - Client for NFS

    - Microsoft Services for NFS Administration

    - RPC External Data Representation

    - RPC Port Mapper

Media server and client

Media server only
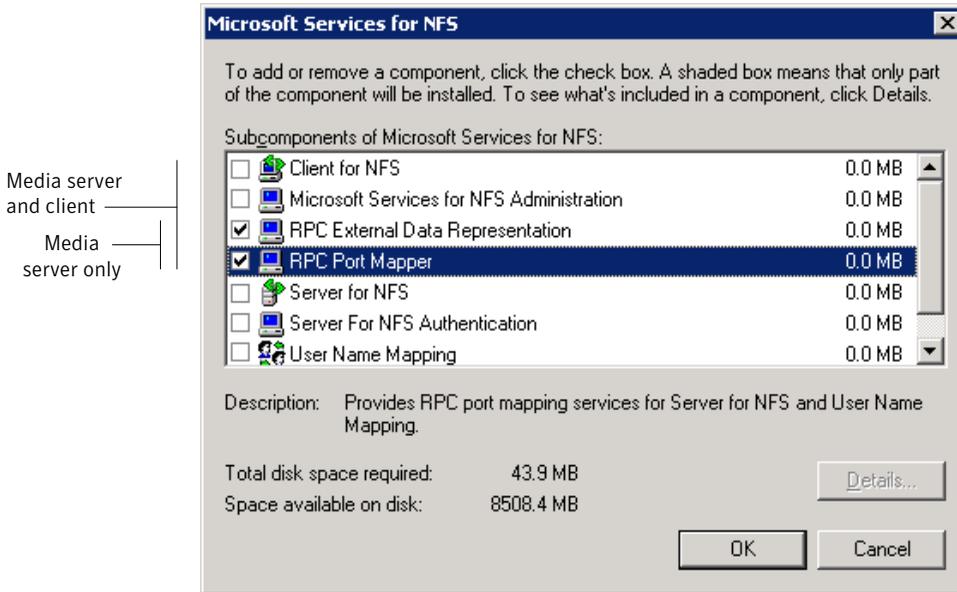
6   Click **OK**.

7   Click **OK**.

8   Click **Next** and complete the Windows Components Wizard.

9   After the installation is complete, open Services in the Control Panel.

10   Depending on configuration of the host, verify that Client for NFS is running or is stopped and disabled:

   ■   For a host that has both the media server and the restore host, ensure Client for NFS is running.

   ■   For a host that is only a NetBackup media server, Client for NFS can be stopped and disabled.

Installing Services for NFS on the restore host on Windows 2003 R2 SP2 (NetBackup for VMware)

This topic describes how to install NFS on a restore host that is on Windows 2003 R2 SP2. Only a standalone restore host requires NFS. If the restore host is also a media server, you must follow a different procedure.

Configuring services for NFS on Windows | 280
**About configuring Services for Network File System (NFS) on the Windows 2003 R2 SP2 NetBackup media server and
NetBackup clients (NetBackup for VMware)**

To install Services for NFS on the restore host on Windows 2003 R2 SP2

1   Click **Start** > **Control Panel** > **Add or Remove Programs**.

2   Click **Add/Remove Windows Components**.

3   Check **Other Network File and Print Services** and click **Details**.

Configuring services for NFS on Windows | 281
**About configuring Services for Network File System (NFS) on the Windows 2003 R2 SP2 NetBackup media server and
NetBackup clients (NetBackup for VMware)**
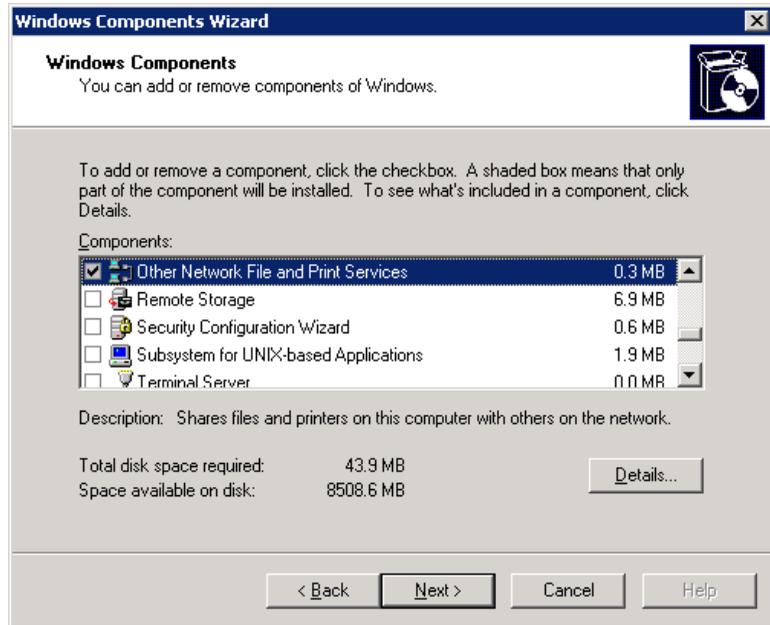
4 Check **Microsoft Service for NFS** and click **Details**.
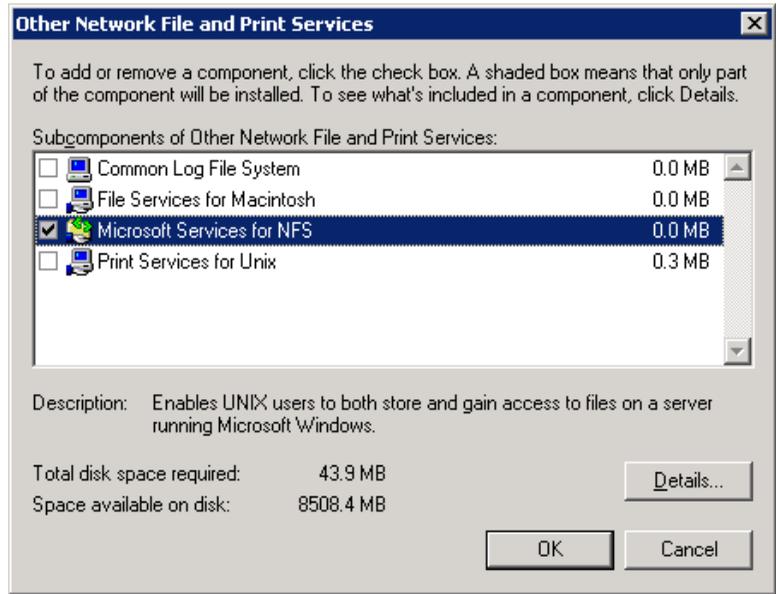
5 Check the following components:

- Client for NFS

- Microsoft Services for NFS Administration

- RPC External Data Representation
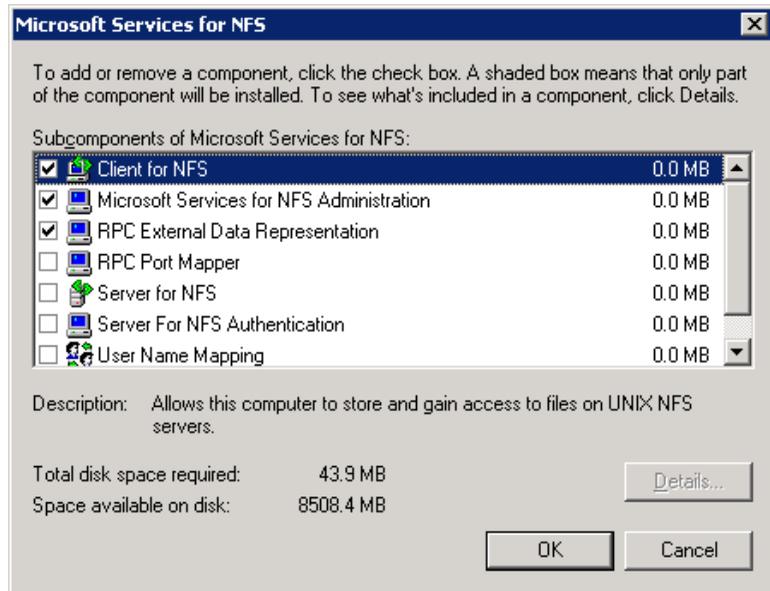
6   Click **OK**.

7   Click **OK**.

8   Click **Next** and complete the Windows Components Wizard.

9   After the installation is complete, open Services in the Control Panel.

10 Ensure that the Client for NFS service is running.

Configuring a UNIX media server and Windows backup or restore host for Granular Recovery Technology (NetBackup for VMware)

For backups and restores that use Granular Recovery Technology (GRT), perform the following configuration if you use a UNIX media server and Windows restore host

■   Confirm that your media server is installed on a platform that supports granular recovery. See the following compatibility list:
    NetBackup 7.x Operating System.
    No other configuration is required for the UNIX media server.

■   Enable or install NFS on the restore host.

■ You can configure a different network port for NBFSD.

Configuring a different network port for NBFSD (NetBackup for VMware)

NBFSD runs on port 7394. If another service uses the standard NBFSD port in your organization, you can configure the service on another port. The following procedures describe how to configure a NetBackup server to use a network port other than the default.

To configure a different network port for NBFSD (Windows server)

1 Log on as administrator on the computer where NetBackup server is installed.

2 Open Regedit.

3 Open the following key.:

```
HKEY_LOCAL_MACHINE\SOFTWARE\VERITAS\NetBackup\CurrentVersion\Config
```

4 Create a new DWORD value named **FSE_PORT**.

5 Right-click on the new value and click **Modify**.

6 In the **Value data** box, provide a port number between 1 and 65535.

7 Click **OK**.

To configure a different network port for NBFSD (UNIX server)

1 Log on as root on the computer where NetBackup server is installed.

2 Open the bp.conf file.

3 Add the following entry, where *XXXX* is an integer and is a port number between 1 and 65535.

    FSE_PORT = *XXXX*

The Reuse VM selection query results option

This appendix includes the following topics:

- About the Reuse VM selection query results option

- The performance of virtual machine discovery is improved in 7.6

About the Reuse VM selection query results option

The NetBackup Test Query screen lists the virtual machines that NetBackup discovered in your virtual environment. Because the automatic selection feature is dynamic, later changes in the environment may affect which virtual machines match the query rules. For example: if virtual machines are added later, the current test results may not be identical to the virtual machines that are selected when the backup runs.

During the period you specify on **Reuse VM selection query results for**, NetBackup reuses the current list of virtual machines as the backup list. It does not consult the query builder or rediscover virtual machines.

The less often your virtual machine environment undergoes changes, the more advantageous it may be to reuse the list of virtual machines for backups. In large environments, discovery of virtual machines takes time and consumes resources on the vCenter server.

Note the following about the Reuse VM selection query results option:

- Determines how long the query results are reused (that is, how often the list of discovered virtual machines is refreshed).

- Controls how often NetBackup performs discovery on the vCenter server.

For the environments that contain many virtual machines, the discovery process may increase the load on the vCenter server.

- Has no effect on the NetBackup policy execution schedule.

- Is invalidated if the query rules are changed or if the policy attributes that affect discovery are changed. In that case, NetBackup rediscovers virtual machines the next time the policy runs.
  The following topic describes the policy attributes that affect discovery:
  See "Effect of Primary VM identifier parameter on Selection column in Test Query results" on page 114.

For example: assume that the **Reuse VM selection query results for** option is set to eight hours and your query selects turned on virtual machines. If additional virtual machines are turned on during the eight hour period, they are not added to the policy's backup list. The policy backs up the virtual machines that were last added to the list (such as when the policy was created). After eight hours, at the next execution of the policy, the recently turned on virtual machines are discovered and added to the backup list.

If the next backup occurs before the Reuse period expires, and a virtual machine was renamed during the Reuse period, NetBackup backs up the renamed virtual machine under its original name. Because the reuse period has not expired, NetBackup does not rediscover virtual machines and therefore cannot identify the virtual machine by its new name. (NetBackup identifies the virtual machine by its instance UUID.) To have backed up the virtual machine with its new name, the Reuse period should have been set to a shorter interval.

Note: The virtual machines that have been selected for backup are not displayed on the policy **Clients** tab. To see which virtual machines NetBackup has selected and backed up, refer to the following topics.

See "Using the Activity Monitor to monitor virtual machine backups" on page 124.

See "Using OpsCenter to report on virtual machine backups" on page 129.

The performance of virtual machine discovery is improved in 7.6

In NetBackup 7.6, the effect of virtual machine discovery on vCenter is significantly reduced. In all but the largest environments, it may be advantageous to set the **Reuse VM selection query results for** option so that discovery occurs more often.

If changes occur to virtual machine configuration (such as adding, deleting, or moving vmdk files), it may be necessary to set **Reuse VM selection query results for** to 0. With a setting of 0, NetBackup rediscovers the virtual machines and their

configuration each time the policy runs. Note: If the vmdk files are reconfigured and the next backup runs without rediscovery, NetBackup is not aware of the vmdk changes. It attempts to back up the virtual machines in their previous configuration. The result may be an incorrect backup.

Backup of VMware raw devices (RDM)

This appendix includes the following topics:

- About VMware raw device mapping (RDM)

- Configurations for backing up RDMs

- About alternate client backup of RDMs

- Requirements for alternate client backup of RDMs

- Configuring alternate client backup of RDMs

About VMware raw device mapping (RDM)

VMware raw device mapping mode (RDM) allows a virtual machine to directly access physical disks. With raw device mapping, a VMware virtual machine can use large storage devices such as disk arrays. Access to the data on an RDM disk is faster than to a fully virtualized disk (vmdk file). An RDM disk can be locally attached to the ESX server or configured on a Fibre Channel SAN.

NetBackup supports the disk arrays that are configured on a virtual machine as RDMs.

Note: NetBackup cannot back up the RDM by means of a VMware backup host.

For notes and restrictions on NetBackup support for VMware RDM, see the following Symantec tech note:

Support for NetBackup 7.x in virtual environments

http://www.symantec.com/docs/TECH127089

Configurations for backing up RDMs

You can use either of the following NetBackup configurations to back up disk arrays as RDMs:

- Without Snapshot Client: Install a NetBackup client on the virtual machine. You can configure NetBackup to back up the virtual machine and any RDMs as if the client was installed on a physical host. Without Snapshot Client software on the virtual machine, the features of Snapshot Client are not available. (This configuration is not discussed in this NetBackup for VMware guide.)

- With Snapshot Client: Install a NetBackup client and Snapshot Client software on the virtual machine. Configure an alternate client backup.

About alternate client backup of RDMs

Alternate client backup of an RDM consists of the following:

- The RDM disk array contains the data to be backed up. Another host containing NetBackup client software and Snapshot Client software must have access to the disk array. This host is the alternate client. In this configuration, the virtual machine is called the primary client.

- A snapshot of the data is created on the disk array and is mounted on the alternate client. The alternate client creates a backup image from the snapshot, using original path names, and streams the image to the NetBackup media server.

- The alternate client handles the backup I/O processing; the backup has little or no effect on the virtual machine. The media server reads the snapshot data from the alternate client and writes the data to storage.

- The virtual machine and alternate client must be running the same operating system, volume manager, and file system. For each of these I/O system components, the alternate client must be at the same level as the primary client, or higher level.
  For complete requirements on alternate client backup, refer to the Policy configuration chapter of the *NetBackup Snapshot Client Administrator's Guide*.

Requirements for alternate client backup of RDMs

To use NetBackup Snapshot Client to back up an RDM, note the following:

- RDM devices must be configured in physical compatibility mode. You select this mode when you create the RDM. Physical compatibility mode is not configured in NetBackup.

  For an introduction to RDM, refer to your VMware documentation. For example, see the following VMware document:

  ESX Server 3 Configuration Guide

- NetBackup may require certain OS and array configuration, depending on the guest OS and the array. For details, see the disk arrays chapter of the *NetBackup Snapshot Client Administrator's Guide*.

- NetBackup client software must be installed on the virtual machine.

- The requirements for the NetBackup for VMware feature (a backup host and the VMware snapshot method) do not apply to backups of RDM disk arrays. To back up RDM disk arrays, you must configure a Snapshot Client alternate client backup.

Configuring alternate client backup of RDMs

This procedure highlights key points in creating a NetBackup alternate client backup of a disk array that is configured as an RDM. For broader details on disk array configuration, refer to the *NetBackup Snapshot Client Administrator's Guide*.

To create an alternate client policy for a disk array that is configured as an RDM

1   Select a policy type that is appropriate for the OS of the virtual machine and for the type of data to back up.

   Refer to the Policy configuration chapter of the *NetBackup Snapshot Client Administrator's Guide*.

2   On the policy **Attributes** tab in the Administration Console, click **Perform snapshot backups** and **Perform off-host backup**.

   The following is a detail from the **Attributes** tab.

3   Select **Alternate Client** from the **Use** pull-down. Do not select **VMware backup host**.

   In the **Machine** field, enter the name of the host that is configured as an off-host backup computer (the alternate client).

4   Click **Options**.

5   Select a snapshot method.

   The VMware method does not apply to alternate client backup and is not available in the list.

   Select a snapshot method that is appropriate for the volume or array. For example:

   - The HP_EVA_Snapclone method or other EVA method for an HP EVA array.

   - The EMC_CLARiiON_Snapview_Clone or other CLARiiON method for an EMC CLARiiON array.

- FlashSnap.

  For FlashSnap, the following must be installed: VxVM 3.2 or later for UNIX, VxVM 4.0 or later for Linux and AIX, or VxVM 3.1 or later for Windows. Also, volumes must be configured over the primary host's disks. The VxVM FlashSnap license must also be installed.

- VSS (for Windows guest operating systems only).

The array may require additional OS and NetBackup configuration as described in the disk arrays chapter of the *NetBackup Snapshot Client Administrator's Guide*. The same guide contains more details on snapshot methods.

6   If required by an array snapshot method that you selected in the previous step, specify the **Snapshot Resources**.

7   In the policy's **Clients** list, select the virtual machine on which the array is configured as an RDM.

8   In the policy's **Backup Selections** tab, specify the disk that you want to back up, or the files or volumes that reside on the disk.

SYMCquiesce utility for Linux virtual machines

This appendix includes the following topics:

- About the SYMCquiesce utility

- Requirements for the SYMCquiesce utility

- Installing the SYMCquiesce utility

- Configuration options for the SYMCquiesce utility

- SYMCquiesce logging and troubleshooting

About the SYMCquiesce utility

The SYMCquiesce utility allows NetBackup to quiesce the Linux file system. Without this utility, NetBackup cannot guarantee that all required data has been flushed to disk when the snapshot occurs. Any data that has not been flushed to disk (still in memory) is not included in a snapshot. In that case, the data that is captured in the snapshot is incomplete.

The SYMCquiesce utility quiesces the Linux file system, to guarantee that all data has been flushed from memory to disk. Quiescing the file system allows any pending data changes to finish before the snapshot occurs. The data in the snapshot is complete.

The latest information on supported platforms and file systems is available in a separate document, *Support for NetBackup 7.x in virtual environments*:

http://www.symantec.com/docs/TECH127089

Note: The SYMCquiesce utility is not required for Windows virtual machines.

Requirements for the SYMCquiesce utility

Note the following requirements for the SYMCquiesce utility:

- The SYMCquiesce utility supports the following Linux operating systems:
  - Red Hat Enterprise Linux version 5.4 and later.
  - SUSE Linux Enterprise Server 11 Update 1 and later.
- The SYMCquiesce utility supports the ext3 and ext4 file systems and the LVM2 volume manager.
- VMware Tools must be installed in the virtual machine.
- The VMware Tools services must be running during the backup.
- The NetBackup **Virtual machine quiesce** parameter must be enabled.
  This option is in the NetBackup policy, Snapshot Client Options dialog, under Configuration parameters.
- The SYMCquiesce utility must be installed in the virtual machine.

Installing the SYMCquiesce utility

To install SYMCquiesce in Linux virtual machines

1. Make sure that VMware Tools are installed and that the VMware Tools services are running in the virtual machine.

   On the virtual machine, run the ps command as follows:

   ```
   ps -e | grep vmtoolsd
   ```

   If VMware Tools are running, the command returns something similar to the following:

   ```
   3068 ? 00:00:00 vmtoolsd
   ```

   For assistance with installation of VMware Tools, refer to your VMware documentation.

2. Copy the SYMCquiesce ISO image into the virtual machine's ESX datastore.

   On the installed NetBackup packages for Windows (master server and client), the ISO image is located in the following folder:

   ```
   \NetBackup\bin\goodies\vmware-quiesce
   ```

3 Attach the SYMCquiesce ISO as a CD-ROM device on the virtual machine.

   The guest OS should mount the CD-ROM automatically.

4 From the mounted CD-ROM, install the SYMCquiesce rpm version that is
   appropriate for the virtual machine platform.

   The SYMCquiesce utility is installed in /opt/SYMCquiesce/.

5 In the NetBackup policy for the virtual machine, make sure that the **Virtual
   machine quiesce** parameter is enabled.

   VMware must be selected as the policy type. Then, on the policy **VMware** tab,
   click **Advanced**.

   If the **Virtual machine quiesce** parameter is not enabled, NetBackup cannot
   quiesce the file system before the snapshot occurs. As a result, the data that
   is captured in the snapshot may not be complete.

   See "VMware - Advanced Attributes dialog" on page 62.

See "Configuring a VMware policy from the Policies utility" on page 52.

Configuration options for the SYMCquiesce utility

The SYMCquiesce utility includes a configuration file (/opt/SYMCquiesce/config)
that contains the following options. By default, the options are commented out with
a # character at the start of the line.

Table E-1   SYMCquiesce configuration options

Configuration option	Description
fail_snapshot_on_failure=true/false	By default, this option is disabled. The snapshot does not fail even if quiescence fails on a volume in the virtual machine. Enable this option to cause the snapshot job and the backup job to fail if quiescence fails.
timeout=*timeout value in seconds*	By default, this option is disabled. The SYMCquiesce utility freezes the virtual machine volumes for three seconds during the snapshot. Enable this option to change the timeout period. You may need to change this timeout if the virtual machine snapshot on the ESX server does not complete within the 3-second window.

For example:

```
#fail_snapshot_on_failure=true
timeout=20
```

In this example, the `fail_snapshot_on_failure` option is commented out (disabled), and the timeout is set to 20 seconds.

SYMCquiesce logging and troubleshooting

SYMCquiesce logs indicate whether quiescence of the Linux virtual machine volumes was successful. SYMCquiesce logs are written to `/opt/SYMCquiesce/logs`. Logging is enabled by default (no configuration step is required) and cannot be disabled.

Log file names are of the form `mmddyy.log`. When a backup runs, a new log is created if one does not already exist for that date. A backup that runs on the 22nd of October 2010 creates a log named `102210.log`.

An example from a SYMCquiesce log:

```
Stats - Thu Oct 28 18:51:58 2010

Freeze of volume [/] returned status [0]
Thaw of volume [/] returned status [0]
Freeze of volume [/boot] returned status [0]
Thaw of volume [/boot] returned status [0]
```

Where:

`Stats` : shows the time of the log entry when volumes where being quiesced.

`status [0]`: no error. The freeze (or thaw) completed successfully.

`status [-1]`: error. The freeze operation or the thaw operation did not complete successfully.

If the freeze (and the thaw) completed successfully, the volume was successfully quiesced.

Note the following:

- You can use the logs with the `fail_snapshot_on_failure` option in /opt/SYMCquiesce/config file. If that option is enabled and snapshots fail, consult the SYMCquiesce logs to see which volume's quiescence fails.

- If the virtual machine has both ext2 and ext3 volumes (or ext2 and ext4), and the `fail_snapshot_on_failure` option is enabled, the snapshot fails. ext2 file systems do not support quiescence. You must disable the `fail_snapshot_on_failure` option to get a successful snapshot of the volumes. Note however that the ext2 volume cannot be quiesced. As a result, any data changes to that volume that had not been flushed to disk before the snapshot are not included in the snapshot.
  See "About the NetBackup.lost+found directory on Linux" on page 164.

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