

HP StoreOnce Backup System and Quest vRanger Implementation Guide for VMware Protection

Technical white paper

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Executive summary

HP StoreOnce Backup Systems and Quest Software's vRanger deliver an efficient, high performance, and robust solution for backing up and recovering VMware environments. vRanger provides simple management and powerful protection management features. StoreOnce Backup Systems provide a high-performance deduplicating disk backup target. This document describes how to implement an end-to-end backup and recovery solution for VMware environments.

A summary of the best-practice recommendations is:

- Configure a single Common Internet File System (CIFS) Network Attached Storage (NAS) Share on the StoreOnce Backup System for the vRanger Repository
- Consolidate the backup of multiple virtual machines into a single vRanger backup job and use its Resource Manager to control the number of concurrent backups per Datastore, VMware Host, and Repository
- Turn off vRanger Repository compression and encryption to improve the deduplication on the StoreOnce Backup System
- Use vRanger to enable VMware's Change Block Tracking on the virtual machines for fastest possible backups
- Enable vRanger's Active Block Mapping to reduce the size of the backups sent to the StoreOnce Backup System
- Run vRanger in a virtual machine for small to medium-sized VMware installations where costs must be minimized
- Run vRanger on a dedicated physical machine for larger environments to improve backup performance
- Use the [HP Sizing Tool](#) to size the StoreOnce Backup System component of the solution
- Ensure the hardware component firmware and software in the StoreOnce Backup System are fully up-to-date; Check at: <http://www.hp.com/support>
- Remember the backup is to deduplicating disk, not general-purpose disk, so configure time for the StoreOnce Backup System Housekeeping process to run every day
- vRanger backups can be integrated with backup applications that support tape if the backup data needs copying/migrating from the StoreOnce Backup System to tape
- Understand the settings that can be tuned to configure the best performing protection solution and test the configuration in a non-production environment before implementation

HP StoreOnce Backup Systems

The StoreOnce Backup Systems are a family of disk-based backup targets (Figure 1). They offer inline data deduplication for cost-effective, consolidated backups, and fast restore of data. For disaster recovery, the StoreOnce Backup System enables better bandwidth replication to create a copy at a remote location.

The StoreOnce Backup System can present CIFS, Network File System (NFS), and Virtual Tape (VT) interfaces for integration with backup applications. Connectivity is over Ethernet (CIFS, NFS, and iSCSI VT) and Fibre Channel (VT). For integration with Quest vRanger, the CIFS or NFS interfaces are supported. vRanger does not support VT and therefore not backup over Fibre Channel. The appliances offer usable physical capacities from 1.5 TB to 72 TB. The effective capacity is the usable capacity multiplied by the achieved deduplication ratio.

The deduplication ratio is dependent upon multiple factors including the data types being protected, the backup mode (full, incremental, differential, and variations on these), backup data retention times and the change rate of the data. VMware images generally deduplicate at a higher ratio than databases or file-system stored data. Other general principles are:

- Data with a high change rate will typically have a lower deduplication ratio than slower changing data.
- Daily full backups will give a higher deduplication ratio than incremental and differential backups
- Longer backup data retention times typically increase the deduplication ratio

Figure 1: The HP StoreOnce Backup System with usable capacity and backup speeds before the effects of deduplication



As an indication, vRanger daily full backups of virtual machines could have a deduplication ratio of up to 50:1, whereas daily incremental backups could get around 10:1. This is indicative only, and the strong recommendation is to run a proof of concept when evaluating deduplication ratios to size the protection solution.

For reliability and ease of management the StoreOnce Backup System are built on HP ProLiant machines and HP disk systems. The unique HP StoreOnce software is optimized to this platform. It is important to ensure the firmware and software in the StoreOnce Backup Systems is fully up-to-date. Check at: <http://www.hp.com/support>.

HP StoreOnce deduplication technology

HP StoreOnce is an inline data deduplication technology. It analyzes the backup data streams as they are written to the appliance and segments the data streams into chunks. For efficient deduplication, the StoreOnce Backup System segments the streams into variable sized chunks with an average size of around 4 KB. A hashing algorithm generates an identifier (hash value) for each chunk that is stored in an index. When an incoming chunk generates a hash value that already exists in the index, the duplicate chunk is not stored again. Instead a much smaller reference to the duplicate chunk is stored. When a recovery is run, the required data is reassembled from the unique chunks and referenced duplicate chunks.

Each HP StoreOnce Share has a Deduplication Store. This store is the deduplication domain. Deduplication does not occur across Deduplication Stores. If a single Share is configured on the HP StoreOnce appliance, the deduplication domain will be the entire appliance. The optimum number of Shares to configure depends upon how the backup application will use the StoreOnce Backup System. It is recommended to configure a single Share for vRanger to use for its Repository. If the data to be protected can be classified into like data types it may be beneficial to use separate Shares/Repositories for each data type. Smaller Shares complete their Housekeeping tasks faster and are likely to retain good performance over time.

The deduplication is one factor that will determine the capacity of the StoreOnce Backup System that is required. It is recommended to use the [HP Sizing Tool](#) to help determine which appliance is required for a given environment.

HP StoreOnce replication technology

Replication enables a copy of the backup data to be created at a second location. This remote copy is most commonly used for disaster recovery (DR) and copy to tape. The replication is bandwidth optimized by the deduplication technology. After the initial replication, only new backup data is replicated to the target site. This can result in bandwidth savings, in line with the deduplication ratio achieved. For a 20:1 deduplication ratio this equates to approximately a 95 percent bandwidth saving compared to having to replicate the full contents of the backup. There is some overhead of control data but typically less than two percent of the total replicated backup size.

If the network between the source and target StoreOnce Backup System is used for other traffic, the replication usage can be throttled by using bandwidth limits as a percentage of the link bandwidth so as not to affect the performance of other applications transferring data over the same network. To prevent StoreOnce Backup System replication at busy times, replication windows can also be configured. Another way to optimize the use of the network is to limit the maximum number of concurrent replication jobs supported by source and target StoreOnce Backup System.

Replication can be configured between any StoreOnce Backup Systems. A single appliance can house Shares that are replication sources and Shares that are replication targets. The fan-in replication of multiple source appliances to a single target appliance is supported, as shown in Figure 7.

Once configured, replication starts when the backup file is written to the Share. If a backup spans multiple files on the Share, replication will start on the first file as soon as the backup job spans to the second file.

Quest vRanger Data Protection Software

vRanger offers comprehensive data protection for VMware environments, delivering fast and reliable backup, recovery, and replication. vRanger captures the entire image of a virtual machine and enables restore at the image, file, or application level.¹ All backup jobs are executed while the source machine is running which means the backup job causes no service interruption.

An intelligent resource manager improve backup speed by leveraging all available ESX and ESXi hosts and controlling the number of simultaneous jobs using any given resource. To optimize use of disk storage and make multiple recovery points (Savepoints) economic, vRanger supports several space savings mechanisms including—VMware Change Block Tracking (CBT), incremental backup, differential backup, compression, and Active Block Mapping (ABM). These space-saving technologies reduce the size of the backups sent to the StoreOnce Backup System which further reduces the physical size of the backup with its inline deduplication and compression. The vRanger space reduction technologies and appliance deduplication and compression are configured to give the optimum end-to-end data compaction.

For scalability, vRanger allows you to connect to multiple vCenter servers to easily protect larger or distributed environments while consolidating backup data onto the StoreOnce Backup System.

Architecture and backup modes

Three backup architectures are supported to meet different requirements and environment sizes. For more detailed information about them, please read [the vRanger Deployment Guide](#) referenced at the end of this document.

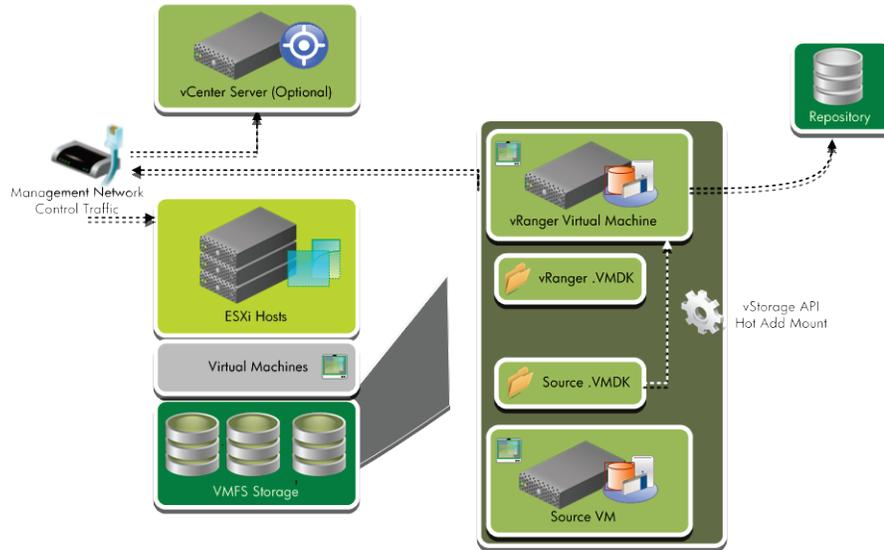
Hot Add

This is an excellent solution for smaller environments using ESXi servers. Hot Add works when vRanger is installed in the virtual machine. It is the least costly way of implementing data protection since it requires no additional hardware other than the StoreOnce Backup System.

vRanger uses Hot Add to mount the source disk directly to its own virtual machine, allowing direct access to the data through VMware's I/O stack rather than through the network.

¹ When using Quest Recovery Manager.

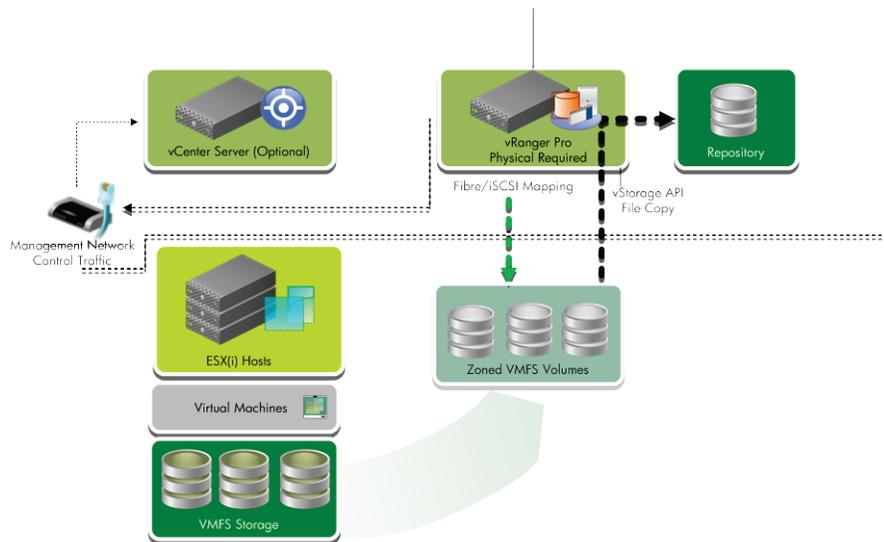
Figure 2: vRanger Hot Add backup mode



Physical proxy

This configuration is for larger environments, and delivers the highest performance for ESX and ESXi servers. This architecture runs vRanger on a dedicated physical machine connected to the VMware shared storage. A performance advantage of the physical proxy is that it offloads the backup processes from the VMware servers and enables a LAN-free backup. Physical servers generally have more processing power than virtual machines so are a sensible option for large VMware installations where performance must not be effected by backups.

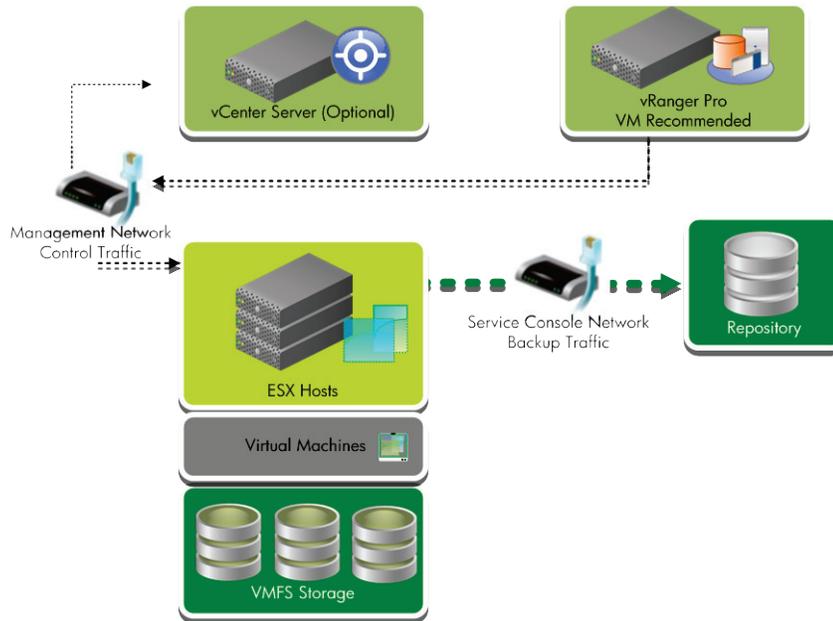
Figure 3: Physical proxy backup mode



Service Console based

This is for any size environment, but is only possible on ESX servers. vRanger can be installed inside a virtual or physical machine. vRanger requests a snapshot of the virtual machine and then initiates direct copy of the virtual machine from the ESX server console to the vRanger Repository. The backup data moves directly over the network to the StoreOnce Backup System (Direct-to-Target) without going through the vRanger server. The Direct-to-Target approach makes this architecture very scalable.

Figure 4: Service Console backup mode (Direct to Target)



Change block tracking

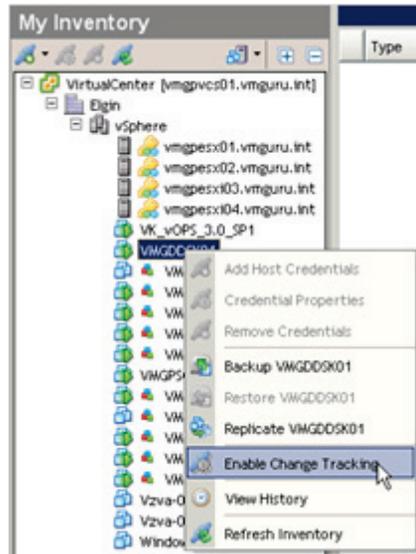
Change Block Tracking (CBT) is a VMware vSphere feature that tracks changes within the virtual machine disk (VMDK) file. With CBT enabled, vRanger can efficiently identify the blocks that have changed since the last backup. Identification of changed blocks is done by the VMware vStorage APIs for Data Protection (VADP), not by scanning the VMDK file. Enabling CBT, typically results in shorter backup operations and reduced resource consumption on network and storage elements. It is recommended to enable CBT for all virtual machines that support it.² There is a slight performance overhead associated with enabling CBT, but it is minimal compared to the benefit it provides.

To enable or disable CBT right click on any virtual machine in the “My Inventory” pane of vRanger and select “Enable Change Tracking” (or “Disable Change Tracking”), See Figure 5. Three small circles (Red-Blue-Green) indicate that CBT is enabled.

Alternatively, CBT can be enabled in the vSphere client for each virtual machine, or you can use the Quest Power GUI with the vRanger PowerPack to enable CBT for multiple virtual machines all at once.

² CBT is supported by VMware for virtual machines running on ESX 4.0, ESXi 4.0 or later hosts (with virtual hardware 7). Virtual machines that are created in ESX 3.5, ESXi 3.5, or below must be migrated to ESX 4.x or ESXi 4.x and Hardware Version 7 for CBT to be supported.

Figure 5: Enable Change Block Tracking in vRanger



Quest vRanger Active Block Mapping and HP StoreOnce Backup System Deduplication

The vRanger backup and replication engine ignores whitespace (unallocated blocks or zero-filled blocks) by default. Additionally, vRanger offers the option to enable Active Block Mapping (ABM) on a per-job basis.

ABM increase backup efficiency of Windows virtual machines by only including blocks that are actively used. ABM verifies that deleted data is not included in the backup job. This means that with ABM enabled, vRanger will only backup the part of a virtual disk that has active data on it. The benefit is smaller backups sent over the network to the StoreOnce Backup System and a shorter backup window. However, compared to backups made without ABM, the use of ABM will result in lower deduplication ratios as reported by the StoreOnce Backup System because vRanger will reduce the amount of backup data sent to the appliance. It is important to measure the end-to-end data compaction not just the deduplication ratio reported by the StoreOnce Backup System. This is covered in more depth below.

vRanger resource management

The vRanger Resource Manager (Figure 6) enables control of the number of backup and replication of tasks to run simultaneously. These controls allow fine tuning of vRanger to achieve greater throughput without impacting the performance on VMware hosts, Datastores, and Repositories (StoreOnce Backup System).

These settings can be tuned depending on the environment; the default settings are a good starting point for testing. If all backups are completed successfully with the default settings, the number of backups per Host, Datastore, Repository, and locally (on Hot Add and Proxy server modes) can be increased. The potential increase can be estimated from the reported load on the hardware.

If all backups do not complete successfully, the default settings should be decreased.

It is important not to run more concurrent backups streams than the StoreOnce Backup System is specified for. See the [Maximum concurrent vRanger backup streams per appliance](#) values in Figure 7 for configuration maximums.

Figure 6: vRanger Resource Management

Configuration Option	Value
Maximum number of tasks running on vRanger (>= 1):	100
Maximum number of tasks running off a LUN (1 - 5):	3
Maximum number of tasks running on a host (1 - 4):	1
Maximum number of tasks running per repository (>=1):	3
Maximum number of tasks running locally (1 - 20):	3

The configuration options available are:

- **Maximum number of task running on vRanger (>=1):** This value limits the total number of simultaneous tasks for the vRanger machine. This is affected by machine type and hardware as well as deployment architecture. The default value is 100, which does not normally need to be changed as other limits take effect before this value is reached.
- **Maximum number of task running off a LUN (1–5):** In order to avoid storage I/O contention issues, it is recommended to limit the number of tasks that can be processed based on their storage location. vRanger defaults to a limit of three backup tasks per LUN. Note: This assumes a 1:1 mapping between the underlying LUN and the Datastore.
- **Maximum number of tasks running on a host (1–4):** This setting should be set fairly low as all of the backup processing (for Service Console backups) occurs on the host. The default per-host limit is set to one. Due to the amount of CPU and memory used by the host to process backups, it is recommended to use caution when changing this value.
- **Maximum number of tasks running per Repository (>=1):** Bandwidth to the Repository is the main limiting factor here. For the StoreOnce Backup System on a Gigabit network the recommendation is a maximum of three concurrent backups, which can consume 75 percent of the bandwidth of the Repository. Monitor network utilization in the StoreOnce Backup System web GUI. Consider use link aggregation or 10GbE network for increased throughput.
- **Maximum number of tasks running locally (1–20):** This option applies to the Hot Add and Proxy Server modes of vRanger and limits the number of simultaneous tasks on the vRanger server. The recommended maximum is one task per CPU core for the Proxy Server mode and one to two tasks per vCPU for the Hot Add mode (start with one task per vCPU and increase if CPU allows). Also reserve 1 one core/vCPU for the operating system and vRanger. For example, a quad-core physical machine or four vCPU virtual machine is able to run three simultaneous backups. Monitor CPU utilization and increase number of CPUs if needed to be able to process more backups (see the licensing section below).

StoreOnce Backup System Maximum Values for vRanger

When configuring backup jobs to a StoreOnce Backup System, consider the following limits. This information is particularly relevant to the maximum number of tasks running per Repository setting described above.

Figure 7: Maximum and guideline values for StoreOnce Backup Systems when used with Quest vRanger

	D2D2502 G2	D2D2504 G2	D2D4106 G2	D2D4112 G2	D2D4312 G2 D2D4324 G2
Max usable capacity	1.5 TB	3.0 TB	4.5 TB	18 TB	D2D4312 36 TB D2D4324 72 TB
Max NAS Shares	4	8	16	24	50
Max fan out: per appliance /Share	2/1	2/1	4/1	4/1	8/1
Max fan in: per appliance /Share	4/1	8/1	16/1	24/1	50/1
Approx Housekeeping time per 100 GB overwritten backup data	6 minutes	6 minutes	4 minutes	4 minutes	2 minutes
Connectivity	2 x 1 GbE	2 x 1 GbE 2 x 10 GbE			
Max open files >24 MB per Share/per appliance	32/32	48/48	64/64	64/64	128/128
Max total open files per appliance	96	112	128	128	640
Max total files per Share	25,000	25,000	25,000	25,000	25,000
Maximum concurrent vRanger backup streams per appliance	4	4	6	6	12

Repositories

vRanger uses a Repository to store backup Savepoints. A best practice is to create the Repository on a StoreOnce Backup System CIFS Share. The Repository is organized using a human readable directory structure with three files for each Savepoint (see Figure 8). The format of the files for each backup job is:

Manifest data: *VMname_Date_Time_BackupType (Full/Inc/Diff).Manifest.metadata*

Config data: *VMname_Date_Time_BackupType (Full/Inc/Diff).VmConfig.metadata*

Backup file: *VMname_Date_Time_BackupType (Full/Inc/Diff)_VMname.vmdk.var*

Figure 8: The view of the vRanger Repository contents

Name	Size	Type
VMGPADC01_20110429_232728_F.Manifest.metadata	2 KB	METADATA File
VMGPADC01_20110429_232728_F.VmConfig.metadata	15 KB	METADATA File
VMGPADC01_20110429_232728_F_1_VMGPADC01_vmdk.var	4,053,093 KB	VAR File
VMGPADC01_20110430_231055_I.Manifest.metadata	2 KB	METADATA File
VMGPADC01_20110430_231055_I.VmConfig.metadata	15 KB	METADATA File
VMGPADC01_20110430_231055_I_1_VMGPADC01_vmdk.var	421,403 KB	VAR File
VMGPADC01_20110501_233256_I.Manifest.metadata	2 KB	METADATA File
VMGPADC01_20110501_233256_I.VmConfig.metadata	15 KB	METADATA File
VMGPADC01_20110501_233256_I_1_VMGPADC01_vmdk.var	205,354 KB	VAR File
VMGPADC01_20110502_231941_I.Manifest.metadata	2 KB	METADATA File
VMGPADC01_20110502_231941_I.VmConfig.metadata	15 KB	METADATA File
VMGPADC01_20110502_231941_I_2_VMGPADC01-flat_vmdk.var	217,524 KB	VAR File
VMGPADC01_20110503_232131_I.Manifest.metadata	2 KB	METADATA File
VMGPADC01_20110503_232131_I.VmConfig.metadata	15 KB	METADATA File
VMGPADC01_20110503_232131_I_2_VMGPADC01_vmdk.var	212,775 KB	VAR File
VMGPADC01_20110504_230632_I.Manifest.metadata	2 KB	METADATA File
VMGPADC01_20110504_230632_I.VmConfig.metadata	15 KB	METADATA File
VMGPADC01_20110504_230632_I_1_VMGPADC01-flat_vmdk.var	226,430 KB	VAR File

Three files associated with the backup job that make it self describing

The human readable format is helpful when restoring the Repository from a tape backup (see Figure 8).

vRanger includes an option for encrypting Repositories, which should not be used when backing up to a Repository on the StoreOnce Backup System because encrypted data cannot be efficiently deduplicated. Each Savepoint stores the manifest file associated with the backup, so that the backup can be recovered even if the vRanger database is not available.

Cataloging

vRanger (Pro edition only) has the option to collect and record file and directory information during backups, and store the information in a catalog database. The catalog can be used to enable a browse and search function that speeds and simplifies file level recovery. Files are cataloged during the backup job, which does not extend the backup window. This feature must be enabled under “Tools—Options—My Jobs—Catalog” and also in backup job options.

Replication

vRanger (Pro edition only) provides image-based replication of virtual machines across LANs and WANs. During vRanger replication, changed data blocks are sent from the source virtual machine to a target virtual machine located at the DR site. The primary considerations for replication performance are the available bandwidth and quality of connection between the two locations.

vRanger replication enables rapid continuation of operations if the source virtual machine is unavailable by switching to the replicated virtual machine. This is a cost effective method of increasing availability and is independent of underlying storage types and capabilities.

vRanger replication and StoreOnce Backup System replication are complementary. The vRanger replicas can be used to resume operations if the primary virtual machines are unavailable but they can contain any errors, corruptions, or viruses that has affected the primary virtual machine. StoreOnce Backup System replicas enable multiple recovery points and are independent of any changes, errors, corruptions, or viruses on the primary after the backup is completed.

Integration of HP StoreOnce Backup System and vRanger

An integrated vRanger and StoreOnce Backup System requires proper licensing for both products as described in the first section below. For optimum performance, there are a number of configuration options that can be tuned, as described in the subsequent sections below.

Licensing

Product licensing is always an important consideration when designing a solution. The licensing schemes for the StoreOnce Backup System and the vRanger are described below. Both products use a simple licensing structure. For prices, check online or contact your HP or Quest partner.

HP StoreOnce Backup System Licensing

The StoreOnce Backup System and any licensed capacity upgrades include all available functionality except replication. As described above, a StoreOnce Backup System can have Shares that are replication sources and Shares that are replication targets. A replication license is required for all appliances that have Shares that are targets in a replication relationship. The Replication license required depends on the model of StoreOnce Backup System (Figure 9).

Figure 9: Part numbers for StoreOnce Backup System Replication licenses

Model	D2D2502 G2	D2D2504 G2	D2D4106 G2	D2D4112 G2	D2D4312 G2	D2D4324 G2
eDelivery license	EH990AAE	EH991AAE	EH999AAE	EH994AAE	EH984AAE	EH987AAE
physical delivery license	EH990A	EH991A	EH999A	EH994A	EH984A	EH987A

For example, a user with eighteen StoreOnce Backup Systems replicating to two D2D43 12 G2 appliances would need two sets of EH984AAE licenses.

The purchase of a replication license for any StoreOnce Backup System entitles the purchaser to a license for StoreOnce Backup System Replication Manager software. HP Replication Manager is a standalone application that provides basic management capabilities in a replication environment and provides an easy way to monitor up to 300 StoreOnce Backup System devices that are in replication relationships.

vRanger Licensing

Every ESX or ESXi host for (which vRanger is expected to provide protection) must be properly licensed, both for VMware and for vRanger. Each physical CPU socket on a licensed ESX or ESXi host requires one vRanger CPU license. vRanger can restore and replicate to a host that does not have a vRanger license.

vRanger does not support the free version of VMware ESXi. In order to use VMware's vStorage APIs to perform LAN Free Backups, a minimum of "vSphere Essentials" licensing is required from VMware.

There are two vRanger editions:

- vRanger Pro: Includes all features
- vRanger Standard: Includes all base features, but not replication or cataloging

Physical installation

The StoreOnce Backup System requires installation into a suitable rack. A rail kit, power cables and full instructions are included with the appliance. A supplied network cable should be connected to the 1 GbE LAN port identified in the installation instructions for the appliance. This connection can be used to run the Installation Wizard (on Windows machines) to discover the StoreOnce Backup System. This is also the recommended port for running the StoreOnce Backup System web GUI. The other LAN port(s) (number and type vary per appliance—see Figure 7) are available for backup and replication traffic. These must be configured separately, after installation on the Network (Configuration) page of the GUI.

The StoreOnce Backup System should be installed on the same subnet as the vRanger server and the protected machines. The appliance can be connected using a single port or dual ports. The dual port configuration can be configured for failover or link aggregate (increased network speed). Single port configuration is the default mode. This can be changed during initial set up or subsequently from the web GUI. Full details are on the User Guide referenced at the end of this document and included on the CD-ROM that ships with the StoreOnce Backup System.

Network Configuration

For IPv4 networks, DHCP network addressing is enabled by default on the StoreOnce Backup System and all the required network parameters will be set automatically. For static IP addressing, a manual assignment of network settings is required.

For IPv6-only networks, the MAC address of the StoreOnce Backup System must be entered (see MAC address on the label on the top of the appliance).

StoreOnce Backup System Discovery and Initial Set Up

For Windows hosts, an StoreOnce Backup System installation wizard (on the CD-ROM supplied with the appliance) can be used to discover the appliance and start the setup. Alternatively, and for non-windows hosts, the web GUI is used for all configurations.

vRanger Initial Configuration

The vRanger startup wizard assists with the initial configuration tasks such as adding licenses, vCenter server(s), ESX and ESXi hosts, Repositories, SMTP server, and email addresses setup. An alternative is to use the Configuration Options dialog in the GUI.

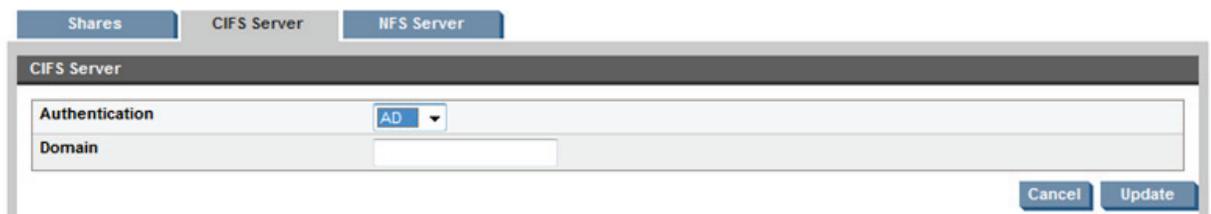
StoreOnce Backup System CIFS Share Authentication

This is required to configure StoreOnce Backup System NAS Share as a target for backups from vRanger.

Open the StoreOnce Backup System web GUI from any machine connected to the network: Enter https: followed by the IPv4 or IPv6 address or name (fully qualified domain name) of the appliance into a web browser. To configure the authentication:

On the Web GUI, Click the “NAS” page and select the “CIFS Server” option, and then select “Edit” to open the configuration screen as seen in Figure 10.

Figure 10: Configuring Authentication for the StoreOnce Backup System CIFS Server



The available authentication modes for the CIFS server are:

- None: This authentication mode requires no username or password authentication and is not recommended. It provides no data security, and as a result, anyone can access the shares and add or delete data.
- User: In this mode it is possible to create “local StoreOnce Backup System users” from the appliance web GUI. Individual users can then be assigned access to the CIFS Share(s). This authentication mode can be used if there is no AD domain available, missing AD domain permissions, or if you prefer not to join an AD domain.
- AD: In this mode, the StoreOnce Backup System CIFS server becomes a member of an AD domain. In order to join an AD domain, the user needs to provide credentials of a user who has permission to add computers and users to the AD domain. After joining an AD domain, access to each Share is controlled by Domain Management tools and domain users or groups can be given access to the CIFS Share(s). This is the recommended authentication mode.

Create HP StoreOnce Backup System CIFS NAS Share

For most StoreOnce Backup System and vRanger integrations, it is recommended to create one HP StoreOnce CIFS Share and use this as the vRanger Repository. If you want to use StoreOnce Backup System replication on a subset of your virtual machines you might consider creating multiple CIFS Shares and multiple vRanger Repositories.

To configure an StoreOnce Backup System CIFS target for use as a vRanger Repository, first select the “NAS” page in the StoreOnce Backup System web GUI. Then, select the “Shares” tab. On this, select the “Create Share” button. This opens the dialogue box to create the Share (Figure 11).

Figure 11: Creating the StoreOnce Backup System NAS Share for use as the vRanger Repository



Share	
Name	Share001
Description	Share for vRanger Repository
Access Protocol	CIFS
Write Protection	<input type="checkbox"/>

- The “Name” field is for the name of the CIFS Share to be created.
- It is recommended to use the “Description” field for a description of the Share and its use; this will be presented to the Windows host for easy identification.
- The “Access Protocol” drop down menu has an option for CIFS and NFS. CIFS should be specified for use with vRanger.
- The “Write Protection” check box should be left unchecked. Then, click on the “Permissions” tab and add the user who you would like to be able to access the Share.
- To create the Share, select the “Create” button.
- When the Share has been created its network path will be added to the information displayed on the Share. Summary details for the newly created Share will be shown in the information pane.
- Note: No capacity is entered for the Share; it will use all available capacity as the vRanger Repository has data written to it. It is effectively thin provisioned.

Add HP StoreOnce Backup System CIFS Share to vRanger

In order for vRanger to write to the CIFS Share, it must be added as a Repository. Any backups to that Repository will then be deduplicated and compressed automatically with zero impact on the host systems.

Figure 12: Add HP StoreOnce Backup System CIFS Share to vRanger

Add Windows Network Share Repository

Windows Network Share Repository Details
Provide Windows Network Share details for the repository.

Repository Name: Share001

Description: HP StorOnce Backup System Daily Backups

User: domain\user

Password: [Masked]

Server: \\server.example.com\share001 **B**rowse

Free Space: [Empty]

Encrypt all backups to this repository

Password: Password for the repository

Confirm: Confirm the Password

OK **Cancel**

Use the “User” and “Password” defined when the Share was created. Make sure you use a fully qualified Domain Name in the “Server” field. Do not check the “Encryption” checkbox, as this will cause vRanger to encrypt the backups before writing them to the StoreOnce Backup System Share. If encryption is specified, it will generate a backup data stream that cannot be deduplicated, reducing the effective backup storage capacity. Specifying encryption also adds a processing load to the vRanger backup engine. If encryption is required, it is recommended to use regular disk for the vRanger Repository.

Backup job options

When configuring backup jobs to the Repository on the StoreOnce Backup System Share, it is recommended to use the options shown in Figure 13.

Figure 13: vRanger backup job options

Backup Wizard

Options Selection
Select the options to apply to this job.

Backup powered on machines only.
vRanger Backup & Replication will check the status of the virtual machine before it begins a backup, and will skip the virtual machine if it is not running. If a virtual machine is not running, it may be the case that it has not changed significantly since the last backup, so creating another backup could be redundant.

Check destination for free space.
vRanger Backup & Replication will perform the backup after verifying that space is available at the destination.

Compress backed up files.
vRanger Backup & Replication will create a compressed copy of the source virtual machine.

Update notes with the latest backup results.
vRanger Backup & Replication will update the virtual machine notes in VirtualCenter with the most recent backup status.

Enable guest quiescing.
Enable this flag if backing up a database server, but only on ESX 3.5 Update 2 or later with VSS enabled in vmware tools.

Enable Active Block Mapping (ABM).
vRanger Backup & Replication will optimize the backup time and size by using Active Block Mapping™ technology on NTFS disks to backup only blocks that are actively used by the guest OS. Deleted data will not be backed up.

Perform LAN-free backup.
vRanger Backup & Replication will perform Lan-free backup. If vRanger is installed on a virtual machine, Hot-Add will be used. If vRanger is installed on a physical machine, fiber/iSCSI will be used.

Perform network backup on LAN-free Failure.
vRanger Backup & Replication will perform the backup using the LAN if there is a problem during the LAN-free backup.

Enable Cataloging.
vRanger Backup & Replication will catalog the files on disk for this backup. Cataloging must be enabled in the Configuration Options.

Particular attention should be paid to the following options:

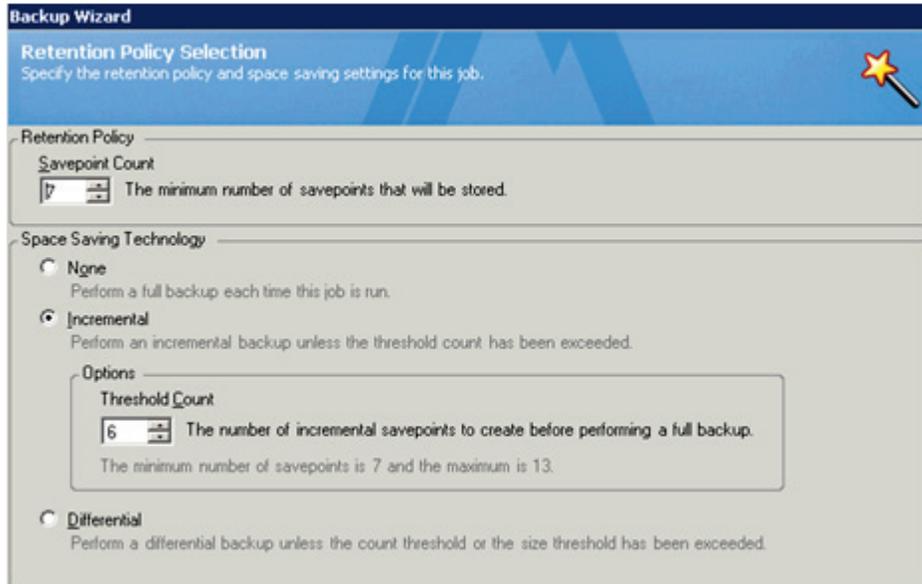
- Compress backed up files should not be enabled. The compression process effectively randomizes the backup data stream, which results in a reduced deduplication ratio on the StoreOnce Backup System and a slower backup job. The StoreOnce Backup System will compress the backup data after deduplicating it to improve the Repository utilization.
- Enable guest quiescing can optionally be enabled if your virtual machines have VMware Tools installed and are VSS enabled (Windows only). Selecting this option means vRanger will request VMware tools to initiate a VSS snapshot in the guest operating system to create a recovery consistent backup.
- Enable Active Block Mapping (ABM) should be enabled, which will reduce the data sent to StoreOnce Backup System by not including deleted blocks in the backup stream.
- Perform LAN-free backup should be selected if vRanger is configured in Hot Add mode and installed on a virtual machine (Figure 2) or in Physical Proxy mode (Figure 3). Do not use this if you want to use a Service Console mode (Figure 4).
- Perform network backup on LAN-Free failure enables failover to network-based backups if a LAN-Free backup fails.

vRanger Retention Policy, Space Saving Technology, and Deduplication

The Retention Policy should be set based on the number of recovery points from which the organization needs to be able to recover. Each recovery point is a previous backup. The parameter to define the number of recovery points is the Savepoint count. This is a setting of the backup job as shown in Figure 14.

More Savepoints enable more recovery points, but at the expense of requiring more disk space for a bigger Repository. A key benefit of using the StoreOnce Backup System for the Repository is that it deduplicates and compresses the backups to enable more backups (Savepoints) to be stored on disk for longer retention.

Figure 14: vRanger Retention Policy and Space Saving Technology



To reduce the size of each backup sent to the StoreOnce Backup System, vRanger has Space Saving Technology. This is configured using one of three options:

- **None**—runs a full backup at each Savepoint. This will give the slowest backups but fastest recoveries.
- **Incremental**—runs incremental (just changes since last backup job) backups between full backups. This will give the fastest backups but slightly slower restores.
- **Differential**—runs differential (just changes since last full backup job) backups between full backups. This will give faster backups than selecting “none” and generally slightly faster restores than selecting “Incremental”.

The space saving technology is one of the parameters that determine the size of the Repository required for a given backup specification. The other key parameter is the deduplication ratio achieved in the StoreOnce Backup System. The deduplication ratio will be higher with vRanger’s Space Saving Technology set to “None” than when Space Saving Technology is set to “Incremental” because the backup data stream will have more duplicate data. The end-to-end data compaction is the product of the vRanger Space Saving Technology and the StoreOnce Backup System deduplication and compression. Figure 15 is an indication of the end-to-end data compaction over time when using the “None” and “Incremental” Space Saving Technology settings. The actual end to end compaction will be different for each installation and dependent upon a number of factors as discussed above. The same factors will determine if full backups or of a mix a Full Plus incremental backups will give the greatest end-to-end compaction. The other advantages of each the Full and Full Plus Incremental vRanger Space Saving Technologies are described in Figure 16.

Figure 15: End-to-end data reduction for Space Saving set to “None” (full backups) and “Incremental” (full + incremental backups). Note: this is indicative and all installations will be different

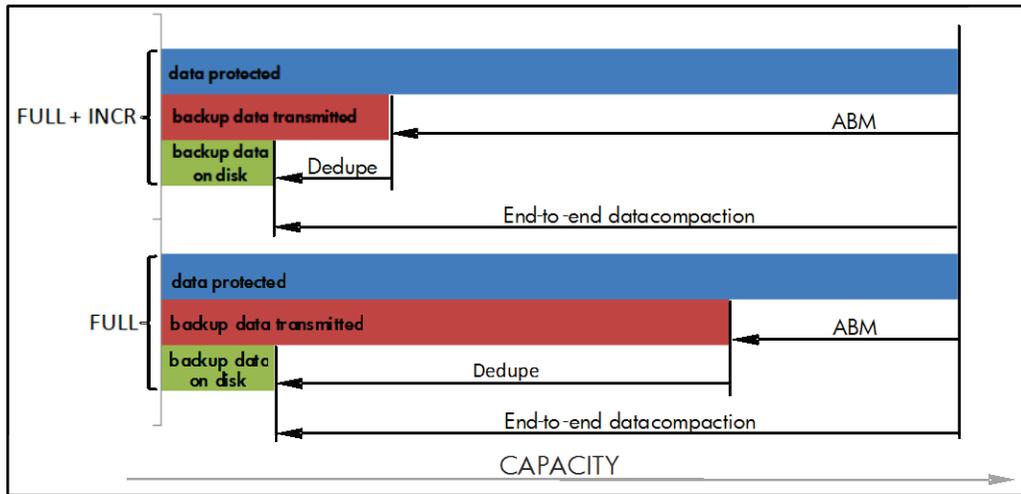


Figure 16: Features of vRanger “None” and “Incremental” Space Saving Technologies

“None” (full backups)	“Incremental” (full + incremental backups)
Faster recovery	Slower recovery
Longer backup windows needed	Shorter backup windows needed
Consumes more network bandwidth	Consumes less network bandwidth

HP StoreOnce Housekeeping

Housekeeping is a regular background task run by the StoreOnce Backup System to optimize the physical storage utilization by reclaiming space after backup data is deleted or expired by vRanger. After a deletion or expiration, any unique chunks are marked for removal and duplicate chunks are de-referenced to the deleted data.

Housekeeping is governed by a back-off algorithm which throttles it back to reduce its impact on other concurrent operations. However, there may still be some impact of housekeeping on the performance of backups running to other files. For this reason it is recommended to schedule Housekeeping to occur outside the vRanger backup window to enable the maximum resources to be applied to processing the backup data stream. By default, the Housekeeping processes are run on a per-backup file basis and will run on the backup file as soon as the file is closed by vRanger.

Housekeeping should be configured not to run at the same time as backups and replication whenever possible. To enable this, a Housekeeping Blackout Window can be specified. This allows one or two separate periods in any 24 hours to be specified during which the resource intensive process of Housekeeping will not run. This enables backup and replication tasks to run uninterrupted for more predictable performance.

The Housekeeping Blackout Windows are specified in the Housekeeping tab of the Administration menu of the StoreOnce Backup System GUI, see Figure 17. The GUI also reports statistics on Housekeeping, which should be used to tune the Blackout Windows.

Figure 17: HP StoreOnce Housekeeping configuration is set to have a daily blackout window between 8pm and 8am to coincide with the time vRanger backups are scheduled

Configure Blackout Windows

Housekeeping blackout windows allow you to automatically pause Housekeeping at certain times. The windows are appliance-wide and will pause Housekeeping for the whole appliance.

System Time: Thursday 15:23
Blackout Window Active: No

Day	Apply First Time Restriction	Start	Finish	Apply Second Time Restriction	Start	Finish
Sunday	<input checked="" type="checkbox"/>	00:00	08:00	<input checked="" type="checkbox"/>	20:00	23:59
Monday	<input checked="" type="checkbox"/>	00:00	08:00	<input checked="" type="checkbox"/>	20:00	23:59
Tuesday	<input checked="" type="checkbox"/>	00:00	08:00	<input checked="" type="checkbox"/>	20:00	23:59
Wednesday	<input checked="" type="checkbox"/>	00:00	08:00	<input checked="" type="checkbox"/>	20:00	23:59
Thursday	<input checked="" type="checkbox"/>	00:00	08:00	<input checked="" type="checkbox"/>	20:00	23:59
Friday	<input checked="" type="checkbox"/>	00:00	08:00	<input checked="" type="checkbox"/>	20:00	23:59
Saturday	<input checked="" type="checkbox"/>	00:00	08:00	<input checked="" type="checkbox"/>	20:00	23:59

Buttons: Pause Housekeeping, Edit

Housekeeping is an essential process to maximize the deduplication efficiency of the appliance; it is important to ensure that it has enough time to complete. As a guide, a daily window when no backups are scheduled should be configured. The required size of this window depends on the daily amount of backup data vRanger adds or expires. Knowing this enables the Housekeeping window to be estimated based on the guidelines in Figure 7.

Open Files

At the end of the backup of each virtual machine, vRanger will verify data integrity across all Savepoints for that virtual machine, as well as expire any Savepoints in excess of the specified Savepoint count. This will open all the related backup files related to that virtual machine. The number of files opened for each virtual machine is a product of the number of Savepoints and the number of virtual disks configured for that virtual machine:

$$\text{Open Files} = \text{vRanger Savepoint Count} \times \text{Number of Virtual Disks}$$

For most backups this will not have an impact. However if an entry-level StoreOnce Backup System is used as the target and there are many Savepoints in the backup job, reference should be made to Figure 7 and the “Max open files >24 MB per Share” value. If the calculated number of open files exceeds the maximum supported value, then the following steps can be taken to reduce the number of open files per Repository on the HP StoreOnce Backup System CIFS Share:

1. Use the vRanger Resource Manager to reduce the number of virtual machines to backup in a single job, or in parallel, to avoid the possibility of two or more virtual machine backups finishing at the same time and all the related files being open concurrently.
2. Reduce the number of Savepoints for a virtual machine.
3. Use a bigger StoreOnce Backup System as the backup target.

Integration with tape for long term retention of backup data

vRanger is optimized for backup to disk devices such as the StoreOnce Backup System. Where backup data must be kept for many months or years it makes operational and economic sense to move the backup data to tape.

The format and layout of the files backed up to the Repository makes it efficient to copy the backups to tape. Backups are written sequentially to the Repository which makes for easy identification of files to copy to tape and can save time and space compared to other backup to disk formats.

This can be done in two different ways:

1. vRanger writes backups to its CIFS Repository. HP Data Protector, or another backup application with tape support, backs up that CIFS Share. Both backup solutions will run independent of each other.
2. Use “pre” command in HP Data Protector, or another backup application with tape support, to initiate vRanger backup. When the vRanger backup is completed, HP Data Protector will start to backup the vRanger CIFS Repository. For details how to do this see [vRanger Deployment Guide](#) referenced below.

Conclusion

StoreOnce Backup Systems and Quest Software’s vRanger deliver an efficient, high performance and robust solution for backing up and recovering small to enterprise VMware environments. The joint solution is easy to manage and delivers high performance deduplicated backups with fast, reliable recovery from disk. This document describes implementation and best practices for an end-to-end solution. The settings should be tuned in a non-production environment before implementation. Multiple additional resources are available from HP Quest and partners to design and implement specific solutions.

Appendix 1 – Certification Test results

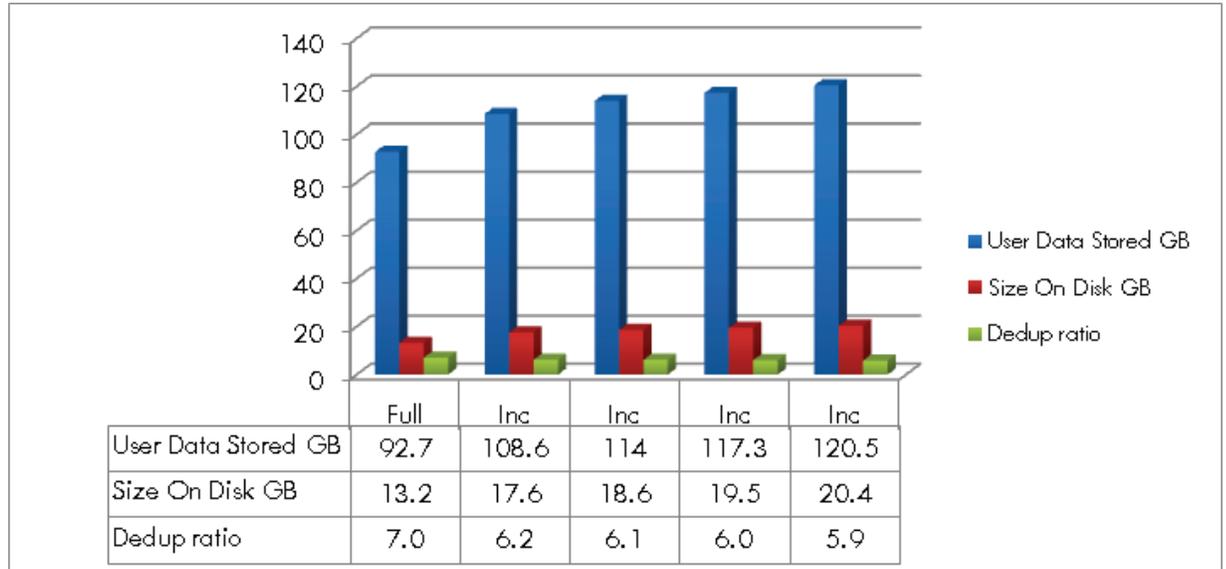
In the certification process, we used vRanger as both physical proxy (HP BL460 G1) and virtual machine (4 vCPU and 4 GB memory) with Hot Add. The goals of the testing was to:

- Verify successful backups with both architectures
- Find best practices for both StoreOnce Backup System and vRanger
- See what deduplication ratios customers should expect

During testing, we:

- Created one CIFS Share on the StoreOnce Backup System
- Created one vRanger backup job to backup 10 virtual machines with mixed OS and versions:
 - Six Win 2003 R2 64 bit, two Win 2008 R2 64 bit and 2 RHEL 6.5 32 bit
 - Original size on disk: 432 GB
- Added 1 GB of random data on first incremental, then 200 MB random data for every following incremental. We used 1 ESX 4.1 host and 1 ESXi 4.1 host connected to HP EVA 8000 XL storage via fibre

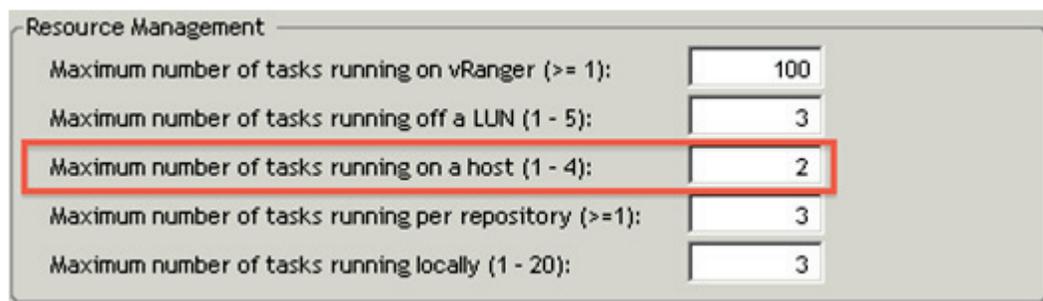
Figure 18: Backup—results Incremental



vRanger efficiently removes whitespace (unallocated blocks and zero filled blocks) and deleted data before sending it to StoreOnce Backup System, which further enhances this with inline target deduplication. The deduplication ratio above is calculated as User Data Stored/Size On Disk. Remember that the original disk size for the selected VMDKs was 432 GB. If we take that in consideration, the end-to-end deduplication values are over 30:1.

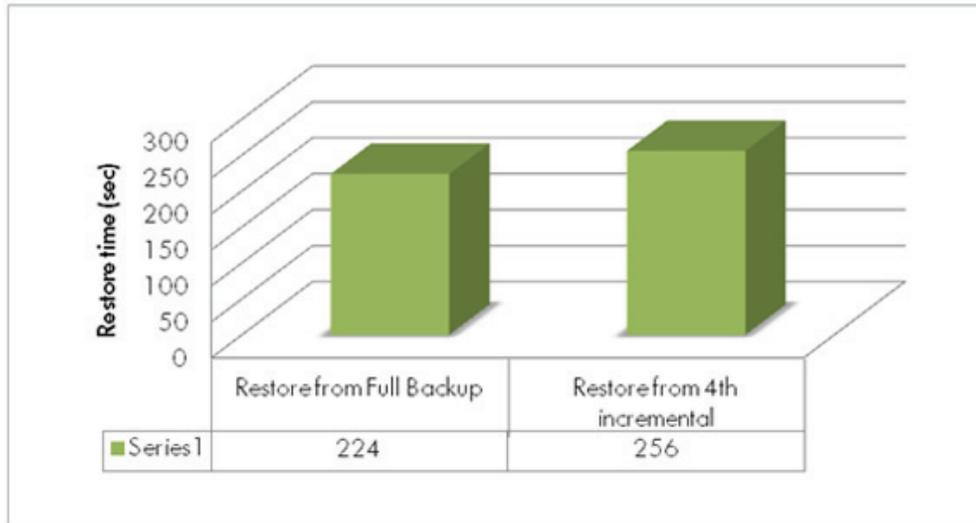
vRanger Resource Management needs to be tuned as we only had 2 ESX(i) hosts and want to be able to run three simultaneously backup tasks. If we add more CPU to the vRanger virtual or physical machine, the maximum number of tasks per Repository and locally can be increased accordingly.

Figure 19: vRanger Resource Management



To measure how much longer it takes to restore from a chain of incremental backups compared to a full backup we used a 50 GB Windows virtual machine. It was restored using vRanger LAN-Free option. In our test case it reads the virtual machine data over LAN from the StoreOnce Backup System and then uses the VMware vStorage API to write data directly to the 4 Gbit/s Fibre Channel SAN. The time difference was only 14 percent. This was achieved because vRanger never restored the same blocks multiple times from different Savepoints, only the blocks needed to recreate the backup were restored from the required incremental backups in the restore chain.

Figure 20: The difference in restore time between restoring a virtual machine from a full backup versus a restore from a full backup and a chain of 4 incremental backups was just 14%. vRanger was configured in the LAN-Free restore mode.



For More Information

HP StoreOnce Backup System general information:

<http://www.hp.com/go/d2d> and <http://www.hp.com/go/storeonce>

HP StoreOnce Backup System Disk Backup Application HP D2D 4312 user guide:

<http://bizsupport1.austin.hp.com/bc/docs/support/SupportManual/c02295179/c02295179.pdf>

HP Sizing Tool:

<http://www.hp.com/go/nssizer>

HP StoreOnce Backup System best practices guide:

<http://bizsupport2.austin.hp.com/bc/docs/support/SupportManual/c02511912/c02511912.pdf>

Quest vRanger general information:

<http://www.quest.com/vranger>

Quest vRanger Evaluation Guide, Quest vRanger Deployment Guide and other documentation:

<http://www.quest.com/vranger/#docs>



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