VMware vSphere® Replication 5.5 Overview

Simple and Effective Virtual Machine Protection

TECHNICAL WHITE PAPER
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Introduction

A fundamental part of protecting IT is ensuring that the services provided by virtual machines are resilient and robust at all levels of the compute stack, from hardware through to the application.

VMware vSphere® Replication is a feature of the VMware vSphere platform. It is designed to augment the recovery capabilities of the vSphere platform by providing a built-in ability to continually replicate a running virtual machine to another location. vSphere Replication creates a copy of a virtual machine that can be stored locally within a cluster or at another site, providing a data source for rapidly restoring a virtual machine within minutes.

vSphere Replication augments offerings in the vSphere availability protection matrix. It provides a solution that enhances business continuity planning, complementing both backup and full disaster recovery, without introducing the complexity and cost of a complete storage array–based replication configuration. 
vSphere Replication enables configuring replication on a per–virtual machine basis and significantly rounds out the capabilities of protection offered by vSphere.

This paper will help users understand what VMware vSphere Replication is, explain some of the benefits of its features, and provide an overview of how it works to protect virtual machines against failure.

What Is vSphere Replication?

vSphere Replication is a feature of the VMware vSphere platform. It copies a virtual machine to another location, within or between clusters, and makes that copy available for restoration through the VMware vSphere Web Client or through the orchestration of a full disaster recovery product such as VMware® vCenter™ Site Recovery Manager™.

vSphere Replication protects the virtual machine on an ongoing basis. It replicates to the copy only the changes that are made to the virtual machine. This ensures that the virtual machine remains protected and is available for recovery directly from the vSphere Web Client without requiring use of an external tool.

vSphere Replication is provided as a no-charge component of all eligible vSphere licenses, ranging from VMware vSphere Essentials Plus Kit to VMware vSphere Enterprise Plus Edition™. As with backups through VMware vSphere Data Protection®, protecting a virtual machine is a critical function of a hypervisor platform for the datacenter.

Unified management of vSphere Replication is offered via the next-generation vSphere Web Client. This provides a common and unified screen for all aspects of virtual datacenter management, including many aspects of protection such as replication, backup and restore.

Some replication technologies provide mere copies of a virtual machine at a remote site without any consideration for the consistency of the application data within the virtual machine. vSphere Replication can be configured to ensure consistent application data, along with virtual machine data, with one simple click when configuring a virtual machine for replication.
Automated integration with Microsoft Volume Shadow Copy Service (VSS) ensures that applications such as Microsoft Exchange Server and Microsoft SQL Server databases are quiescent and consistent when replica data is being generated. A quick call to the virtual machine’s VSS layer flushes any outstanding application writes to ensure that the data that is replicated is static and fully recoverable.

There are no application agents or administration required for this process. Application consistency is inherent to the copies made by vSphere Replication and is achieved through communication with the Microsoft Windows operating system (OS) via the installed VMware Tools™.

vSphere Replication also enables administrators to choose retention of historical replications as potential points in time to revert a recovered system. When configuring replication for a virtual machine, administrators simply select whether or not to retain multiple points in time; they then can choose how many historical copies are to be retained and for how many days. They can retain a maximum of 24 points in time and can customize the retention configuration. For example, a user might choose to retain one copy daily for as many as 24 days, 24 copies throughout a day for only one day, or any other selection that their requirements might dictate.
How Does It Work?

vSphere Replication is a deeply integrated component of the vSphere platform. It is the only true “hypervisor-level” replication engine available today. Changed blocks in the virtual machine disk(s) for a running virtual machine are sent to a secondary location, where they are received by a virtual appliance that writes them to an on-disk redo log. Only when that redo log is complete and all blocks in a given replication are received is that set of data applied to the virtual machine disks for the offline (protection) copy of the virtual machine.

Figure 3. Replicate Virtual Machines’ Changed Blocks

vSphere Replication consists of an agent that is a part of the core vSphere 5.5 installation package on each host, along with a set of virtual appliances that are deployed from the management interface. From a conceptual perspective, the agent is responsible for both tracking and sending changed data from a running virtual machine; the remote appliance receives the replication and applies it to the offline disk files for the virtual machine. The vSphere Replication appliance also manages replication, which enables the administrator to see the virtual machines’ protection status and to recover them with a few simple actions.

Configuring replication for as many as 500 virtual machines through the same management interface that is used for all VMware vCenter™ operations is an easy process of right-clicking a virtual machine and selecting the destination for its replica.

Figure 4. Selecting an RPO for Multiple Virtual Machines
vSphere Replication performs an initial, full synchronization of the source virtual machine and its replica copy. If wanted, a seed copy of data can be placed at the destination to reduce the time and bandwidth required for the initial replication. A seed copy of a virtual machine consists of a clone of the original virtual machine disk file, which can be placed at the target location via a variety of mechanisms. Seeding is not a necessary process, and vSphere Replication creates an initial copy at the target location whether or not a seed is present. If a user provides a seed for replication, the contained data is used to reduce the amount of replication required to initially synchronize the primary disk and its replica. A seed can be created manually or can be cloned and put into place by any mechanism the administrator chooses, such as offline copying, FTP, “sneakernet,” or even using an ISO or a clone of a virtual machine, provided that the disk UUID of the seed is the same as that of the original system being copied.

After baseline synchronization is complete, vSphere Replication switches to transferring only the blocks of data that have changed. The vSphere kernel itself tracks unique writes to the disk files of protected virtual machines and identifies and replicates only those blocks that have experienced unique writes during the configured RPO. This ensures that a minimal amount of data is sent over the network to the target, and it enables aggressive RPOs. After unique data has been sent, there is no need that it be sent again. Only changes are replicated, and those blocks are sent to the target location’s vSphere Replication Appliance.

At the target location, the data is received and checked within the vSphere Replication Appliance. Only fully consistent data is then written (via Network File Copy) to the redo log at the target cluster’s vSphere hosts; only when the redo log is complete and all expected data has been received will it thereby be written to disk. This manner of waiting for a completely consistent block group ensures recoverability of the replica virtual machine at all times, even if data is lost during transit or a crash occurs at any point during the transfer.

From the perspective of the protected virtual machine, this entire process is completely transparent and requires no changes to configuration or ongoing management. The replication is nonintrusive, irrespective of the OS within the virtual machine.
**Simplicity Without Sacrificing Functionality**

vSphere Replication is inherently a lightweight replication protocol. By replicating only changed blocks on an ongoing basis, network bandwidth can be saved and commit times for data are minimized.

The vSphere Replication framework consists of a vSphere Replication appliance that is paired with a single vCenter Server system. This appliance provides the management framework for vSphere Replication and also acts as the target for replicated blocks. Increased scale or the presence of multiple remote sites can lead to the choice of deploying up to nine additional vSphere Replication server virtual appliances, which are deployed in exactly the same fashion as the original vSphere Replication appliance. By contrast, however, they function strictly as a destination target for replication and enable simple scaling and distribution of the replication framework. They do not participate in the management of vSphere Replication; they exist strictly to enable various topologies and for traffic separation purposes.

With vSphere Replication 5.5, users can choose to replicate to a number of different locations: to another site with both a vCenter Server system and a vSphere Replication appliance; to another site with only a vSphere Replication server, within a datacenter to another location on disk; or to any combination they choose. A user might even choose to replicate between two remote offices that have only a vSphere Replication server deployed and do not have a vCenter Server system or a vSphere Replication appliance, as long as they are managed from a central location that does have those objects. As many as 500 virtual machine replications can be managed with an individual vSphere Replication appliance instance, irrespective of the topologies chosen.

![Diagram of vSphere Replication with Multiple Sites and vSphere Replication Servers](image)

**Figure 6.** Framework for Replication with Multiple Sites and vSphere Replication Servers – One Datacenter Replicating to Two Remote Sites

Within this framework, RPOs for each virtual machine can be defined, ranging from 15 minutes to 24 hours. This RPO can be changed on demand without interruption, enabling administrators to fine-tune replication based on dynamic factors such as change rates, bandwidth availability and so on.
Because the RPO is unique to each virtual machine, more-critical virtual machines can be given a more aggressive replication target than others. Groups of virtual machines, however, can be selected en masse to enable large-scale changes. Each disk within a virtual machine can be independently configured to be replicated or not replicated, offering further opportunity to save bandwidth and time for recovery. For instance, a database server might consist of multiple disks, one of which is dedicated to a temporary scratch location. This disk is not required for replication. Likewise, sometimes a swap file or paging file is redirected to a dedicated disk that might also be excluded from replication to save bandwidth for transient data.
The replicated disks are independent of format, layout and snapshots of the primary copy. For example, a virtual machine disk file that is thick provisioned on a Fibre Channel SAN at the primary location can be thin provisioned to local disk for recovery, if so chosen. vSphere Replication eliminates the requirement that replication have identical storage hardware. Likewise, because the virtual machine replica is “cold booted” when recovery takes place, there is no need that server hardware be identical if replicating between clusters.

At its core, vSphere Replication enables policy-driven protection of systems—because the configuration of an object’s replication is attached as a property of the virtual machine itself—while also enabling virtual machines to continue operating without any change, overhead or interruption.

The tracking mechanism that identifies changed blocks of a virtual machine resides above the storage layer, enabling replication that is fully independent of disk location, disk format, thin- or thick-provisioned disks, and whether or not snapshots are in use by the virtual machine.
Recovering a Virtual Machine

Recovery of a virtual machine can be necessitated for a number of reasons, including testing, impending outages, and even disaster recovery. vSphere Replication is designed to enable administrators to manually recover an individual machine with a few clicks in the vSphere Web Client.

It is not the goal of vSphere Replication to provide complex orchestration of disaster recovery in the manner of vCenter Site Recovery Manager. Instead, vSphere Replication offers replication on a per-virtual machine basis to enable fine-grained recovery configurations for environments that require them. If wanted, however, vSphere Replication can act as the replication engine for vCenter Site Recovery Manager, with no extra configuration or special considerations for setup. vCenter Site Recovery Manager can recognize machines that are protected with vSphere Replication and can “inherit” their protection.

With vSphere Replication, recovery of a virtual machine can be started easily by one of three methods. After navigating to replication Status in the vSphere Replication area of the vSphere Web Client, the administrator first selects the virtual machine to be recovered. A recovery action can be initiated by right-clicking, clicking the recovery icon, and selecting Recover from the Actions drop-down menu.

The replica cannot be powered on and recovered if the original virtual machine is still reachable and is still powered on. To continue the recovery process, the primary copy of the virtual machine must be unreachable by vCenter Server or powered off. The next step is to choose a destination for the virtual machine—a folder to hold it and a cluster or resource pool in which it will be powered on. A method of recovery can be chosen, including whether to synchronize the most recent changes, if the protected virtual machine is available. If, however, the protected system is not available or is in an undesirable state, the user can alternately proceed to recover the virtual machine using the last good replication and not synchronize the most recent changes.
After these items are selected, recovery will begin. This process creates a powered-on copy of the virtual machine connected to the replica disk, but it does not connect any of the virtual network cards to any port groups. This can help prevent situations where the same virtual machine might be active on the network in two locations simultaneously, as well as broadcast collision and routing issues involving duplicates. After the virtual machine is fully booted, the administrator reviews the recovery and status of the booted replica and simply attaches the virtual machine to the appropriate networks to complete the recovery.

**Retention of Multiple Points in Time**

vSphere Replication 5.5 introduced the option to retain historical points in time for recovery. As described earlier in this document, this policy is selected when replication is configured for a virtual machine.
If a virtual machine has been replicated and historical point-in-time retention was chosen, the administrator has the ability to revert the virtual machine to one of the earlier replicas. The points in time are represented as virtual machine snapshots that can be browsed using the VMware vSphere Client™ Snapshot Manager. The point-in-time snapshots are labeled with the date stamp of the moment at which they were created. The administrator chooses a snapshot to use and can either revert to that point in time or delete one or more snapshots.

Figure 13. After Recovering a Virtual Machine with Preserved Points in Time, Use the Snapshot Manager to Revert to an Earlier Point

Recovery of a virtual machine is a simple process that can be accomplished in a safe and reliable fashion with a few clicks in the GUI.
Next Steps

Protect Your Virtual Machines from Loss and Downtime with vSphere Replication

Make vSphere Replication a part of your vSphere 5.5 deployment and improve your virtual machine availability without introducing risk. Register today for a trial of vSphere and enjoy the benefits of replication of your critical virtual machines as an integrated part of your IT platform.

Additional Documentation

For more information about vSphere, visit the product pages at http://www.vmware.com/products/vSphere.

The following links are to online vSphere and vCenter Server documents:

- Product documentation
- VMware knowledge base

VMware Contact Information

For additional information or to purchase VMware vSphere 5.1, the VMware global network of solution providers is ready to assist. If you want to contact VMware directly, you can reach a sales representative at 1-877-4VMWARE (650-475-5000 outside North America) or email sales@vmware.com. When emailing, include the state, country, and company name from which you are inquiring.

Providing Feedback

VMware appreciates your feedback on the material included in this guide and in particular would be grateful for any guidance on the following topics:

- How useful was the information in this guide?
- What other specific topics would you like to see covered?

Please send your feedback to docfeedback@vmware.com, with “vSphere Replication 5.5 Overview” in the subject line. Thank you for your help in making this guide a valuable resource.

About the Author

Ken Werneburg is a senior technical marketing manager at VMware. He works on business continuity and disaster recovery solutions in the Cloud and Infrastructure Management group. Ken has been with VMware since 2006.

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