Abstract

EMC® RecoverPoint provides full support for data replication and disaster recovery for VMware® ESX® Server and ESX servers’ virtual machine clients. This white paper describes how RecoverPoint can be utilized to provide local and remote data protection and recovery for VMware ESX environments. It also covers the supported configurations available for VMware ESX Server and ESX virtual machine environments and the integration of RecoverPoint with VMware vCenter™ Site Recovery Manager.

August 2012
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Part Number h2352.7
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Executive summary

EMC® RecoverPoint is an advanced enterprise-class disaster recovery solution supporting heterogeneous storage and server environments. RecoverPoint provides bi-directional local and remote data replication across any distance, and utilizes continuous data protection technologies to provide consistent point-in-time recovery. RecoverPoint helps customers accelerate protection and provides operational and disaster recovery of their VMware® Infrastructure, without impacting production environments. RecoverPoint is ideally suited for replicating and protecting physical and virtual server environments.

Introduction

Server virtualization technology allows one physical server platform to run multiple virtual machines simultaneously. Many customers have taken advantage of server virtualization, such as that provided by VMware ESX®, to consolidate their server infrastructure and simplify their disaster recovery platforms. These customers may have also invested in an enterprise-class SAN to support their primary data center and disaster recovery sites. This leads to some challenges when it comes to managing data protection for their local and remote data centers, especially for applications running on a virtual machine in an ESX server.

This white paper describes how customers can utilize RecoverPoint to enhance the disaster recovery and data protection capabilities of their physical and virtualized VMware applications with local and remote replication. RecoverPoint supports vSphere 4.x and vSphere 5.x. RecoverPoint supports VMware vCenter Site Recovery Manager 4.x and 5.x. When you use RecoverPoint you are not required to install VMware HA or DRS.

Audience

This white paper is targeted to VMware storage and server administrators, IT managers, and storage professionals, as well as integrators, consultants, and distributors.

RecoverPoint support of VMware

RecoverPoint supports the local and/or remote replication of iSCSI and SAN-attached volumes. RecoverPoint supports RDM and VMFS 3/5 volumes and if the VMware ESX server is configured for boot from SAN (BFS), then the boot volumes can also be replicated to the remote site. RecoverPoint captures changes to data by intercepting every write (either to an RDM volume or to a VMFS volume) that reaches the SAN.
Array-based write splitting

RecoverPoint supports write splitting for VMware VMs on VMFS and RDM volumes for the Symmetrix VMAX 40K, 20K, 10K, Symmetrix VMAXe, VPLEX Local, VPLEX Metro, VNX series and CLARiiON CX3 and CX4 arrays. The RecoverPoint Symmetrix write splitter supports Symmetrix VMAX 40K, 20K and 10K with Enginuity 5876 and Symmetrix VMAXe with Enginuity 5875. The VPLEX write splitter is a feature of GenSyncrony 5.1, the VNX/CLARiiON write splitter is supported on VNX OE R31 or higher and on FLARE® 26, 28, 29, and 30. The splitter supports Fibre Channel (FC) volumes presented by the array to any host, including to an ESX server. The VNX/CLARiiON RecoverPoint write splitter also supports iSCSI volumes.

The RecoverPoint write-splitter operates in each array where it monitors writes to protected volumes and ensures that the RecoverPoint appliance receives a copy of the write. Up to four RecoverPoint clusters can be attached to the same VPLEX, VNX series or CLARiiON array and up to six RecoverPoint clusters can be attached to the same Symmetrix VMAX family or Symmetrix VMAXe family array. A benefit of this is that multiple production sites can use the same array such as might exist in a shared disaster recovery site or at a service provider’s site.

![Splitter Architecture Diagram](image-url)

**Figure 1. Splitter architecture**

Host-based write splitting

RecoverPoint provides a host-based write splitter (also called a KDriver) for Windows Server platforms that is supported with VMware. For VMware, the KDriver is installed on each Windows virtual machine where it operates above any multipath driver, but below the file system and volume management layers. The KDriver monitors writes and ensures that a copy of all writes to a protected volume is sent to the RecoverPoint appliance. Since the KDriver runs in the virtual machine, the only volumes that can be replicated by RecoverPoint would be SAN volumes attached to the virtual machine in physical RDM mode (RDM/P).
Intelligent fabric support

RecoverPoint write splitting is also provided through intelligent fabric APIs provided on EMC Connectrix switches using Brocade and Cisco technology. For VMware, RecoverPoint supports the Brocade Storage Application Services APIs on the Connectrix AP-7600B switch. Also supported is the Cisco SANTap APIs provided on the Connectrix Storage Services Module and the MDS 18/4 Multi-Services Blade, either of which can be installed in a Connectrix MDS-9000 director family, or in the Connectrix MDS-9222i switch. For replication, VMFS volumes as well as volumes attached to the virtual machine in physical RDM mode (RDM/P) are supported.

For EMC block storage, EMC recommends that the array-based write splitter be utilized and that for non-EMC block storage, EMC recommends that a VPLEX be used in front of the non-EMC storage, and that the virtual volumes are replicated with the VPLEX RecoverPoint write splitter.

Choosing your RecoverPoint splitter

The following table summarizes the VMware features and limits for each of the three write-splitting technologies supported by RecoverPoint.

Array-based write splitter

As this table shows, the array-based write splitter is the most effective configuration for VMware replication, which is why it is recommended. With an array-based write splitter, any of the RDMs or volumes containing VMFS 3/5 can be replicated. The only restriction on the write splitter is that all of the volumes for a specific VM must reside on array or platforms that are supported by and attached to the RecoverPoint appliance.

Host Splitter Configuration

For this configuration, the RecoverPoint host splitter is installed on each virtual machine that has data that needs to be replicated. There are a few limitations on the host driver. First, it only supports the Windows platforms; second, only the virtual machines' data can be replicated, and it must be attached as a RDM/P volume, and the boot volumes are not replicated; third, only a maximum of 255 guest machines per ESX server can be supported for replication, which is a VMware restriction; and fourth only RecoverPoint/CL is supported.

Table 1. RecoverPoint splitter comparisons

<table>
<thead>
<tr>
<th>Splitter Features</th>
<th>Array-based write splitter (VMAX 40K, 20K, 10K, VMAXe, VPLEX, VNX, CLARiiON)</th>
<th>Windows host write splitter</th>
<th>Brocade/Cisco Intelligent Fabric write splitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports physical RDM</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Supports virtual RDM</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Splitter Features</td>
<td>Array-based write splitter (VMAX 40K, 20K, 10K, VMAXe, VPLEX, VNX, CLARiiON)</td>
<td>Windows host write splitter</td>
<td>Brocade/Cisco Intelligent Fabric write splitter</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Supports VMFS 3</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Supports VMFS 5</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Supports VMotion®</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Supports HA/DRS</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Supports vCenter™ Site Recovery Manager</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Supports P2V replication</td>
<td>RDM/P and VMFS</td>
<td>RDM/P only</td>
<td>RDM/P and VMFS</td>
</tr>
<tr>
<td>Supports V2V replication</td>
<td>RDM/P and VMFS</td>
<td>RDM/P only</td>
<td>RDM/P and VMFS</td>
</tr>
<tr>
<td>Supports guest OS BFS</td>
<td>RDM/P and VMFS</td>
<td>RDM/P only</td>
<td>RDM/P and VMFS</td>
</tr>
<tr>
<td>Supports ESX BFS</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Maximum number of LUNs supported per ESX server</td>
<td>N/A</td>
<td>255 (VMware restriction)</td>
<td>N/A</td>
</tr>
<tr>
<td>Heterogeneous array support</td>
<td>EMC Symmetrix VMAX 40K, 20K, 10K, Symmetrix VMAXe, VPLEX, VNX and CLARiiON CX3/CX4+3rd party with VPLEX or FTS</td>
<td>EMC VNX, CLARiiON CX™, Symmetrix® and selected 3rd-party storage</td>
<td>EMC+3rd Party</td>
</tr>
<tr>
<td>Can be shared between RecoverPoint clusters</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

Intelligent Fabric-based write splitter

The last configuration uses intelligent fabric splitting, which is provided on some Brocade and Cisco director-class switches. Using intelligent fabric splitting the volumes can reside anywhere in the SAN. Intelligent fabric splitting enables the replication of ESX boot volumes, virtual machine boot volumes (either as physical RDM volumes or as a VMFS volume), and virtual machine data volumes (either as physical RDM volumes or as VMFS volumes).

Using VMware vCenter Site Recovery Manager

VMware vCenter SRM automates the recovery process so it becomes as simple as pressing a single button. There is no need for the user to interact with the RecoverPoint console and the VMware console; instead VMware automates the
process. All the user has to do is ensure that the production virtual machines are mapped to LUNs that are replicated by RecoverPoint to the remote site.

SRM leverages RecoverPoint to provide external replication solution between protected and recovery sites. The workflow that is built into SRM automatically discovers the datastores that are set up for replication between the protected and recovery sites. You can configure SRM to support bi-directional protection between the two sites.

RecoverPoint sits below the VMware Infrastructure and is responsible for replicating all changes from the production LUNs to the remote replicate LUNs at the disaster recovery site. The RecoverPoint storage replication adapter is installed on the same servers that are running vCenter Server and the vCenter Server Site Recovery Manager plug-in in the production and disaster recovery sites.

The benefits of RecoverPoint are that the replication can be between differing arrays, such as between a Symmetrix and a VNX series or between an EMC storage array and a Non-EMC storage array. There is no requirement that the production volumes be attached to the VMware servers in RDM/P mode; instead the data can reside on VMFS file systems that are contained on the production LUNs. Finally, with RecoverPoint the distance between the sites is not a limit, since RecoverPoint replicates the data asynchronously but maintains the write-order consistency at the remote site, ensuring that all replicas remain fully consistent.

Integration with RecoverPoint

VMware vCenter Site Recovery Manager is designed as a plug-in to VMware vCenter Server so that the SRM disaster recovery tasks can be executed inside the same management tool as other VM administration tasks such as creation, migration, and deletion. VMware vCenter SRM is highly automated and is responsible for the setup, test, and recovery workflows for disaster recovery automation. SRM enables you to accelerate recovery and ensure successful recovery by automating the recovery process and eliminating the complexity of managing and testing recovery plans. VMware vCenter SRM eliminates complex manual recovery steps and removes the risk and worry from disaster recovery.

VMware vCenter SRM reduces the RTO for disaster recovery and relies on RecoverPoint to reduce the RPO for disaster recovery. To implement replication, RecoverPoint maps the VMware vCenter SRM requests into the appropriate RecoverPoint actions.
All of the benefits of RecoverPoint discussed in this paper also apply when VMware vCenter SRM uses RecoverPoint for replication. This includes benefits such as the use of the various RecoverPoint write splitters, heterogeneous storage and policy-based replication. SRM is designed for site-to-site replication, as such it only works with remote replication as provided by RecoverPoint CRR, or if continuous local and remote data protection is being used, SRM will only operate with the remote replica copy. The local (or CDP) copy of a CLR consistency group will be unaffected by the SRM operations and will remain available for use; however, RecoverPoint will pause the transfer to the local copy until production is resumed at the protected site.

Automation and testing

Testing disaster recovery plans and ensuring that they are executed correctly are critical to making recovery reliable. However, testing is difficult with traditional solutions due to the high cost, complexity, and disruption associated with tests. Another challenge is ensuring that staff are trained and prepared to successfully execute the complex process of recovery.

VMware vCenter SRM is not a replication technology but a technology that manages the processes and automation steps in recovery. It uses RecoverPoint to replicate data from the primary site to the secondary site. SRM recovery plans leverage RecoverPoint's image access capability to nondisruptively test the failover process to ensure that the secondary image is consistent and usable.
The previous figure shows what the architecture looks like once SRM has been installed and configured with RecoverPoint to support the VMware Infrastructure environment. For a brief video chalk talk see EMC and VMware: The Ultimate Disaster Recovery Solution at http://www.emc.com/collateral/demos/microsites/mediaplayer-video/video-baker-tothepoint.htm.

VAAl support

VMware vSphere™ 4.1 introduced the vStorage API for Array Integration (VAAl), which speeds up certain VMware operations by offloading them to array-based hardware. By default, all VAAI commands are enabled when upgrading to or installing ESX/ESXi™ 4.1 and later. If the RecoverPoint splitter does not support a particular VAAI command, this VAAI command must be disabled on all ESX servers in the vSphere cluster before presenting datastores to ESX hosts. The VAAI commands are:

- Full copy: Can significantly speed up the process of deploying virtual machines. Implemented via the xcopy SCSI command.
- Block zero: May speed up bulk zeroing of a disk. Also called copy same.
- Hardware-assisted locking: Implements a LUN locking mechanism that is more efficient in the clustered host environment. Also called Atomic Test and Set. Implemented using the Compare and Swap SCSI command.
- UNMAP: Allows the ESXi host to inform the storage array that files or VMs had been moved or deleted from a Thin Provisioned VMFS datastore. Added as a VAAI command in vSphere 5.0U1.
Notice: Failure to disable an unsupported VAAI command may lead to data corruption, production data being unavailable to ESX hosts, degraded performance, or switch reboot.

RecoverPoint splitters support each VAAI command at one of the following levels:

- **Unsupported.** If the RecoverPoint splitter does not support a particular VAAI command, it must be disabled on all ESX servers. Failure to disable an unsupported VAAI command may lead to data corruption, production data being unavailable to ESX hosts, degraded performance, or switch reboot.
- **Blocking.** When RecoverPoint blocks or rejects the use of a VAAI command, VMware automatically immediately reverts to legacy behavior, with no risk to data or performance.
- **Supported.** RecoverPoint supports the VAAI command and its functionality.

### Table 2. VAAI commands supported by RecoverPoint, according to write-splitter type

<table>
<thead>
<tr>
<th>Feature</th>
<th>Windows write splitter</th>
<th>Brocade write splitter</th>
<th>Cisco-SANTap write splitter</th>
<th>Array-based write splitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full copy</td>
<td>Unsupported</td>
<td>Blocked</td>
<td>Blocked</td>
<td>Blocked</td>
</tr>
<tr>
<td>Block zeroing</td>
<td>Unsupported</td>
<td>Blocked</td>
<td>Blocked</td>
<td>Blocked</td>
</tr>
<tr>
<td>Hardware-assisted locking</td>
<td>Unsupported</td>
<td>Blocked</td>
<td>Blocked</td>
<td>Supported</td>
</tr>
<tr>
<td>UNMAP – vSphere 5.0U1 and later</td>
<td>Unsupported</td>
<td>Blocked</td>
<td>Blocked</td>
<td>Supported</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**VMware affinity**

In the RecoverPoint Management Application GUI the user can view ESX servers and all their virtual machines, datastores, and RDM drives. This view also displays the replication status of each volume.

For virtual machines that are partially protected by RecoverPoint, the administrator can modify existing RecoverPoint consistency groups to add a replication set containing the unprotected volume. For virtual machines that are not protected by RecoverPoint, the administrator can create a new consistency group with a replication set for each volume not configured for replication.

Any change to virtual machines’ protection status, such as moving from being fully protected to being partially protected, will result in RecoverPoint logging and raising an alert. Additionally, all of the information shown on the Management Application GUI for each virtual machine can be queried through the RecoverPoint CLI.
Replication configurations

RecoverPoint will protect VMware ESX Server virtual machines in the following configurations:

- Replication of a physical server to a local and/or remote standby virtual machine
- Replication of a virtual machine to a local and/or remote virtual machine
- Replication of a physical server to a remote standby physical server with local replication to a standby virtual machine
- Replication of a virtual machine in one or more ESX servers to local and remote physical machines
- Replication of a virtual machine to a remote virtual machine with failover automation provided by VMware vCenter SRM
- Replication of VPLEX virtual volumes that contain one or more virtual machines to a local and/or remote volume
- Replication of VPLEX virtual volumes that contain one or more virtual machines to a remote volume with failover automation provided by VMware vCenter SRM

Conclusion

The innovative technology of EMC RecoverPoint supports flexible levels of protection, without distance limitations and performance degradation. With its unique architecture, powerful data recovery features, and business-driven approach, RecoverPoint offers superior levels of local and remote data protection and business continuity to organizations running VMware ESX.

References

More information on EMC RecoverPoint can be found at the RecoverPoint page on EMC.com and in the following documents on the EMC Powerlink website:

- Introduction to EMC RecoverPoint 3.5: New Features and Functions — Applied Technology
- Improving Microsoft Exchange Server Recovery with EMC RecoverPoint — Applied Technology
- EMC RecoverPoint Family Overview — A Detailed Review
- EMC RecoverPoint Replicating VMware ESX Technical Notes (Powerlink only)
- Using EMC RecoverPoint Concurrent Local and Remote for Operational and Disaster Recovery – Applied Technology
- Solving Data Protection Challenges with EMC RecoverPoint – Best Practices Planning
- EMC RecoverPoint Adapter for VMware vCenter Site Recovery Manger Release Notes (Powerlink only)