EMC REPLICATION MANAGER AND EMC RECOVERPOINT

Abstract

EMC® Replication Manager integrates with EMC’s RecoverPoint technology, offering recovery management of RecoverPoint production, local, and remote images. This technology can create CDP and CRR images of data stored in heterogeneous storage environments. This white paper describes how EMC Replication Manager 5.3.2 integrates with RecoverPoint to offer an end-to-end solution to deliver consistent, scalable performance across a heterogeneous storage environment. It discusses recommendations for configuration, replication, mount, and restore of RecoverPoint replicas. In addition, this paper reviews Replication Manager’s support for RecoverPoint in a VMware environment. April 2012
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Executive summary

EMC® RecoverPoint is an enterprise-class data protection, replication, and disaster recovery solution designed to protect application data on heterogeneous SAN-attached servers and storage arrays. RecoverPoint runs on an out-of-band appliance and combines industry-leading continuous data protection (CDP) technology with unique bandwidth reduction technology, no-data-loss replica creation, and updating to protect data both locally and remotely.

RecoverPoint provide local protection of production volumes using CDP, which captures every write and saves it in a history journal. It also provides continuous remote replication (CRR) for production volumes, using near-CDP technology that transfers significant writes, based on an application’s RPO/RTO, to a remote site where they are saved in a history journal. It can also protect the same volume locally and remotely, which is called concurrent local and remote (CLR) data protection. With RecoverPoint, data recovery can be performed locally and/or remotely by rewinding the target volumes back to a selected point in time by using earlier versions of data saved in the journal.

EMC Replication Manager, when utilized with EMC RecoverPoint, provides solutions that eliminate backup windows without impacting production. This integration helps customers create application-consistent copies of business-critical data locally with RecoverPoint CDP or remotely with RecoverPoint CRR or both local and remote with RecoverPoint CLR. Customers can safeguard their business-critical applications, such as Oracle, Microsoft Exchange Server, Microsoft SQL Server, and VMware-based virtual machines, using local, remote or both RecoverPoint replicas that can be restored to any significant point in time that falls within their protection window.

The RecoverPoint family is comprised of three products: RecoverPoint/CL, RecoverPoint/ESX and RecoverPoint/SE.

The entry-point product is RecoverPoint/SE, which is designed for the homogenous CLARiiON/VNX Block® market, represented by midsize enterprises. RecoverPoint/SE supports two RecoverPoint appliances in each site and has supports all the storage inside the CLARiiON or VNX array. RecoverPoint/SE is limited to replicating locally inside a single CLARiiON/VNX Block array or remotely between two CLARiiON/VNX Block arrays.

RecoverPoint/EX is designed for the Symmetrix VMAX 10K, Symmetrix VMAX 20K, Symmetrix VMAX 40K, VPLEX Local and VPLEX Metro, VNX™ series, CLARiiON® CX3 and CX4, and Celerra® unified storage environments; and RecoverPoint/SE for VNX series, CLARiiON, and Celerra unified environments. RecoverPoint/EX and RecoverPoint/SE are optimized for the EMC storage they support with built-in array-based write splitters. Note: Replication Manager does not support VPLEX virtual volumes.
RecoverPoint/CL is the full-featured product and is best suited for high-end commercial and enterprise organizations. It starts with two RecoverPoint appliances at each site and can grow to eight appliances per site. Capacity is licensed in 1 TB increments, and scales up to 300 TB per cluster. RecoverPoint/CL offers advanced features such as support for intelligent fabric switches, replication across heterogeneous storage arrays, built-in bandwidth optimization, and data compression.

Replication Manager manages EMC point-in-time replication technologies through a centralized management console. Replication Manager coordinates the entire data replication process—from discovery and configuration to the management of multiple application-consistent disk-based replicas. Auto-discover your replication environment and enable streamlined management by scheduling, recording, and cataloging replica information including auto-expiration.

RecoverPoint enables local operational recovery and remote disaster recovery, while Replication Manager streamlines the process by coordinating with the host/application to create the replica, managing the copy process, and handling all of the steps required in the event of a recovery. Replication Manager handles backup and recovery in such a way that the data that has been backed up/recovered is application-consistent.

Replication Manager creates RecoverPoint replica bookmarks simply, quickly, and automatically in physical and VMware environments. In fact, it automates all the important procedures like replication, mount, unmount, and restore related to data replication as well as expiring old replicas based on the defined retention policy.

This white paper describes internal aspects of EMC Replication Manager and explains how it interacts with RecoverPoint CDP and CRR during storage discovery, replica creation, mount, unmount, and restore.

This white paper also describes how Replication Manager interacts with critical applications, such as Oracle, Microsoft Exchange Server, and Microsoft SQL Server applications in physical and VMware environments.

**Note:** Unless otherwise stated in this white paper, any reference to RecoverPoint also applies to RecoverPoint/SE.

**Audience**

This paper has been written for the following audiences:

- Business decision makers, including storage and server administrators, IT managers, and application engineers, as well as storage integrators, consultants, and distributors
- Existing RecoverPoint and Replication Manager customers
- EMC internal and field personnel who assist customers with RecoverPoint technology and Replication Manager installation
**RecoverPoint overview**

EMC RecoverPoint provides local and remote data protection, enabling reliable replication of data over any distance; that is, locally within the same site, and/or remotely to another site—even halfway around the globe. Specifically, RecoverPoint protects and supports replication of data that applications are writing over Fibre Channel to local SAN-attached storage. RecoverPoint uses existing Fibre Channel infrastructure to integrate seamlessly with existing host applications and data storage subsystems. For long distances, it uses either Fibre Channel or an existing IP network to send the data over a WAN.

RecoverPoint captures changes to production volumes, replicates the changes based on the specified RPO for the production volumes to the target volumes, and stores those changes into a history journal for later recovery.

RecoverPoint integrates with Microsoft Exchange and SQL Server though the Volume Shadow Copy Services (VSS) API. It also integrates with other business applications though its programming interface.

RecoverPoint replication is based on consistency groups. A consistency group is one or more replication sets consisting of a production source volume and its local and/or remote replica volumes. A RecoverPoint consistency group ensures that updates to the replica volumes are always consistent and in correct write order; that is, the replicas can always be used to continue working or to restore the production source, in case it is damaged. All of the volumes in a consistency group are monitored to ensure consistency and write-order fidelity. If two volumes are dependent on one another (for instance, a database and a database log), they must be in the same consistency group. Imagine a motion picture film. The video frames are saved on one volume, the audio on another. But neither will make sense without the other. The saves must be coordinated so that they will always be consistent with one another. In other words, the volumes must be replicated together in one consistency group. That will guarantee that at any point, the saved data will represent a true state of the film.

RecoverPoint replication is also policy-driven. A replication policy, based on the particular business needs of your company, is uniquely specified for each consistency group. The policy comprises a set of parameters that collectively governs the way in which replication is carried out. Replication behavior changes dynamically during system operation in light of the policy, level of system activity, and availability of network resources.

**Continuous replication**

The advantage of continuous replication is its ability to provide low RPO, near-synchronous replication without degrading the performance of the host applications. For remote replication, RecoverPoint uses small-aperture image snapshots. By reducing the lag between writing data to storage at the source side and writing the same data at the target side, the extent to which the copy is not up to date is dramatically reduced. For local replication, the lag approaches zero and every change is replicated and retained in the local journal.
Among the other advantages inherent in RecoverPoint’s support for remote replication is that only the changes made since the previous snapshot are transferred, and then only after applying bandwidth reduction and data compression technologies. The data can be compressed up to 10x, which results in significant savings in network bandwidth. Moreover, because the quantity of data that comprises a snapshot is so small, RecoverPoint can inexpensively maintain a journal containing many images. This journal is useful for event rollback when necessary. RecoverPoint replication offers an intelligent and effective remote replication solution. Additionally, RecoverPoint can consolidate multiple recovery points into daily, weekly, or even monthly recovery points to extend the duration of the journal.

RecoverPoint automatically optimizes replication performance based on current conditions, including the replication type (local, remote, or both), application load, throughput capacity, and replication policy. Regardless of the replication optimization, RecoverPoint is unique in its ability to guarantee a consistent copy at the target side under all circumstances, and in its ability to maintain the distributed write-order fidelity in multi-host heterogeneous SAN environments. The components of RecoverPoint can be installed into new or existing SANs, and are compatible with heterogeneous host environments and storage arrays.

RecoverPoint provides the following features:

- Local protection for operational recovery and remote data protection for disaster recovery.
- Integrated continuous data protection technology that enables recovery from data corruption due to human error and rolling disasters. Moreover, data remains consistent at the target side in the face of virtually any system failure.
- RecoverPoint is built on a highly available architecture and runs on its own appliance platform, not on the host server (where it would use valuable memory and CPU cycles), and not on the storage subsystem, where it would use storage resources.
- The replicated copy is always up to date, with multiple copies of the data accessible at all times enabling failover with no data loss.
- Data transfer continues without interruption even during concurrent processing of one or both replicated copies.
- RecoverPoint minimizes use of bandwidth for replication, while reacting dynamically to changing conditions.
- Support for heterogeneous environments:
  - Works with EMC and qualified third-party storage
  - Supports intelligent fabric-based write splitting on switches from Brocade and Cisco
  - Supports multiple storage tiers and enables mixing of EMC and third-party storage
- Supports Symmetrix VMAX 10K, Symmetrix VMAX 20K, Symmetrix VMAX 40K, VPLEX and CLARiiON/VNX array-based write splitting
- Eliminates downtime associated with replication and recovery of data.
- Dramatic storage and network bandwidth savings compared to host or array-based data replication.

RecoverPoint architecture

Specific components of EMC RecoverPoint are shown in Figure 1.

![RecoverPoint Architecture](image)

For further information on RecoverPoint software components, refer to the *EMC RecoverPoint Administration Guide*. Also visit the [EMC RecoverPoint page](#) for more information.

**Replication Manager Overview**

EMC Replication Manager automates and simplifies management of disk-based replicas in support of EMC’s point-in-time replication software, including EMC RecoverPoint, the EMC TimeFinder® family, SnapView™, SAN Copy™, SnapSure™, Replicator™, and Invista® clones. It orchestrates the management of critical business applications and underlying EMC replication technologies to create and manage point-in-time replicas at the application level for a variety of purposes—including backup acceleration, instant restore, re-purposing for non-production environments such as development, simulation, and repurposing, as well as migrating data to lower-cost storage. Customers interested in lowering costs through reducing manual scripting efforts, improving recovery, and creating parallel access to information can implement Replication Manager for backup acceleration, instant recovery, and data repurposing.
Replication Manager handles database mapping and leverages the native quiesce features within the given application such as using VSS for Exchange, VDI for SQL Server, and hot backup mode for Oracle. Replication Manager also utilizes VMware® snapshot technology to create a consistent snapshot of VMFS datastores containing virtual machines. This is useful while creating application-consistent replicas. These replicas are valid backup copies of the data and are ready for immediate use by the secondary server as well as for instant restore back to production.

The features of Replication Manager include the following:

- Streamlined management for EMC’s point-in-time replica products via a single console and point-and-click interface, integrating the technology stack from the application to the storage and replicas.
- Automated discovery of storage arrays, applications, replica technologies, and hosts in the environment.
- Reduced custom scripting that can save customers time and money that might otherwise be spent writing and modifying custom scripts necessary to keep pace with changes to their replication environment.
- Reduced recovery time of disk-based replicas to minutes rather than hours or days, enabling customers to meet service-level agreements for predictable recovery point objectives (RPOs) and recovery time objectives (RTOs).
- Automated replica management addresses the information-access challenges faced by business today; further business continuity can be achieved by automating and managing replicas used for backup acceleration, instant restore to production, repurposing for reporting and test/development environments, as well as moving copies of data to more cost-effective storage.
- User roles with varying degrees of privileges enable others in the organization to be self-sufficient.

**Replication Manager Architecture**

Replication Manager uses a LAN and SAN to communicate and control storage-based functions. Figure 2 shows the Replication Manager architecture and the components that reside in various parts of the system. An introduction to each component is provided.
Replication Manager GUI Console and CLI

The Replication Manager Console is a portable Java application that lets you control Replication Manager from a Windows system that has a TCP/IP connection to the Replication Manager Server.

A command line interface is also provided to facilitate scripting. It can be run interactively or in batch mode.

Replication Manager Server

The server software is installed on a Windows system. It controls replication activities and stores data about each replica. The server software has three distinct components:

- **Replication Manager Server Service**, also known as the IRD, controls and coordinates replication and recovery activity for all storage corresponding to registered clients and their application sets. The IRD also handles all requests from the Replication Manager Console and CLI.

- The **policy engine** links Replication Manager with the supported storage technologies. The policy engine is a set of dynamic libraries that link to the Replication Manager Server Service. The policy engine analyzes the storage environment and selects the appropriate storage for the replica.

- **Replication Manager Repository** is an embedded database that stores data about application sets (for instance, information about Exchange storage groups), jobs (mount, backup, log truncation, and so on), and replicas.
Replication Manager Agents

Replication Manager uses specialized agent software to communicate with the database or file system that is being replicated. Replication Manager Agent software is installed on each host that participates in the replication process, including hosts that manage production data and hosts that are used to mount and back up replicas. The agent software has three distinct components:

- **Replication Manager Client Service (IRCCD)** — waits for incoming requests from the Replication Manager Server (IRD), and then coordinates all operations on the agent.
- **Storage Services** — The component that manages the storage relationships between the IRCCD and the storage technologies/storage array used to create the replicas. For each storage array, Replication Manager has a separate library, dynamically linked and loaded with the IRCCD at runtime. Each library provides Replication Manager with a logical view of the data that resides on the storage array; therefore, Replication Manager can ensure that the data can be replicated safely.

  For example, the Storage Services RecoverPoint library takes care of replication of RecoverPoint-based consistency groups. The Storage Services CLARiiON library takes care of replication of CLARiiON/VNX Block-based storage technologies. The Storage Services Symmetrix library takes care of replication of Symmetrix-based storage technology.

- **Application Agents** — Replication Manager has a separate agent to work with each application like Microsoft Exchange, Oracle, Microsoft SQL Server, and supported file systems. Each agent is a separate library, dynamically linked and loaded with the IRCCD at runtime.

  Each agent provides Replication Manager with a logical view of the application that resides on the storage device; therefore, Replication Manager can:

  - Specify which data to replicate.
  - Quiesce the database.
  - Return the database to normal operation.
  - Shut down and/or unmount databases during restore operations

  For example, in the case of an Oracle replication, the Oracle Application Agent connects to the Oracle database, obtains a list of the data files, and shuts down the database.

For more information, refer to the Replication Manager support information from the E-Lab™ Interoperability Navigator on the Powerlink® website.

Replication Manager Client

Replication Manager supports CLARiiON/VNX Block and Symmetrix storage arrays that are used by RecoverPoint CDP, CRR, and CLR on Microsoft Windows Server 2003.
and Windows Server 2008. Replication Manager also supports VMware VMDK (virtual disk), Microsoft initiator discovered disks, and VMware RDM/P disk replicas for these same RecoverPoint configurations.

Replication Manager Client communicates with the RecoverPoint appliance to perform the following:

- Discover the consistency groups and storage resources
- Apply application-consistent bookmarks
- Recover the replicated data back to a specific application-consistent bookmark

The Replication Manager Client also ensures that the data is replicated safely.

**Business problems solved with Replication Manager and RecoverPoint**

EMC Replication Manager, when utilized with EMC RecoverPoint, provides solutions that eliminate backup windows without impacting production. By creating application-consistent copies of business-critical data locally with RecoverPoint CDP or remotely with RecoverPoint CRR the user can roll back to any point in time or to an application-consistent point-in-time copy. This enables instant restores or surgical repairs of the production environment.

The user can also create production replicas for repurposing activities such as development, QA, reporting, or training environments. When EMC snap and clone technology is combined with RecoverPoint the user gains even more flexibility, particularly for repurposing environments.

For example, in the event one of your non-production environments requires the use of a production copy, it may be desirable to create a snap or clone of that environment for longer-term activities. Using EMC Replication Manager you would select the appropriate image, then mount the RecoverPoint point-in-time image to a mount host and then create a snap or clone for long-term repurposing. Unmounting the RecoverPoint image frees up valuable journaling resources for production but leaves the clone or snap mounted for long term usage.

**Applications supported for RecoverPoint with Replication Manager**

This section summarizes the applications jointly supported by Replication Manager and RecoverPoint.

**Oracle database**

Replication Manager supports Oracle databases on Windows Server 2003 or Windows Server 2008 on file systems. Replication Manager can bookmark specific CDP, CRR,
or CLR images that reside on EMC CLARiiON or VNX Block or Symmetrix volumes, and can bookmark a RecoverPoint CDP and CRR replicas of standard Oracle databases. The software protects these databases by creating and managing application sets that contain one or more Oracle databases or specific Oracle tablespaces. These replicas can be mounted or later restored to the original production environment.

Before each replication, Replication Manager discovers the location of the data to replicate, and identifies the pathnames for all the data files in the requested tablespaces. Replication Manager then offers two methods for bookmarking a RecoverPoint CDP or CRR replica of an Oracle database:

- Online using hot backup mode
- Offline by shutting down the database

Creating replicas with hot backup mode

Oracle online replication with hot backup mode allows organizations to bookmark an image of the data while the database continues to serve data. Replication Manager puts the database into hot backup mode prior to creating the RecoverPoint bookmark. The software tracks changes to the database in an online redo log, and can later apply those changes to the database, after the bookmark has been created.

You can provide pre- and post-replication scripts to perform any specific tasks before and after the replica is created; however, if you do choose to specify pre- and post-replication scripts, the pre-replication script must invoke the Oracle Online Backup mode and the post-replication script must release the database from Online Backup mode. If you do not provide pre- and post-replication scripts, Replication Manager performs these tasks for you.

The Oracle Agent also performs the following tasks:

- Catalogs the replica by copying all relevant information to the Replication Manager Server database
- Saves the archive redo logs covering the time since the start of the replication (after the first new log was started)

Creating replicas with offline mode

Oracle replication with offline mode allows organizations to create an application-consistent recovery point of the data by shutting down the database before creating the bookmark. Replication Manager starts the Oracle database automatically after creating the bookmark. Shutting down is necessary to maintain consistency of the Oracle application. The software tracks changes to the database in the redo log, and can later apply those changes to the database, after the bookmark has been created.

You can provide pre- and post-replication scripts to perform any specific tasks before and after the replica is created; however, if you do choose to specify pre- and post-replication scripts, the pre-replication script must include the command to shut down the instance. If you provide a pre-replication script for an offline replication, Replication Manager checks that the database instance is shut down before issuing a
RecoverPoint bookmark. If it is not, Replication Manager fails the replication. If a post-replication script is specified for the job, the script must include the command to start up the database instance. If you do not provide pre- and post-replication scripts, Replication Manager performs these tasks for you.

Replication Manager performs the following tasks:

- Catalogs the RecoverPoint images by copying all relevant information to the Replication Manager Server database
- Saves the archive redo logs covering the time since the start of the replication (after the first new log was started)
- Initiates and controls the mounts and restores of Oracle databases, archived redo logs, and control files
- Optionally mounts a replica to an alternate host, as long as that host has an installed Oracle database server
- Optionally restores the replica to the production database server

**Microsoft SQL Server database**

Replication Manager can protect SQL Server databases by creating and managing application sets that contain either entire SQL Server databases or one or more filegroups. The software supports SQL Server alone and installed in a cluster running Microsoft Cluster Service (MSCS). Replication Manager offers two replication options for SQL Server databases protected by RecoverPoint CDP or CRR:

- Full Database
- Filegroup

Replication Manager uses the Microsoft SQL Server Virtual Device Interface (VDI) to create a consistent snapshot of the data in the defined application set.

In a full database replication, Replication Manager copies all the data and related transaction logs (for example, .ldf), which must also be located on disks in the same storage array as the data. For a filegroup replication, the software copies one or more filegroups (usually a subset of the filegroups that compose the database). Related active transaction log(s) are not replicated as part of a filegroup replication.

Replication Manager supports two approaches for replication for SQL Server databases: full online with the advanced recovery option, and copy online with the advance recovery option for recovering a database. Copy online with the advanced recovery option is supported from SQL Server 2005 only. For these advanced recovery options, Replication Manager uses Microsoft SQL Server VDI mode to quiesce the SQL data.

Before each replication occurs, Replication Manager discovers the location of the data to replicate, and identifies pathnames for all datafiles and active logs in the dataset. Replication Manager freezes I/O to the database and issues a RecoverPoint
bookmark, and then the Replication Manager SQL Server agent thaws I/O to the database and the SQL Server database can resume normal operations, including writes to the database. The Replication Manager SQL Server agent catalogs the replica by copying all relevant information to its internal database. The agent also catalogs the locations of the data files, transaction log files, and the metadata file required for a restore or mount.

**Microsoft Exchange database**

Replication Manager can replicate and mount one or more Microsoft Exchange storage groups or all storage groups in the Exchange mailbox server, and automates RecoverPoint-related operations to bookmark Exchange database replicas. Replication Manager also integrates with Microsoft Volume Shadow Copy Services (VSS) technology, enabling the RecoverPoint CDP or CRR replicas to be used for backup or other secondary applications—without disrupting production systems. The software manages a number of functions and processes that enable automated local replication, including checking database integrity and coordinating the recovery process.

Before and during replication, Replication Manager performs these steps:

1. Discovers the location of the data to replicate and identifies pathnames for all the data in the requested storage groups.
2. Coordinates with VSS to quiesce Exchange I/O just long enough (a few seconds) to issue a RecoverPoint bookmark.
3. Mounts the RecoverPoint replica (data and log LUNs) to the mount host.
4. Verifies the integrity of the Exchange database and log files.
5. Once replication is complete, Replication Manager automatically dismounts the RecoverPoint replica from the mount host.

The Replication Manager Microsoft Exchange agent is a specialized module of agent software that enables Replication Manager to create RecoverPoint bookmarks of Microsoft Exchange storage groups. It also allows Replication Manager to initiate and control online or offline replications of Microsoft Exchange data at the storage group level.

In an Exchange/VSS environment, users can select Online Full, Online Copy, or Online Differential (Exchange 2007 only) as the replication option. For the Online Full option, Replication Manager replicates the storage group(s), transaction logs, and checkpoint files, and then verifies the consistency of the databases and logs and then truncates the logs. For the Online Copy option, Replication Manager replicates the storage group(s), transaction logs, and checkpoint files in the same way as it does during an Online Full option, however, it does not truncate the logs. Copy replications are often intended for testing and diagnostic purposes only. Lastly for the Online Differential option, available only for Exchange 2007, Replication Manager replicates only the transaction logs since the last full or incremental backup. A full backup of the selected storage group must exist or the replication fails. If the system files are on
another volume, it is also replicated. The transaction logs are not truncated on completion of the backup.

Replication Manager offers some advanced features that change how consistency checks are executed. Enabling these features can impact performance. For most users the default settings are sufficient. These advanced features include:

- **Minimize log checking** — Choosing this option speeds up the log checking by instructing the consistency checking software to check only those logs that are required to recover the database. Selecting this option improves the performance of the consistency check.

- **Parallel consistency checks** — Consistency checks can run against the databases in parallel (all databases for a storage group at the same time) or sequentially. If the databases all reside on the same LUN, use the sequential option.

- **I/O throttling during consistency checks** — In some versions of Exchange, consistency checks can be paused to throttle the consistency checking operation. Specific functionality of consistency check throttling depends upon the version of Exchange as follows:
  - **Exchange 2003** - Throttling is available in SP2 only and you can only specify the number of I/Os after which to pause.
  - **Exchange 2007** - Throttling options allow you to specify the number of I/Os after which to pause and the duration of the pause.

The Replication Manager Exchange agent can initiate and control mounts and restores of Microsoft Exchange replicas. The Exchange agent can:

- Mount a replica to an alternate mount host at the same location/new location as the production host
- Mount a replica to the original production host in a new location

Replication Manager can manage a full (database and log) restore of Exchange replicas to the production Exchange server. When a Microsoft Exchange replica is restored, any of the following restore options can be chosen:

- All storage groups in the application set
- One or more storage groups from the application set
- One or more databases from the application set

From Replication Manager 5.1.2, users can restore just the logs in case of Exchange 2007.
Replication Manager with RecoverPoint in VMware environments

VMware virtualization lets one server do the job of multiple servers, by sharing the resources of one server across multiple environments. VMware ESX Server is a virtualization layer that runs on physical servers. It abstracts processor, memory, storage, and networking resources to provision multiple virtual machines (VMs). VMware ESX Server allows you to host multiple virtual machines and multiple applications on a single physical server. RecoverPoint is tightly integrated with VMware.

RecoverPoint can replicate VMware application data either as part of a VMware File System (VMFS), or as a LUN accessed by VMware using raw device mapping (RDM). In either case, RecoverPoint replicates only entire LUNs. You must use RDM in physical mode (RDM/P) when your configuration includes the following:

- The virtual machine is using a RecoverPoint Windows-based KDriver.
- A physical host is replicated to a virtual machine (also known as physical to virtual or P2V).
- A virtual machine is replicated to a physical host (also known as virtual to physical or V2P).
- The application requires SAN-awareness or access to a layered SAN application.
- The application vendor recommends raw device mapping.

In all other cases, either VMware file systems or RDM may be replicated. However for recovery purposes it is important that each VMware file system and all of its LUNs are in a single RecoverPoint consistency group. If it becomes necessary to recover data from a previous point in time of a RecoverPoint replica, it will be necessary to roll back all LUNs and all the virtual machines in the consistency group or group set. You may wish to create multiple VMware file system volumes and place them in separate consistency groups, so that you can distribute virtual machines in separate VMware file systems and manage the VMware file systems independently of one another for finer-grained control of virtual machines.

Many VMware features only work if virtual machines are configured to use VMFS. It is important to support application-consistent replication using RecoverPoint if the data/logs span VMFS and RDM disks.

Replication Manager version 5.1.3 and later releases support VMware virtual disks, Microsoft iSCSI initiator discovered disks, and RDM/P disk replicas created on a Windows guest operating system environment using CLARiiON/VNX Block and Symmetrix arrays and RecoverPoint replication technology. The VMware VMotion, DRS, and High Availability features are also supported in VMware environments with Replication Manager.
**Replica Management within Guest OS**

![Diagram showing Replica Management within Guest OS](image)

**Figure 3. VMware VMDK, RDM/P, and Microsoft iSCSI initiator discovered disks**

**VMware VMDK support**

Replication Manager supports virtual disks on CLARiiON/VNX Block and Symmetrix arrays on Windows guest operating systems in RecoverPoint environments. By configuring a dedicated VMFS-to-VMDK mapping for application data, Replication Manager has the ability to manage application-consistent replicas in RecoverPoint for typical applications such as SQL Server 2005 and 2008, Oracle 10g and 11g, and Windows volumes. Although single VMFS volumes can contain one or more LUNs and one single VMFS can contain one or more VMDKs, Replication Manager supports only one VMDK per VMFS and one LUN per VMFS.

By configuring a dedicated VMFS to virtual disks for production replicas Replication Manager ensures application consistency for business continuity, backup acceleration, and/or repurposing.

**Microsoft iSCSI initiator discovered disk support**

Replication Manager supports Microsoft iSCSI initiator discovered disks on CLARiiON/VNX Block arrays for creating application-consistent replicas of SQL Server 2005, Oracle 10g and 11g, and Windows volumes in RecoverPoint environments.
VMware RDM/P disk replica support

Replication Manager supports raw device mapping disks in physical mode with RecoverPoint on CLARiiON/VNX Block and Symmetrix arrays. RDM/P provides a mechanism for a virtual machine to have direct access to a LUN on the physical storage subsystem. An RDM/P disk can be thought of as a symbolic link from a VMFS volume to a raw LUN.

Replication Manager supports mapping of the application files on RDM/P devices to the virtual volumes on a VMware virtual machine for Exchange, SQL Server, and Oracle.

Here are few key points to remember to ensure Replication Manager support for RecoverPoint in a VMware environment:

- Do not install EMC PowerPath® on a virtual machine.
- VirtualCenter credentials should be specified while registering the guest OS in the Replication Manager Server.

Configuring RecoverPoint and Replication Manager

This section summarizes the prerequisites required to install and configure RecoverPoint with Replication Manager.

To set up RecoverPoint for use with Replication Manager, install and configure RecoverPoint according to the RecoverPoint documentation. Ensure that the splitters for all mount hosts are attached to the RecoverPoint target volumes they are going to use. Replication Manager support for RecoverPoint requires system time to be synchronized on all production and mount hosts. Identify all volumes belonging to those RecoverPoint consistency groups that are to be covered by Replication Manager. Replication Manager requires that all volumes in an application set map to the volumes in a consistency group.

Replication Manager supports the following RecoverPoint replication options:

- Continuous data protection – RecoverPoint replicates to another storage array at the same site. In a RecoverPoint installation that is used exclusively for CDP, you install RecoverPoint appliances at only one site and do not specify a WAN interface.
- Continuous remote replication - RecoverPoint replicates over a WAN to a remote site. There is no limit to the replication distance.
- Concurrent local and remote – RecoverPoint protects production LUNs locally using CDP and remotely using CRR. Both copies can have different protection windows and RPO policies.

After RecoverPoint setup is complete, perform the following steps within Replication Manager from the Getting Started panel of the Replication Manager console for
creating application-consistent bookmarks. Begin by registering the production and mount hosts. During host registration, enable RecoverPoint support for the hosts, and identify a RecoverPoint appliance to be used. For VMware environments, register the vCenter (formally VirtualCenter) hostname.

![Register New Host](image)

Figure 4. Registering the RecoverPoint appliance

Next, use the Add Storage Wizard to discover the RecoverPoint appliance. If the configuration uses CLARiiON/VNX Block storage, you must also select the associated CLARiiON/VNX Block array in order to provide CLARiiON/VNX Block array credentials.
Creating RecoverPoint CDP or CRR replicas

RecoverPoint supports both local and remote replication across heterogeneous storage. RecoverPoint replicas are full copies of the data that can be created using production data changes that are stored in a RecoverPoint journal. Application-consistent replicas (also known as specific point in time) are created by Replication Manager jobs. RecoverPoint’s normal operation is to create crash-consistent replicas based on RPO objectives provided by the RecoverPoint administrator. For application-consistent replicas, RecoverPoint relies on external application-aware agents to perform the quiesce and will then bookmark (flag) the image as an application-consistent image. Replication Manager works with RecoverPoint to schedule and create these images, enabling application-consistent replicas by quiescing applications before issuing a RecoverPoint bookmark, and thawing applications once the bookmark is created.
The following steps describe how to create a RecoverPoint replica with Replication Manager.

1. Create an application set. In this first step for replica creation, users can specify the data objects to be replicated. Replication Manager detects which applications (that is, file systems, databases) are present on all hosts. Replication Manager discovers database instances while creating an application set. Replication Manager collects the necessary credentials and information to gain access to the database instance. Users can select file systems and databases for replication.

![Application Set Wizard](image)

**Figure 6. Application Set Wizard showing the naming of the application data and selection of objects**

2. Create a job. Replication Manager jobs are application-centric, which means that users specify the logical object to be replicated (for example, a database) and then replicate the corresponding physical devices. RecoverPoint is data-centric, which means that users specify the volumes to be replicated (the physical devices) and RecoverPoint replicates these physical devices. When used together, Replication Manager ensures that the RecoverPoint consistency group contains all devices that belong to the specific logical object that is being replicated. Also, Replication Manager will guide the user to add specific devices that may be missing or remove extraneous devices.

3. Give an appropriate job name to the RecoverPoint job and select the Replication Source. RecoverPoint CDP, RecoverPoint CRR and RecoverPoint
CLR are the available options. Additionally, RecoverPoint bookmarks are the replication technology available.

Figure 7. Job Wizard for configuration

4. Advanced replication settings allow users to select the number of retries, and specify any pre-/post-processing scripts as well as consistency method options.
5. Configuring a job in Replication Manager includes mount options. The Mount Options panel is used to automatically mount the replica to a target host and perform actions, such as running consistency checks (Exchange), performing a backup, or running a post-mount script. This is optional. User can use the Mount Wizard to mount the replica on a mount host after replication as well. If the user selects the mount option while configuring a job, then the mount operation begins after the replication completes.

![Job Wizard](image)

Figure 8. Advanced Replication Settings

6. Figure 9. Mount options within the Job Wizard

7. The job wizard also includes screens to allow users to configure other options. Refer to the *EMC Replication Manager Product Guide* and Online help for specifics.

8. If the source LUN is a VMware virtual disk, then the following prerequisites apply:

9. Ensure that there is only one virtual disk per VMFS and one LUN per VMFS. Multiple LUNs making up a VMFS cause the replication to fail.

10. Configure vCenter (VirtualCenter) credentials in the host properties for each VMware host while registering the Guest OS in the Replication Manager Server. See Figure 4.

11. Right-click the job you want to run and select **Run a Job** from the context menu. See Figure 10.
12. Figure 10. Right-click on a job within Replication Manager and select "Run a Job".

13. Click OK to start the job.

14. Figure 11. Running Replication Manager jobs

15. Replication Manager utilizes the existing RecoverPoint consistency group for the application.

16. The consistency group must already exist and RecoverPoint replication must not be paused.

17. Replication Manager checks that all of the volumes discovered during the application mapping are present in the consistency group; if not all present then the job fails.
18. Once Replication Manager has validated the configuration, it will freeze the application as stated above, issue a RecoverPoint bookmark, and then thaw the application.

19. Next, if configured for mount, Replication Manager starts the mount activity automatically.

**Mounting RecoverPoint CDP or CRR replicas**

Replication Manager provides flexible mount options, which surfaces the CDP or CRR replica on a separate mount host, or alternatively, to a different location on the production host. RDM/P-based replicas may be mounted to physical or VMware virtual machines, while virtual disk replicas may be mounted to VMware virtual machines and VMFS replicas may be presented to ESX servers.

**Prerequisites for mounting a VMware virtual disk replica**

Observe the following prerequisites prior to mounting a VMware virtual disk replica:

- There must be enough unique SCSI target IDs available on the mount virtual machine.
- The LVM disk resignature bit must be set on the ESX server.

**Mount a replica on demand**

To mount a replica on demand, follow these steps:

1. Right-click the replica that you want to mount from the list. The Mount Wizard appears.
2. Choose an existing mount host from the drop-down list.
3. Choose the path options for the mount.
4. Configure additional mount options based on the application (Oracle, Exchange, SQL Server, or file system).
5. Click **Finish** to start the mount. A progress dialog box appears and displays the status of the mount.

The Replication Manager Client performs the following tasks:

a) Selects the appropriate RecoverPoint consistency group replica (CDP or CRR) by bookmark and enables image access through RecoverPoint. This results in the target LUN being rolled back to the specific point in time represented by the bookmark, and then the LUNs are unmasked so that they are visible in the SAN and accessible to the mount host.

b) Rescans the devices on the mount host.

For a VMware mount host (ESX Server), Replication Manager rescans the RecoverPoint CDP or CRR replica of a VMFS by using the Replication Manager VMware access layer library.
c) Mounts the RecoverPoint CDP or CRR replica as specified. If it is a VMDK disk, then the virtual disk mount is a normal Windows VDS mount. Otherwise it is a VMware RDM/P disk that is mounted using a normal Windows VSS mount.
d) Recovers the database if specified by the user.

**Restrictions for RecoverPoint**

There are a few things to remember when mounting a LUN replicated by RecoverPoint.

- You can mount only one RecoverPoint replica at a time, per application set, per site. In other words, for an application set, only one RecoverPoint replica can be mounted on the local site (CDP), and one on the remote site (CRR).
- After an application set modification, especially after adding or removing volumes from the application set, run a RecoverPoint job before attempting a crash-consistent (any point in time) mount or restore. This gives Replication Manager the information it needs to mount to the correct drive letters, attach to the database, and so on.
- Changes made to a RecoverPoint replica while it is mounted are not persistent; they are lost when you unmount the replica. This behavior is different from mounted replicas using some other replication technologies supported by Replication Manager. Unlike other replication technologies, changes made to a mounted replica can be restored.
- You can restore from a read-write mounted RecoverPoint replica (unlike other replication technologies); changes made to a mounted RecoverPoint replica are propagated to the production volumes during a restore. When the replica is unmounted, changes made to the mounted replica are lost.
- Target volumes must be visible to the mount host.
- If you mount a point in time outside of the protection window, Replication Manager will mount the nearest available time, but the Replication Manager Console will display the time you requested while the replica history log will display the actual time mounted.
- In the event that your production data is unavailable, due to failure of the local RPA or array for example, Replication Manager permits you to mount the remote copy. The consistency group copy you wish to mount must be available.
- VMware restricts a virtual machine from seeing more than one disk with the same virtual disk UID. So production mount of a virtual disk is not supported.

**Unmounting RecoverPoint replicas**

To unmount a RecoverPoint replica, the user right-clicks on the replica and selects the **Unmount** option as shown in Figure 13.
Figure 13. Unmounting a RecoverPoint replica

The Replication Manager Client performs the following tasks by communicating to RecoverPoint:

- Replication Manager unmounts the RecoverPoint CDP or CRR replica (either a normal LUN or a VMware LUN with a VMDK, Microsoft iSCSI initiator discovered disk, or a VMware RDM/P disk). For a normal LUN, Replication Manager follows the normal VSS unmount code path. For a VMware LUN with VMDK, Microsoft iSCSI initiator discovered disk, or a VMware RDM/P disk, Replication Manager follows the normal VDS unmount code path.
- Replication Manager then communicates with RecoverPoint to disable image access for the appropriate RecoverPoint consistency group. This change results in the LUN(s) being masked from the SAN by RecoverPoint and no longer visible to the mount host.
- Rescan the devices on a mount host.
- Remove dead paths.

Restoring from a RecoverPoint CDP or CRR replica

If a database or file system becomes corrupt, it is critical for Replication Manager users to be able to recover their data from a replica. Replication Manager can restore a complete database or file system back to the production environment from a RecoverPoint CDP or CRR replica.

When you recover a database or file system in Replication Manager, the Replication Manager Client performs the following tasks:

- Replication Manager unmounts the production database and file systems.
• Replication Manager selects the appropriate RecoverPoint consistency group replica (CDP or CRR) by bookmark and temporarily enables image access through RecoverPoint.

  This process results in the target LUN(s) being rolled back to the specific point in time represented by the bookmark and provides a starting point for the restore operation.

• Replication Manager communicates with RecoverPoint to recover to production for the appropriate RecoverPoint consistency group.

  This results in the production LUN(s) being restored by intelligently updating them to be identical to the appropriate point-in-time image from the target LUN(s).

• Replication Manager communicates with RecoverPoint to resume production for the appropriate RecoverPoint consistency group.

  This process tells RecoverPoint to resume protection of the application such that any writes that occur on the production LUN(s) will be intercepted by RecoverPoint and replicated to the target LUN(s).

• Replication Manager mounts the database or file system on the production servers.

• Replication Manager performs any restore-selected options such as database recovery.

Note the following before restoring from a RecoverPoint replica:

• RecoverPoint restores are all-or-nothing. You cannot restore a specific file group or table space, for example, from a RecoverPoint replica.

• After an application set modification, especially after adding or removing volumes from the application set, immediately run a RecoverPoint job. This step is especially important if you are planning any crash-consistent (any point in time) mounts or restores. Running the job gives Replication Manager the information it needs to mount to the correct drive letters, attach to the database, and so on.

• If you change the property of a RecoverPoint consistency group whose replicas are managed by Replication Manager, immediately run a RecoverPoint job.

• Before restoring, verify that:

  o RecoverPoint CDP or CRR is enabled for volumes contained in the Replication Manager application set.
  o No job is running for the application set.
  o Target production volumes are mounted.
During a restore, Replication Manager performs the following steps:

1. Unmount the production volumes. This unmount operation removes the source LUN(s) from the host’s virtual frame.
2. Communicate with RecoverPoint to recover the production volumes. This will resynchronize the production volume from the selected RecoverPoint CDP or CRR image.
3. Wait for RecoverPoint to complete the resynchronization operation.
4. After resynchronization is complete, have RecoverPoint resume replication of the production volumes.
5. Rescan the devices on the production host machine.
6. Mount the source volumes.
7. Recover the database if specified.

For VMware virtual disk, the Replication Manager VMware access layer library is used to unmount VMFS, mount VMFS, and make VMware virtual disk visible to the VMware host.
The results of a successful restore through Replication Manager.
Environments supported for RecoverPoint

Support for storage arrays
Replication Manager supports RecoverPoint on Symmetrix VMAX 10K, Symmetrix VMAX 20K, Symmetrix VMAX 40K and CLARiiON/VNX Block arrays, as well as on Fibre Channel attached block volumes available with Celerra NS20, NS40, NS80, NS-120, NS-480 and NS-960, and on Symmetrix Fibre Channel arrays. Replication Manager 5.3.2 does not support non-EMC arrays, even if RecoverPoint supports those arrays.

Support for physical hosts
This section lists the supported operating systems and applications that can interoperate with RecoverPoint and Replication Manager 5.3.3

- Supported operating systems:
  - Linux, Solaris, AIX, HP (Please refer to latest Replication Manager support matrix)

- Supported applications:
  - Oracle 10g, 11g

Support for VMware hosts
This section explains supported OS and applications for VMware VMDKs (virtual disks), Microsoft iSCSI initiator discovered disks, and RDM/P disks on RecoverPoint with Replication Manager 5.3.2. Note that ESX Server should be running VMware ESX 3.5 and VirtualCenter should be VC 2.5.

- Supported operating systems:

- Supported applications:
  - Oracle Database 10g, Oracle Database 11g
  - Microsoft Exchange Server 2003, 2007 (supported with VMware RDM/P disks only)

Microsoft Exchange Server is not supported for VMware VMDKs because the VMDKs do not have the appropriate SCSI INQUIRY data required for VSS hardware snapshots. So VSS is not supported. For this reason Microsoft Exchange Server is not supported.

For the most up-to-date information on supported versions, please refer to the EMC Replication Manager Support Matrix and the RecoverPoint section in the E-Lab Interoperability Navigator on the Powerlink website.
**Conclusion**

Replication Manager offers comprehensive protection for RecoverPoint environments and supports RecoverPoint CDP and CRR replicas in physical and virtual environments. These replicas can be mounted, restored, and recovered using Replication Manager.

The procedures described in this white paper can help you develop replication strategies for RecoverPoint in physical as well as virtual environments.

**References**

For more information refer to the following sources on Powerlink:

- EMC Replication Manager Administrator’s Guide
- EMC Replication Manager Product Guide
- EMC Replication Manager Release Notes
- EMC Replication Manager Support Matrix and EMC RecoverPoint Support Matrix (on Powerlink’s E-Lab Interoperability Navigator)
- EMC RecoverPoint Administrator’s Guide
- EMC RecoverPoint Release Notes

The following white papers are also available on EMC.com:

- EMC RecoverPoint Family Overview – A Detailed Review
- Improving Microsoft Exchange Server Recovery with EMC RecoverPoint- Applied Technology
- Simplifying Your SAP Environment with EMC RecoverPoint- Applied Technology
- Using EMC RecoverPoint Concurrent Local and Remote for Operational and Disaster Recovery - Applied Technology