Abstract

EMC® Replication Manager can be configured to interoperate with EMC Symmetrix® Remote Data Facility/Cluster Enabler (SRDF®/CE) to create replicas of certain applications residing in clustered environments. This white paper describes this specialized environment and exactly how to configure the environment to support an EMC Replication Manager implementation. The paper also discusses the capabilities of Replication Manager within the environment and provides references to other related documentation that can provide further information.

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Executive summary
In today's world, high availability and disaster recovery are critical components of any enterprise-wide storage solution. One solution that EMC offers to help customers protect their critical data is Symmetrix Remote Data Facility with Cluster Enabler (SRDF®/CE). This software facilitates the creation of remote, synchronous copies of mission-critical data that is also protected from loss by the presence of Microsoft Cluster Server software.

Replication Manager is tolerant of environments where SRDF/CE has been installed and, with careful planning and configuration, the product can be used to create application-consistent replicas of applications that are deployed and protected using SRDF/CE.

Introduction
This white paper outlines the configuration steps and special considerations involved in preparing your SRDF/CE environment to support Replication Manager. It also describes the special considerations associated with using Replication Manager to create replicas, mount those replicas, and restore those replicas in the context of an SRDF/CE implementation.

Audience
This paper is intended for EMC customer support, field engineers, and customers who are engaged in implementing the EMC Replication Manager product in an SRDF/CE environment in support of Microsoft applications (Exchange or SQL Server). The paper is designed to alert the reader to special considerations important when designing a Replication Manager solution to protect data within an SRDF/CE environment.

Terminology
The following is a glossary of important terms useful to reader.

- **BCV device** — A Symmetrix business continuance volume (BCV) that functions as a mirrored media to a standard device for a protected storage environment.
- **Cluster** — A group of two or more independent computers addressed and used as a single system.
- **Cluster aware software** — Software that provides a restart mechanism invoked whenever the application resource is moved to another node in the cluster.
- **Cluster Service** — The collection of software on each node that manages all cluster-specific activity.
- **Quorum disk** — An ordinary disk volume used as a special communication mechanism between server systems. In an MSCS cluster, a small amount of cluster system data (a few megabytes) is stored on this volume.
- **Mirror devices** — RAID protection within the DMX (RAID 1).
- **R1/R2** — R1 indicates the production volume. R2 indicates the DR volume.
- **SRDF (Symmetrix Remote Data Facility)** — A feature of Microcode that is separately licensed and allows data to be replicated across geographically dispersed sites.
- **SRDF/S** — An SRDF mode of operation that ensures 100 percent synchronous mirroring between the two Symmetrix arrays. Applications are notified that an I/O (or I/O chain) is complete when the R2 Symmetrix array acknowledges the data has been secured in cache.
- **SRDF/CE Symmetrix Remote Data Facility Cluster Enabler** — High-availability geographical clustering with simplified disaster recovery/restart.
- **Symmetrix TimeFinder®** — A powerful suite of local storage replication technologies that leverage EMC’s Symmetrix storage architecture. This basic suite of products include TimeFinder/Clone,
TimeFinder/Snap, and TimeFinder/Mirror, each of which can be used to create local replicas of production data for faster disk-based restores or repurposing.

- **Virtual server** — Windows enables the creation of virtual servers. Unlike a physical server, a virtual server is not associated with a specific computer and can be failed over like a group. If the node hosting the virtual server fails, clients can still access its resources using the same server name.

**Replication Manager overview**

Replication Manager is an enterprise product that facilitates the rapid and reliable creation of data replicas using a wide range of EMC storage array technology. In addition, Replication Manager is application-aware, with the technology built in to interact with selected applications and database technologies in order to create quiesced, consistent replicas of many popular application environments. In addition to these attributes, Replication Manager can be configured to work with the popular Symmetrix Remote Data Facility/Cluster Enabler for MSCS (SRDF/CE). Support for this specialized software is not automatic. This white paper describes important special configuration steps and manual procedures that are necessary to ensure the proper interaction of Replication Manager and SRDF/CE. Figure 1 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 software architecture](image)

**Figure 1. Replication Manager software architecture**

**Replication Manager 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. 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:

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• **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.

• **Policy Engine** links Replication Manager with the supported storage technologies. The Replication Manager Server Service uses the policy engine to analyze the storage environment and select the appropriate storage for the replica.

• **Replication Manager Repository** is an embedded database that stores data about application sets (for instance, information about SQL Server databases and filegroups), jobs (backup options, mount options, and so on), and replicas.

When installed on Microsoft Cluster Server, Replication Manager Server is a cluster-aware application and its components will fail over to a passive node in the event of a cluster failover.

**Replication Manager agents**

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**, also known as IRCCD, waits for incoming requests from the IRD, then coordinates all operations on the agent.

• **Storage services** component manages the storage relationships between the client service and the storage technologies used to create the replicas.

• **Application agents** are provided for each supported file system and database application, including Microsoft SQL Server. Each agent is a separate dynamic library (DLL) that is loaded by the client service as needed. The following section describes the SQL Server agent in detail.

**Supported storage technologies**

This section summarizes the storage technologies supported by Replication Manager that relate to SRDF/CE replication.

**Symmetrix and other replication technologies**

On Symmetrix arrays, Replication Manager can take advantage of TimeFinder/Mirror (BCVs), TimeFinder/Clone (STDs), or TimeFinder/Snap (VDEVs). Symmetrix-based storage technologies to consider for SQL Server replication are:

• TimeFinder/Mirror, which creates mirror images of active production volumes from a standard device onto a BCV device

• TimeFinder/Mirror (remote), which creates mirror images of active production volumes from a standard device onto BCVs for R2 devices across an SRDF link

• TimeFinder/Clone, which creates copies of active production volumes in which the source and target devices can be either STD or BCV devices

• TimeFinder/Clone (remote), which creates copies across an SRDF link from an R1 device onto a STD or BCV on a remote Symmetrix

Note: This paper describes how to enhance this functionality to include support for geographic clustering via SRDF/CE for MSCS.

• TimeFinder/Snap, which creates copies of active production volumes or R1 devices onto a TimeFinder/Snap (also known as a VDEV) on the local Symmetrix

• Symmetrix TimeFinder/Snap (remote), which creates copies of active production volumes onto TimeFinder/Snaps (VDEVs) by way of an R2 device located on a remote Symmetrix array (connected to the production volumes using SRDF/S)

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Note: This paper describes how to enhance this functionality to include support for geographic clustering via SRDF/CE for MSCS.

• SAN Copy™ (Symmetrix-to-CLARiiON®)

Replication Manager also supports CLARiiON®, Celerra®, and Invista® storage. It can operate in environments that include SRDF/CE, VMware, VMware SRM, and EMC RecoverPoint.

SRDF/CE overview

SRDF/CE enhances high availability and automated failover through storage-based replication via SRDF/S that is also integrated with the popular server clustering software Microsoft Cluster Services (MSCS).

This solution offers complete site high availability by integrating host-based clustering software with storage-based remote replication. Traditional cluster environments do not integrate the cluster application with the storage replication technology. SRDF/CE removes this limitation by delivering tight integration of storage-based replication with industry-leading cluster applications.

To summarize, SRDF/Cluster Enabler provides:

• High availability for servers and applications
• Disaster recovery and restart
• Increased data availability with continued service during server and host application failures
• Decreased system downtime, minimizing revenue lost in the event of a site disaster
• Higher return on your Symmetrix investment
• Support for multiple clusters and/or multiple heterogeneous clusters on a pair of Symmetrix systems

Implementation considerations

Implementing Replication Manager into an SRDF/CE environment requires that you use a very specific set of supporting hardware and software. This section provides an overview of supported configurations, images of the configuration, specifics of supported software versions, and related configuration guidelines. Review this section carefully to ensure that your hardware and software configurations support this integration.

General information

SRDF/CE configurations facilitate the transfer of MSCS clusters with up to eight or 16 nodes (depending on the version of the operating system) to a geographically distributed site across SRDF/S links.

SRDF/CE sites that have Replication Manager incorporated into them can include the following cluster resource groups across an SRDF/CE link:

• Cluster resource group to protect Microsoft SQL Server or Microsoft Exchange data and logs (includes the quorum disk for the cluster)
• Cluster resource group to protect the Replication Manager Server to ensure that the server fails over along with the application data
• Cluster resource group to protect the mount host and ensure that a mount host is available on the active node of the cluster

Supported configurations

When considering how to implement Replication Manager in a SRDF/CE environment, there are two configurations to use as a guide. Use the first configuration when Replication Manager is an integral part of the disaster recovery plan and must be available immediately after failover. Use the second configuration
when Replication Manager is less critical to the disaster recovery plan and service level requirements provide for a reasonable period of time to recover the Replication Manager part of the environment.

**Configuration 1 – includes high availability for Replication Manager**

In this configuration, the Replication Manager Server is installed as a clustered resource in the SRDF/CE cluster. When a failure occurs at the primary site, the server can fail over to the secondary site and continue to run scheduled jobs. Refer to "Installing Replication Manager in an SRDF/CE environment" on page 9 for information about installing the server as a clustered resource.

The mount hosts in this configuration are virtual servers and are also part of an SRDF/CE cluster. In this scenario, create a virtual mount host resource group for each deployed mount host. The virtual mount host resource group consists of an IP address and network name resource. EMC recommends customers deploy a virtual mount host for each instance of Exchange or SQL Server. In that configuration, if one of the resources fails over to the secondary site, the corresponding virtual mount host also fails over at the same time and jobs continue to run uninterrupted. Certain cleanup tasks must occur after a failover. These tasks are explained later in this white paper.

Figure 2 shows a graphical representation of the recommended SRDF/CE environment.

**Figure 2. SRDF/CE recommended configuration**

**Configuration 2 – does not include high availability for Replication Manager**

In this alternate configuration, there are two Replication Manager Servers installed. One Replication Manager Server is installed at the primary site as the “primary server.” A second Replication Manager Server is installed at the secondary site as the “secondary server.” Changes to the database on the primary server are transferred to the secondary server to ensure its database is up to date. If the primary server becomes unavailable, the role of the secondary server can be changed to primary, ensuring that Replication Manager continues to run scheduled jobs.
There are two physical mount hosts in this configuration, with two different names – one at the primary site and one at the secondary site. Because the names of the mount hosts are different, manual intervention is required to modify the mount host name in the jobs after Exchange or SQL Server failover to the secondary site.

Configuration planning

When using SRDF/CE, high availability is a critical component of the solution. Replication Manager Server must be tolerant of environments where SRDF/CE is installed. There are a set of preliminary configuration steps necessary to prepare an SRDF/CE environment for a Replication Manager environment. Those steps and considerations are outlined below:

- **64-bit environments** — SRDF/CE requires the 64-bit version of Solutions Enabler. Replication Manager offers a native 64-bit agent that must be used in order to interact with the SRDF/CE environment. On Windows 2003 x64, Replication Manager can support native x64 Exchange 2007 and SQL Server 2005 or SQL Server 2008 agents. A native x64 file system agent is also supported. 32-bit environments are also supported.

- **Replication Manager support** — You must install Replication Manager 5.2 or later (64-bit versions) in your SRDF/CE environment. Refer to "Installing Replication Manager in an SRDF/CE environment" on page 9 for more information on what components to install where. With this implementation you can create replicas of Microsoft Exchange and Microsoft SQL Server applications.

  **Note:** For the latest support information, refer to the *EMC Replication Manager Support Matrix*, which is available from the Powerlink® website at [http://Powerlink.EMC.com](http://Powerlink.EMC.com).

- **Microsoft Volume ShadowCopy Services (VSS)** — Replication Manager leverages Microsoft VSS to interact with the application during the replication process. VSS imposes a maximum 10-second window during which I/Os may be frozen to the source LUNs of the production instance. Replication Manager must complete the creation of the replica and split the mirrors within that timeframe or the replication fails. Due to this limitation, it may be necessary to limit the number of source LUNs per application set. For example, you may need to break the replication of an Exchange instance down into separate storage groups for each application set.

Using Replication Manager in an SRDF/CE environment

The remainder of this paper describes how to use Replication Manager in an SRDF/CE environment.

**Installing Replication Manager in an SRDF/CE environment**

In order to ensure that Replication Manager works correctly in an SRDF/CE environment, you must install the appropriate Replication Manager components in the proper nodes of the environment.

Installing Replication Manager 5.2 in an SRDF/CE environment

To install the major release (Replication Manager 5.2.0) in as SRDF/CE environment, follow these general steps. For more detailed step-by-step information, refer to the *EMC Replication Manager Administrator's Guide*. These installation steps are for the preferred configuration shown in Figure 2 on page 8, not for the alternate configuration. The following steps include instructions for installing Replication Manager as a cluster resource as well as installing Replication Manager software on both nodes for the mount host.

1. Create a new resource group in the SRDF/CE cluster for Replication Manager.

2. Create an appropriate network name, IP address, and physical disk resources in the Replication Manager cluster resource group created in step 1. Refer to the *EMC Replication Manager Administrator's Guide* for guidelines on the minimum disk resources required to install the Replication Manager Server.
3. Install the Replication Manager 5.2 software on the primary node. Select the Replication Manager Server, "x64 Agents for SRDF/CE" option during the installation of the Replication Manager Agent for SQL and/or Exchange, and the Replication Manager Console.

4. Install any service packs and use the upgrade option to upgrade to the service pack (if necessary).

Note: Do not install the RM Server on all nodes of the cluster, install it only on the primary node.

5. Install Replication Manager SQL Server or Exchange Agent and choose the "x64 Agents for SRDF/CE" option during the installation, and the Replication Manager Console on all secondary nodes.

6. Install any service packs and use the upgrade option to upgrade to the service pack (if necessary).

7. Create a new cluster resource group on each node to provide mount hosts for both primary and secondary sites.

8. Install the appropriate Replication Manager Agent software on the mount hosts and choose the "x64 Agents for SRDF/CE" option. Perform this step on both the primary and secondary nodes of the cluster.

9. Install any service packs and use the upgrade option to upgrade to the service pack on each mount host (if necessary).

Preparing to create replicas in an SRDF/CE environment

When preparing an SRDF/CE environment for replication, you must take into account the added complexity of having a local and remote site. In this configuration, it is important to create replicas on both the local and the remote site to provide full protection in case of a failover.

Remember the following considerations:

- **Storage considerations** — If storage to create SRDF/CE replicas is coming from a Replication Manager storage pool, include storage from both the local and remote array in that Replication Manager storage pools. This ensures that, after a failover or failback, you can still run SRDF/CE jobs on either the local or remote site and appropriate storage will still be available.

- **Effects of failover or failback on existing replicas** — Remote replicas (created on the remote site) will no longer be valid for restore after a failover. Those replicas must be expired and deleted either manually or by the use of custom scripts after the failover occurs. The LUNs used to create these replicas will be used to create local replicas (on the array that was formally the remote array) after failover occurs. Same is true for local replicas after a failback.

Note: Customized scripts can be implemented to automate Replication Manager tasks that must be performed upon failover/failback. The scripts themselves are not supported by EMC. Special arrangements can be made with EMC to receive assistance with this kind of custom scripting. Please contact your sales representative for more information. There is some EMC confidential documentation that describes examples of scripting that can help manage SRDF/CE failover, however, this is not directly available to customers and requires a special service engagement.

Mounting a replica in an SRDF/CE environment

It is important to configure the Replication Manager environment to support mounts both before and after a failover or failback of an SRDF/CE environment. EMC recommends that you configure at least one mount host on both the local and remote sites. There are two possible methods for configuring mount hosts for an SRDF/CE configuration. The first method is preferred.
Using a virtual server as the mount host
To use a virtual server as your mount host, follow these steps for each mount host:

1. Create a new SRDF/CE cluster with one server at each of the local and remote sites.

2. Zone the physical nodes to the appropriate array, depending upon whether you want to access the local or remote array.

3. Create a new cluster resource group called "RM Mount Host."

4. Create an IP address resource in that new cluster resource group.

5. Create a Network Name resource in the new cluster group that is dependent upon the IP address resource.

6. When you create a job that you want to mount in the SRDF/CE environment, use the network name you specified to identify the mount host.

After failover or failback, move the RM Mount Host cluster resource group to the new primary site, either manually or by the use of custom scripts.

Note: Customized scripts can be implemented to automate Replication Manager tasks that must be performed upon failover/failback. The scripts themselves are not supported by EMC. Special arrangements can be made with EMC to receive assistance with this kind of custom scripting. Please contact your sales representative for more information. There is some EMC confidential documentation that describes examples of scripting that can help manage SRDF/CE failover, however, this is not directly available to customers and requires a special service engagement.

Using separate physical servers as the mount host
To use multiple physical mount hosts (at least one on each site) set up the physical mount hosts as you would any other mount host, registering the hosts with the Replication Manager Server. When a failover or failback operation occurs, you must modify the jobs to use the mount host on the new site. It would also work to have duplicate jobs and duplicate schedules (a set for each site). In this scenario, the schedules could be enabled or disabled depending on which site is active.

Cleaning up replicas that have remained mounted during a failover or failback
EMC recommends that you unmount any SRDF/CE replicas as soon as practical in order to avoid issues that occur when a failover or failback occurs while a replica remains mounted. If a replica remains mounted during a failover operation, follow these steps to perform a cleanup:

1. Review the storage tab of the replica properties and record any devices currently in use for the affected replica(s). Those Symmetrix IDs and device IDs will be necessary to run the commands in the following steps.

2. In Replication Manager, perform an unmount operation. This operation will fail and ask if you want to clear the mount status. Choose to clear the mount status.

3. Manually remove the mount points.

4. Make the device(s) not ready using the following command:

   Symdev -sid xxxxx not_ready dev

   Where

   xxxxx is the Symmetrix id.
dev describes the device to make not ready.

5. Unlock the devices using the following command:

```
Symdev -sid xxxx -range dev:dev -lock release
```

Where

xxxxx is the Symmetrix id.

dev:dev describes the range of devices to unlock.

Restoring replicas in an SRDF/CE environment

Restoring local replicas in an SRDF/CE environment has a major impact on the performance of the environment during the restore because a restore requires a refresh of a large amount of data locally that, in turn, requires that data to travel across the SRDF link. This can slow response times during the restore significantly. Whenever possible, schedule restores at times of lowest demand for the SRDF link.

Restore operations must follow the following guidelines.

Before failover:

- Restoring from a local replica is supported before a failover occurs.
- Restoring from a remote replica is not supported within Replication Manager. Remote replicas must be restored manually.

After failover/failback:

- Restoring from a (formerly) local replica is not supported after failover occurs.
- Restoring from a (formerly) remote replica is not supported after a failback occurs.
- Restoring from a local replica on the original site after a failover/failback sequence has been completed is not possible, as these replicas are now out of date.
Conclusion

Replication Manager can operate in an SRDF/CE environment, given strict adherence to the setup guidelines outlined in this paper. The interaction of Replication Manager with SRDF/CE is not currently fully automatic and certain restrictions do apply. This paper outlines the expected behavior, where there are restrictions, and how best to use Replication Manager in this environment. There are other documents and case studies that you may want to review as well.

References

For more information on implementing Replication Manager in an SRDF/CE environment, review any of the following documents:

- **EMC Symmetrix Remote Data Facility/Cluster Enabler (SRDF/CE) and Replication Manager with Microsoft Exchange Server 2007 — Case Study**
  This document outlines the EMC Proof-of-Concept (PoC) that demonstrated the functional and performance aspects of SRDF/CE for MSCS combined with Replication Manager and Microsoft Exchange 2007.

- **Reference Architecture: Enterprise Exchange 2003 DMX-3 4500 Replication Manager and SRDF/CE for MSCS**
  This document describes the reference architecture of the Enterprise Exchange 2003 and EMC Symmetrix DMX-3 4500 tested with Replication Manager and SRDF/CE software. This configuration was tested and validated by EMC Global Solutions Operations.

- **Integration Guide: Enterprise Exchange 2003 DMX-3 4500 Replication and SRDF/CE**
  This guide provides information on converting an existing Microsoft clustered Exchange environment into a geographically dispersed cluster using synchronous SRDF/CE.