Mainframe EMC Symmetrix Remote Data Facility (SRDF) Four-Site Migration

Version 1.0

- Dynamic SRDF Four-Site Data Migration Configuration
- Consolidation Performance Analysis
- Migration Pilot and Cutover

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As part of an effort to improve and enhance the performance and capabilities of its product line, EMC routinely releases revisions to its hardware and software. Therefore, some functions described in this guide may not be supported by all versions of the software or hardware currently in use. For the most up-to-date information on product features, refer to the product release notes.

This document describes best practices and a detailed example of using SRDF four-site migration (also known as dual-site migration) in a mainframe environment to migrate from existing local and remote Symmetrix arrays to replacement local and remote Symmetrix arrays, providing immediate remote protection of production data at migration cutover. The example is also an instance of a consolidation reducing the number of Symmetrix arrays in the new data centers; the consolidation is validated by a performance analysis included in this document.

Audience

The intended audience for this document is storage administrators, system administrators, and anyone interested in migrating both the local and remotely mirrored copies of devices from one set of Symmetrix arrays to another.

Readers of this document are expected to be familiar with:

◆ Symmetrix family hardware and Enginuity features
◆ EMC ResourcePak Base for z/OS
◆ Symmetrix Remote Data Facility (SRDF)
◆ SRDF Host Component for z/OS
◆ TimeFinder/Mirror product set for z/OS
This document is divided into nine chapters:

- **Chapter 1, “Introduction,”** summarizes the overall migration project steps and briefly describes each task and references chapters that cover the task steps in more detail.
- **Chapter 2, “EMC Foundation Products,”** provides an introduction to EMC Symmetrix hardware and software technologies that are used to implement the example SRDF four-site migration.
- **Chapter 3, “Symmetrix Remote Data Facility (SRDF),”** provides a detailed overview of SRDF and all of the features that will be used to support the example SRDF four-site migration.
- **Chapter 4, “SRDF Four-Site Migration,”** provides a detailed description of the combination of EMC SRDF and TimeFinder features used to implement SRDF four-site data migration.
- **Chapter 5, “Performance Analysis,”** describes a strategic storage workload performance analysis conducted to ensure that the consolidation aspect of this example migration would work.
- **Chapter 6, “Data Migration Storage Configuration,”** provides an example of the installations, upgrades and conversion and dynamic RDF configuration steps needed to configure and start the example SRDF four-site data migration.
- **Chapter 7, “Migration Pilot,”** provides an example of the steps for dynamically reconfiguring SRDF for the migration pilot verification, and reconfiguring back to production SRDF.
- **Chapter 8, “Migration Cutover,”** provides an example of the steps to stop production I/O and ensure that all data has been propagated to the new production and disaster recovery sites as well as cutover the production application to use the new sites.
- **Chapter 9, “Migration Cleanup,”** provides an example of the steps to cleanup the no longer needed SRDF migration configuration and briefly describes alternatives for decommissioning old storage arrays.

Examples provided in this TechBook cover methods for performing various Symmetrix configuration, SRDF and TimeFinder operations. These examples were developed for a particular migration instance and may need tailoring to suit other four-site migration environments. Any procedures outlined in this TechBook should be thoroughly tested before being implemented in a production environment.
This document is the third in a series of Data Migration TechBooks. Readers should reference the first volume, *Choosing a Data Migration Solution for EMC Symmetrix*, that explores the complexity of data migration and how to select a data migration solution for Symmetrix in an open systems environment.

For readers who have access to EMC Powerlink®, check EMC Powerlink for new TechBooks in this Data Migration series or visit the Vervante On Demand Publishing website:

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Related documentation
Related documents, available on EMC Powerlink, include:

- EMC Mainframe Product Overview
- Mainframe Enablers Installation and Customization Guide
- ResourcePak Base for z/OS Product Guide
- SRDF Host Component for z/OS Product Guide
- Consistency Groups for z/OS Product Guide
- TimeFinder/Mirror for z/OS Product Guide
- TimeFinder Utility for z/OS Product Guide
- TimeFinder/Clone Mainframe SNAP Facility Product Guide
- Mainframe Enablers Release Notes
- Mainframe Enablers Message and Code Guide
- Best Practices for SRDF/A Delta Set Extension Technical Note
- White Paper: Exploiting HyperPAV in EMC Symmetrix DMX Environments - Applied Technology

Conventions used in this document
EMC uses the following conventions for special notices.

Note: A note presents information that is important, but not hazard-related.

CAUTION
A caution contains information essential to avoid data loss or damage to the system or equipment
**Typographical conventions**

EMC uses the following type style conventions in this document:

**Normal**

Used in running (nonprocedural) text for:

- Names of interface elements (such as names of windows, dialog boxes, buttons, fields, and menus)
- Names of resources, attributes, pools, Boolean expressions, buttons, DQL statements, keywords, clauses, environment variables, functions, utilities
- URLs, pathnames, filenames, directory names, computer names, filenames, links, groups, service keys, file systems, notifications

**Bold**

Used in running (nonprocedural) text for:

- Names of commands, daemons, options, programs, processes, services, applications, utilities, kernels, notifications, system calls, man pages

Used in procedures for:

- Names of interface elements (such as names of windows, dialog boxes, buttons, fields, and menus)
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- Full titles of publications referenced in text
- Emphasis (for example a new term)
- Variables

**Courier**

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- System output, such as an error message or script
- URLs, complete paths, filenames, prompts, and syntax when shown outside of running text

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Used for:

- Specific user input (such as commands)

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Used in procedures for:

- Variables on command line
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{ }

Braces indicate content that you must specify (that is, x or y or z)

...

Ellipses indicate nonessential information omitted from the example
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TechBooks@emc.com
This chapter provides a brief executive summary of the entire SRDF four-site migration described in this TechBook. The topics covered include:

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1.1 Introduction

The EMC® Symmetrix® Remote Data Facility (SRDF®) family of replication software offers various levels of Symmetrix-based business continuance, disaster recovery, and data mobility solutions. SRDF products offer the capability to maintain multiple, host-independent, mirrored copies of data. The Symmetrix systems can be in the same room, in different buildings within the same campus, or hundreds to thousands of kilometers apart. By maintaining copies of data in different physical locations, SRDF is an effective mechanism for data center migration. This TechBook will focus on the use of SRDF for four-site migration (also known as dual-site migration) in a mainframe environment to migrate from existing local and remote Symmetrix arrays to replacement local and remote Symmetrix arrays.

1.2 Data Migration definition

Data Migration can be defined as the one-time movement of data from a source to a target, where the data will subsequently only be accessed at the target. The key to this definition is that for any particular piece of data, this is a one time movement. This one time movement differentiates Data Migration from Replication where the application continues to access the source data after the target copy is created. Also, the one time movement differentiates Data Migration from Data Mobility where incremental updates to the data would continue to be applied.

In the case of an SRDF four-site migration, SRDF is being used both for active remote replication and data migration at the same time. Additionally, it is the ability to immediately have disaster recovery (DR) protection using SRDF on the newly migrated to sites that makes four-site migration a valuable solution. As a result of this dual role, SRDF replication operations are included in the examples in this TechBook, because maintaining the remotely replicated DR site is a required part of the solution.

1.3 SRDF four-site data migration project high-level flow

This document is based on an actual EMC customer migration. The steps included in this document are only a subset of all the actions conducted for the full migration. The overall flow of a migration is summarized in Figure 1 on page 17.
The first step selecting a migration method is greatly abbreviated and covered in this introductory chapter. The second step is covered in Chapter 5, “Performance Analysis.” The third, fourth, and fifth steps, which are installing and upgrading hardware and software, configuring SRDF for migration, and starting the migration synchronization, are covered in Chapter 6, “Data Migration Storage Configuration.” The final three steps are covered in their own chapters: Chapter 7, “Migration Pilot,” Chapter 8, “Migration Cutover,” and Chapter 9, “Migration Cleanup.”
1.4 Selecting SRDF four-site data migration

Any particular data migration can be solved by multiple migration methods. Key factors that would result in choosing SRDF four-site data migration include:

◆ Migration from Symmetrix-to-Symmetrix storage arrays
◆ Requirement for remote replication during and after the migration
◆ Requirement for immediate remote replication support at migration cutover

Much more could be written about this selection process including addressing the possible need for temporary additional SRDF ports and network bandwidth to support both the current and migration replication. Since the emphasis of this TechBook is on the configuration and execution of the migration, these selection issues will not be covered. The key features of SRDF four-site data migration including meeting the factors listed above are described more fully in Chapter 3, “Symmetrix Remote Data Facility (SRDF),” and Chapter 4, “SRDF Four-Site Migration.”

1.5 Performance analysis to meet consolidation goals

Customers frequently technically refresh their storage arrays to gain the feature, cost, and performance benefits available with updated hardware and software. Often, they seek to capitalize on those benefits by consolidating multiple old storage arrays into one or fewer newer arrays. In order to ensure that they also maintain or achieve desired performance improvements, it is necessary to conduct a formal performance analysis. An example of such a formal performance analysis can be seen in Chapter 5, “Performance Analysis.”
1.6 Install and upgrade hardware as needed

Migrating to new storage arrays obviously requires the installation and setup of the new hardware and software. Nearly every migration will also require upgrading of existing hardware and software to support either the migration operations or continued operation interacting with the newly installed hardware and software. Newer products are typically only qualified to interact with recent versions of interconnected hardware and software. Therefore, the older versions already present usually have to be upgraded before the migration can begin. It may also be necessary to install or upgrade additional hardware and software to support the migration operations themselves. This TechBook includes the installations and upgrades needed to support the example SRDF four-site migration shown in Chapter 6, “Data Migration Storage Configuration.”

1.7 Configure SRDF for migration and new disaster recovery

SRDF can be dynamically configured to add additional groups, paths, and source/target pairs for remote replication. SRDF four-site migration requires dynamic RDF configuration to be enabled in order to dynamically change the remote replication for the migration pilot and migration cutover steps. Static RDF configurations that may already be in place can be converted to dynamic configurations in order to support SRDF four-site migration. The new storage arrays also need to be configured to support the required SRDF disaster recovery paths, SRDF migration paths, and logical devices for the data to be migrated to. This TechBook includes the conversion and dynamic RDF configuration steps needed to support the example SRDF four-site migration in Chapter 6, “Data Migration Storage Configuration.”

1.8 Start SRDF migration synchronization

After all of the required paths and devices are configured the actual RDF groups and device pairs can be defined. Now, with everything in place, it is time to start the data migration from the original production site devices to the new production site devices and cascaded to the new disaster site devices. For production application performance reasons, this will typically be conducted in an SRDF mode that makes limited use of resources. As a result the migration may take more time and may require additional actions to achieve a testable synchronization point for the migration pilot and cutover. The steps for dynamically
configuring RDF group and pairs and starting the data migration for the example SRDF four-site migration are shown in Chapter 6, “Data Migration Storage Configuration.”

1.9 Migration pilot

When using SRDF four-site migration as described in this TechBook example, the SRDF migration of data is occurring concurrently with SRDF disaster recovery protection. In order to test and verify the new production and disaster recovery sites in full disaster recovery mode, it will be necessary to temporarily suspend active DR protection for the current production site. The best practice is to save a synchronization point to maintain a DR solution which temporarily extends the recovery point objective (RPO). At this point, SRDF can be dynamically reconfigured to put the new production and disaster recovery sites in full disaster recovery mode. The user would then fully test the new sites to validate that everything works as it should. In the example case, production I/O was continuing during the migration pilot verification phase, therefore it is necessary to resume the original RDF configuration to obtain all production data changes before the migration cutover stage. The migration pilot step may be repeated multiple times depending on the scope and results of the verification procedures used. The steps for saving a synchronization point and dynamically reconfiguring RDF for migration pilot verification and back to production RDF are presented in Chapter 7, “Migration Pilot.”

1.10 Migration cutover

Migration cutover is very similar to the migration pilot. The key differences being that there will be no return to the original production environment; instead, the application will be permanently moved to the new production site with immediate SRDF DR support. Therefore, additional steps are required to stop production I/O and ensure that all data has been propagated to the new production and DR sites as well as to cut over the production application to use the new sites. Additionally, for this example it was necessary to monitor the workload performance during the first week of running production on new storage arrays to ensure the customer is meeting their production Service Level Agreements (SLAs). This TechBook includes the steps for migration cutover in Chapter 8, “Migration Cutover.”
1.11 Migration cleanup

After production cutover is complete and the customer is ready to abandon the possibility of returning to using the original production and disaster recovery sites, the new production site SRDF configuration is modified to forget about the old production site. Then the Symmetrix arrays at the original production and disaster recovery sites are free to be repurposed. This TechBook outlines the steps for migration cleanup in Chapter 9, “Migration Cleanup.”

1.12 Operational interfaces

In the mainframe environment there are multiple interfaces available to control SRDF and TimeFinder® including: ResourcePak® base for z/OS, SRDF Host Component for z/OS, TimeFinder/Mirror product set for z/OS, EMC z/OS Storage Manager (EzSM), EMC Ionix™ ControlCenter®, and Symmetrix Management Console (SMC). This TechBook will include examples that use ResourcePak base for z/OS, SRDF Host Component for z/OS, and the TimeFinder/Mirror product set for z/OS.
This chapter provides brief descriptions of EMC Symmetrix hardware and software technologies that are used to implement the example SRDF four-site migration. The topics covered include:

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- 2.3 EMC z/OS host management products........................................ 28
- 2.4 Consulting and IT Services ............................................................. 35
2.1 Introduction

This chapter provides brief introductions of EMC products that are used in migrations like the example described in this TechBook. Products are presented in the following groupings: Symmetrix, z/OS host management products, and Services:

- Symmetrix storage arrays are present in all migrations using the Symmetrix Remote Data Facility (SRDF) product family, because both the source and target arrays must be Symmetrix systems. Best practices for using SRDF include the use of the TimeFinder family of local replication products to save a gold copy of the remotely protected data at key times described later in this TechBook example. Solutions Enabler, the Symmetrix Management Console (SMC) and EMC Ionix ControlCenter Symmetrix Manager are associated management software for managing the Symmetrix.

- z/OS host management products provide mainframe host interfaces for managing Symmetrix arrays including the SRDF and TimeFinder replication features.

- Consulting and IT Services are very often a key component of actual data migrations. In many cases, a majority of the migration costs are in discovery, documentation, mapping and design, provisioning, piloting and qualification. EMC Services are a key method to reduce risk and ensure the success of data migrations.
2.2 EMC Symmetrix storage arrays and associated software

The following sections describe the Symmetrix array: basic architecture, operating environment, replication, and management software.

2.2.1 Basic Symmetrix architecture

Symmetrix is a high-end enterprise storage system with maximum capacity and the highest performance, consolidating massive amounts of data and host applications and storage tiers on reliable, cost-effective networked storage. Symmetrix provides broad connectivity with 4 Gb/s performance, advanced security, high availability, and energy efficiency in an easy-to-operate storage system.

Symmetrix is an Integrated Cached Disk Array (ICDA). All I/Os are cached. There are three functional areas:

- Shared Global Memory provides cache memory
- Front-end directors connect to hosts and service all host I/O requests to/from cache
- Back-end directors stage and destage data between cache and physical disk drives

The Symmetrix architecture can be compared to a MPP (Massively Parallel Processing) server with directors working simultaneously performing all the tasks of the array.

2.2.2 EMC Enginuity Operating Environment

Symmetrix storage arrays run EMC Enginuity™, the most mature, comprehensive, stable, highly available and proven storage operating environment in the industry. Enginuity is the emulation code, service processor code, and other software used by a Symmetrix to implement core functionality. Each processor in every director is loaded with specific emulation code. Enginuity coordinates the independent director processors to act as one Integrated Cached Disk Array.

Enginuity provides base system functionality and advanced features like local (TimeFinder) and remote (SRDF) replication, and other optional software products.

2.2.3 Symmetrix Remote Data Facility (SRDF) family

The EMC Symmetrix Remote Data Facility (SRDF) family of replication software offers various levels of Symmetrix-based business continuance, disaster recovery and data mobility solutions. SRDF
products offer the capability to maintain multiple, host-independent, mirrored copies of data. The Symmetrix systems can be in the same room, in different buildings within the same campus, or hundreds to thousands of kilometers apart. By maintaining copies of data in different physical locations, SRDF is an effective mechanism for data center migration. SRDF is designed for Symmetrix-to-Symmetrix connections through Fibre Channel, Gigabit Ethernet (GigE), and ESCON. SRDF is described in greater detail in Chapter 3, “Symmetrix Remote Data Facility (SRDF).”

2.2.4 TimeFinder family

The EMC TimeFinder family of software is the most powerful suite of local storage replication solutions available. Fully leveraging the industry-leading high-end Symmetrix hardware architecture, it offers unmatched deployment flexibility and massive scalability to deliver a wide range of in-the-system data copying capabilities to meet mixed service level requirements without operational impact. The field-proven TimeFinder family is the most widely deployed set of high-end replication solutions in the industry, with tens of thousands of installations in the most demanding environments. And, only the TimeFinder family can provide cross-volume and cross-storage system consistency, tight integration with industry-leading applications, and simplified usage through automated management. The EMC TimeFinder family of local replication allows users to nondisruptively create and manage point-in-time copies of data to allow operational processes, such as backup, reporting, and application testing to be performed independent of the source application to maximize service levels without impacting performance or availability. The use of the TimeFinder family in this TechBook migration example can be found in Section 7.4.3, “Re-establish Remote BCVs in Site D.”

2.2.5 Management software

Configuration and management of Symmetrix arrays and associated features can be conducted using multiple products including the Symmetrix Management Console (SMC), EMC Ionix ControlCenter Symmetrix Manager, EMC ResourcePak Base for z/OS, SRDF Host Component, and the TimeFinder/Mirror Product Set for OS/390 and z/OS. Management tools for both mainframe and open systems environments are briefly described here and z/OS specific interfaces used through the rest of this TechBook are described more fully at Section 2.3, “EMC z/OS host management products.”
### 2.2.5.1 Symmetrix Management Console (SMC)

EMC Symmetrix Management Console makes managing EMC Symmetrix storage simple through a web browser interface. SMC can manage operations from device creation to Virtual Provisioning™ to replication configuration and monitoring.

### 2.2.5.2 Symmetrix Manager

EMC Ionix ControlCenter Symmetrix Manager is a central feature of the ControlCenter family of products, which provides a unified view for multiple arrays, a single-pane-of-glass interface. Symmetrix Manager is used to discover, monitor, and configure Symmetrix storage from a single console including the ability to automate key system management, and replication tasks.
2.3 EMC z/OS host management products

z/OS management products used for SRDF migration include: EMC ResourcePak Base for z/OS, SRDF Host Component, and the TimeFinder/Mirror product set for OS/390 and z/OS.

2.3.1 EMC ResourcePak Base for z/OS

EMC ResourcePak Base for z/OS is a software facility that provides communication between mainframe-based applications (provided by EMC or independent software vendors, ISVs) and a Symmetrix storage subsystem. ResourcePak Base improves ease of use of mainframe-based Symmetrix applications. ResourcePak Base delivers the EMC Symmetrix Control Facility (EMCSCF) for IBM and IBM-compatible mainframes. EMCSCF provides a uniform interface for EMC and ISV software products, where all products use the same interface at the same function level. EMCSCF delivers a persistent address space on the host that facilitates communication between the host and the Symmetrix as well as other EMC-delivered and partner-delivered applications.

ResourcePak Base is the delivery mechanism for the EMC Symmetrix Applications Programming Interface for z/OS (SymmAPI™-MF). The z/OS SymmAPI architecture is illustrated in Figure 2.

Figure 2  z/OS SymmAPI architecture

ResourcePak Base provides a central point of control by giving software a persistent address space on the mainframe for SymmAPI-MF functions that perform tasks such as:
◆ Maintaining an active repository of information about EMC Symmetrix devices attached to z/OS environments and making that information available to other EMC products.
◆ Performing automation functions.
◆ Inter-LPAR (logical partition) communication through the Symmetrix storage subsystem.

ResourcePak Base provides faster delivery of new Symmetrix functions by EMC and ISV partners and easier upgrades. It also provides the ability to gather more meaningful data when using tools such as TimeFinder Query because device status information is cached along with other important metadata. ResourcePak Base facilitates interprogram communication through a persistent address space on the host. This means that programs are not statically linked, but can be linked dynamically, thus making software installation quicker and easier. ResourcePak Base for z/OS is a prerequisite for EMC mainframe applications such as the TimeFinder Product Set for z/OS or SRDF Host Component for z/OS and is included with these products.

2.3.1.1 ResourcePak Base features
ResourcePak Base provides the following functionality with EMCSCF:
- Cross-system communication
- Nondisruptive SymmAPI-MF refreshes
- Save Device and DSE Monitors
- SRDF/A Monitor
- Controller naming
- Group Name Service support
- Pool management
- SRDF/AR resiliency
- SRDF/A Multi-Session Consistency
- SWAP services
- Recovery services
- SAF security
- Licensed feature code management

2.3.2 SRDF Host Component
EMC Symmetrix Remote Data Facility (SRDF) is an EMC Symmetrix-based business continuance and disaster recovery solution. The SRDF product family provides a mirrored data storage solution that allows you to duplicate production site data on one or more remote target Symmetrix systems. SRDF Host Component is a z/OS subsystem for controlling SRDF processes and monitoring SRDF status by using
commands executed from a host. SRDF Host Component for z/OS is delivered with members of the SRDF product family. User interfaces to the SRDF Host Component are provided via both TSO (ISPF) and batch commands. An optional interface is provided for EMC TimeFinder commands as well as SRDF commands to centralize commands for both replication products. You can issue SRDF Host Component commands to both local and remote Symmetrix systems. Commands destined for remote Symmetrix systems are transmitted via local Symmetrix systems to remote Symmetrix systems via SRDF links.

SRDF Host Component supports three key features: automation, security and an ISPF interface.

2.3.2.1 Automation
SRDF Host Component provides command automation by associating a command, response token, and console ID for all responses to SRDF Host Component commands. This automation allows you to enter commands from and retrieve responses to automation products such as:

- NETVIEW
- AutoOPERATOR
- AF/OPERATOR

2.3.2.2 Security
SRDF Host Component provides security by allowing you to validate authorization through the z/OS SAF interface. As a result, you can use any of the following SAF-compliant security products to ensure proper user authorization:

- RACF
- CA-ACF2
- CA-Top Secret

Note: The security product you select must be compatible with RACF release 1.9 or later.

2.3.2.3 ISPF interface
SRDF Host Component provides a TSO ISPF interface that is implemented as an ISPF dialog. The ISPF interface allows you to enter SRDF Host Component commands and view the command responses from your TSO session. EMC ResourcePak Base (included with SRDF Host Component) includes EMCTOOLS, an ISPF interface that allows you to control several of the EMC zSeries products.
The menus and panels of this interface use REXX and ISPF dialogs to:

- Query your Symmetrix environment
- Issue commands to control that environment
- Build and retain customized command streams

EMCTOOLS provides a “main menu” that includes a SRDF Host Component option. This option allows you to issue SRDF Host Components commands and perform Host Component functions.

The *EMC ResourcePak Base for z/OS Product Guide* describes EMCTOOLS and its Host Component option.

### 2.3.3 TimeFinder/Mirror product set

The TimeFinder/Mirror product set for OS/390 and z/OS (called TimeFinder in this guide) is a business continuance solution.

TimeFinder enables you to make full-volume copies of production data from a standard Symmetrix device (which is online for regular I/O operations from the host) to a Business Continuance Volume (BCV) with which the standard device is paired. The BCV device can then be separated (split) from the standard device and then be used for backup, restore, decision support, or applications testing. After host processing on the BCV device is complete, the BCV can again be mirrored to a standard device, either the same device to which it was previously paired, or with a different device.

#### 2.3.3.1 Mainframe-specific features

Mainframe-specific features of the TimeFinder/Mirror product include:

- Creating dependent write consistent BCVs locally or remotely (with TimeFinder/Consistency Group) without the need to quiesce production jobs.
- Performing BCV operations important to IS departments including:
  - Using the BCV as the source for backup operations.
  - Using the BCV for test LPARs with real data. The speed with which a BCV can be reconstituted means that multiple test cycles can occur rapidly and sequentially. Applications can be staged using BCVs before committing them to the next application refresh cycle.
  - Using the BCV as the source for data warehousing applications rather than the production volumes. Because the BCVs are a point-in-time mirror image of the production data, they can be used as "gold" copies of data to be written and rewritten repeatedly.
With SRDF/Automated Replication (SRDF/AR), making point-in-time safety copies of data sent across links to remote system. Support for mainframe TimeFinder-based queries.

- Compatible with mainframe security mechanisms such as RACF.
- Integration with database management system (DBMS) utilities available from several Independent Software Vendors (ISVs) and their products.
- Integration with many mainframe-specific ISVs and their products.

2.3.3.2 TimeFinder/Mirror has two local replication technologies that are implemented differently in Enginuity 5874 and prior.

**Under Enginuity 5773 and earlier**
Under Enginuity 5773 and earlier, TimeFinder/Mirror used two local-replication technologies as shown in Figure 3:

![TimeFinder/Mirror under Enginuity 5773 and earlier](ICO-IMG-000803)

**Figure 3** TimeFinder/Mirror under Enginuity 5773 and earlier

Under Enginuity 5773 or earlier versions, the BCV was a specially tagged volume established when the Symmetrix unit was configured. The BCV functioned as a mirror that you could manipulate with the TimeFinder/Mirror ESTABLISH, SPLIT, RE-ESTABLISH, and RESTORE commands.
In Enginuity 5x71, a second method was added that used TimeFinder/Clone (a component of TimeFinder/Clone Mainframe SNAP Facility) to control the business continuance process. This technology was clone emulation. Under clone emulation, an internal API function converts TimeFinder/Mirror commands to EMC TimeFinder/Clone Mainframe SNAP Facility commands.

Clone emulation was first used with RAID 5 and RAID 6 BCVs (in all cases). Later, TimeFinder/Mirror let users control, at their option, all other types of BCVs through clone emulation.

In all cases, clone emulation was transparent. As shown in Figure 3 on page 32, users could continue to employ the standard TimeFinder/Mirror commands and parameters. The TimeFinder/Mirror commands pass through an emulation layer to control clone copy BCVs.

To use clone emulation, users needed to enable the TimeFinder/Clone component of TimeFinder/Clone Mainframe SNAP Facility (and the TimeFinder/Consistency Group component if they want consistent split operations).

**Enginuity 5874**
Starting with Enginuity 5874, TimeFinder/Mirror uses clone emulation for all operations, as shown in Figure 4:
There are no specific steps you need to take. Whenever TimeFinder/Mirror internally detects a Symmetrix controller running at Enginuity level 5874 and later, TimeFinder/Mirror automatically sets the mode to clone emulation. There are few changes you have to make to TimeFinder/Mirror commands and parameters; this information can be found in EMC TimeFinder/Mirror for z/OS Product Guide.

To use TimeFinder/Mirror with Enginuity 5874, you need to install the Mainframe Enablers and enable the TimeFinder/Clone component of TimeFinder/Clone Mainframe SNAP Facility (and the TimeFinder/Consistency Group component if you want consistent split operations).
2.4 Consulting and IT Services

Effective storage data migration is a complex process involving many steps. EMC offers consulting and IT services that can help with many of these steps. The example depicted in this TechBook was conducted using EMC services.

2.4.1 Infrastructure consulting

2.4.1.1 Backup, recovery, and archive

Address the critical storage challenge of backup and archiving by analyzing architectural alternatives and devising strategies based on cost/benefit, capabilities, and design requirements.

2.4.1.2 Business continuity

Develop a high availability and disaster recovery strategy to protect critical business functions through an end-to-end approach, addressing people, process, and technology.

2.4.1.3 Cloud computing strategy service

Develop the business case, design the optimum architecture, and create a plan for transforming the IT organization.

2.4.1.4 Compliance

Improve alignment with business policies and industry regulations while reducing information management costs by providing sustainable, standardized practices.

2.4.1.5 Data center networking

Increase the operational agility of networked infrastructure. Customized engagements to help mitigate risk, improve service levels, and realize cost advantage by mapping technology needs to business objectives.

2.4.1.6 Green IT

Align infrastructure strategy with business, sustainability, and technology goals. Reduce an enterprise’s carbon footprint while increasing data center efficiency and enhancing overall productivity.

2.4.1.7 Information security

Map business and regulatory requirements to policies, programs, and strategies. Reduce risk and the cost and complexity of regulatory compliance.
2.4.1.8 **Infrastructure consolidation consulting**
Streamline data centers to realize cost, energy, and service delivery benefits.

2.4.1.9 **IT service management**
Improve the efficiency and effectiveness of IT operations to handle today's rapidly growing enterprise information. Define service catalogs, rationalize and refine processes, and redesign IT organizations.

2.4.1.10 **Managed availability services**
Provide multiyear business continuity program support to drive continuing improvements in service levels. EMC consultants recommend, implement, and manage an ongoing business continuity program addressing an organization's specific requirements.

2.4.1.11 **Private cloud architecture impact advisory service**
EMC, Cisco, and VMware provide an organization and its stakeholders an approach to modeling private cloud to the organization’s specific data center environment.

2.4.1.12 **Strategy for remote office infrastructure**
Manage risk, cost, and performance across a distributed enterprise. EMC consultants provide a strategy that encompasses people, process, and technology. Optimize remote infrastructure to meet demanding service-level requirements.

2.4.1.13 **Virtualization services**
Develop a holistic virtualization strategy to increase asset utilization, improve operational efficiency, raise service quality, speed ROI, and reduce overall costs.

2.4.2 **Implementation**

2.4.2.1 **Assessment services**
Identify possible strategies for your information infrastructure to meet your business and technical goals and plans.

2.4.2.2 **Business continuity implementation services**
Get a complete suite of services for business continuity needs.
2.4.2.3 Design and implementation services
   Get best practices recommendations and proven methodologies for hardware and software design and implementation.

2.4.2.4 Disk security services
   Secure information and support compliance initiatives.

2.4.2.5 Enterprise content management implementation services
   Combine enterprise content management with storage, virtualization, archiving, and backup and recovery.

2.4.2.6 Migration services
   Ensure safe migration of data among EMC storage systems or between heterogeneous systems.

2.4.2.7 Performance assessments/health check services
   Maintain high service levels by identifying factors that affect storage-platform performance.
This chapter provides definitions and descriptions of SRDF capabilities in a mainframe environment. All of the features needed to support SRDF four-site migrations are explained in detail. The topics covered include:

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- 3.2 SRDF/Synchronous (SRDF/S) ......................................... 42
- 3.3 SRDF/Asynchronous (SRDF/A) ................................. 43
- 3.4 SRDF/Data Mobility (SRDF/DM) and adaptive copy modes .. 46
- 3.5 SRDF/Automated Replication (SRDF/AR) ...................... 47
- 3.6 Concurrent SRDF .......................................................... 49
- 3.7 Cascaded SRDF ............................................................. 50
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3.1 Introduction

The EMC Symmetrix Remote Data Facility (SRDF) family of replication software offers various levels of Symmetrix-based business continuance, disaster recovery and data mobility solutions. SRDF products offer the capability to maintain multiple, host-independent, mirrored copies of data. The Symmetrix systems can be in the same room, in different buildings within the same campus, or hundreds to thousands of kilometers apart. By maintaining copies of data in different physical locations, SRDF is an effective mechanism for data center migration. SRDF is designed for Symmetrix-to-Symmetrix connections through Fibre Channel, Gigabit Ethernet (GigE), and ESCON. SRDF has been a part of Enginuity since 1994 running as part of Enginuity in front-end directors.

Figure 5 on page 41 illustrates the SRDF family base products and additional options.
The SRDF family consists of three base solutions:

- **SRDF/Synchronous (SRDF/S)** — High-performance, host-independent, real-time synchronous remote replication from one Symmetrix to one or more Symmetrix systems.

- **SRDF/Asynchronous (SRDF/A)** — High-performance extended distance asynchronous replication using a Delta Set architecture for optimal bandwidth utilization and minimal host performance impact.

- **SRDF/Data Mobility (SRDF/DM)** — Rapid transfer of data from source volumes to remote volumes anywhere in the world, permitting information to be shared and content to be distributed, or information consolidated for parallel processing activities.
There are a number of additional options and features that can be added to the base solutions to solve specific service level requirements. These options include:

- SRDF/Automated Replication (SRDF/AR) solutions for meeting very specific, remote replication service-level requirements
- SRDF/Star for advanced multisite failover with continuous protection
- SRDF/Consistency Groups (SRDF/CG) for data consistency
- SRDF/Cluster Enabler (SRDF/CE) for integration with host-based clustering products such as Microsoft Cluster Server (MSCS) and VERITAS Cluster Server (VCS)
- Cascaded SRDF for a three-site, extended distance replication using a dual role device, and SRDF/Extended Distance Protection (SRDF/EDP) using a diskless dual role device.

### 3.2 SRDF/Synchronous (SRDF/S)

SRDF/S is a business continuance solution that maintains a real-time (synchronous) copy of data at the logical volume level in Symmetrix systems in the same or separate locations. The SRDF/S operation is transparent to the host operating system and host applications. It does not require additional host software for duplicating data on the participating Symmetrix arrays. Figure 6 illustrates that the host I/O to the Symmetrix is not acknowledged until the remote target Symmetrix has acknowledged it. Therefore SRDF/S has some impact on the production application and is limited to a ~200 km distance.
3.3 SRDF/Asynchronous (SRDF/A)

Beginning with Enginuity level 5670, SRDF/A (Figure 7) is another mode of remote replication that allows customers to asynchronously replicate data while maintaining a dependent write consistent copy of the data on the secondary (R2) device at all times with no performance impact on the host. The dependent write consistent copy of the data at the remote side is typically only seconds behind the primary (R1) side. SRDF/A session data is transferred to the secondary Symmetrix system in predefined timed cycles or delta sets, eliminating the redundancy of multiple same track changes being transferred over the link, potentially reducing the required bandwidth.

Figure 7 illustrates the SRDF/A I/O flow.

SRDF/A provides a long-distance replication solution with minimal impact on performance. This level of protection is intended for customers who require minimal host application impact while maintaining a dependent write consistent, restartable image of their data at the secondary site. In the event of a disaster at the R1 site or if SRDF links are lost during data transfer, a partial delta set of data can be discarded, preserving dependent write consistency on the secondary site with a data loss of no more than two SRDF/A cycles.

3.3.1 SRDF/A consistency protection using MSC

An SRDF consistency group (SRDF/CG) is a composite group comprised of Symmetrix SRDF devices (RDF1, RDF2, or RDF21), which is enabled for remote database consistency. The devices in the consistency group are configured to act in unison to maintain the integrity of a database when distributed across multiple Symmetrix arrays or across multiple devices within an array.
SRDF consistency protection software preserves the dependent write consistency of devices within the group by monitoring data propagation from source devices to their corresponding target devices. If a source R1 device in the consistency group cannot propagate data to its corresponding R2 device, the SRDF consistency software suspends data propagation from all the R1 devices in the group. This allows you to quickly recover from certain types of failures or physical disasters by retaining a consistent, DBMS-restartable copy of your database. SRDF consistency group protection is available for both synchronous mode (SRDF/S) and asynchronous mode (SRDF/A). SRDF consistency protection for SRDF/A devices is provided using Multi-Session Consistency (MSC).

3.3.2 SRDF/A Delta Set Extension (DSE)

Enginuity version 5772 introduced SRDF/A Delta Set Extension (DSE) for managing the buffering of delta set data. DSE provides a mechanism for augmenting the cache-based delta set buffering mechanism of SRDF/A with a disk-based buffering ability. This extended delta set buffering ability may allow SRDF/A to ride through larger and/or longer SRDF/A throughput imbalances than would be possible with cache-based delta set buffering alone.

There are a number of advantages to having SRDF/A ride through the conditions described above without dropping:

- Lower demands on remote link bandwidth - If an SRDF/A session drops, the session must be resynchronized for protection operations to resume. Because the resynchronization process is driven by an invalid track table with a resolution that is in units of full tracks, the amount of data that must be sent across the links may be inflated. The amount of inflation depends on the host-write block size and the degree of locality of reference in the workload.

- Better RPO - If an SRDF/A session incurs a link outage, the time required for the next cycle switch will be longer than if the link had remained active. The cycle elongates because there is some amount of time required to initiate and perform the resynchronization and, as noted above, the resynchronization may inflate the amount of data that must be sent over the links.

- Simpler operation - SRDF/A’s ability to remain active eliminates the procedural process to return a link outage session to its online state.
You can configure DSE for any SRDF/A session and within any configuration in which SRDF/A is a participant, including SRDF/Star and concurrent RDF. DSE is designed to preserve the major benefits of SRDF/A, including impact on host-write response time that is typically not measurable, the use of write folding to reduce remote link bandwidth requirements, and the options SRDF/A provides for managing consistency.

The customer migration that this TechBook is based on included the implementation of SRDF/A DSE protection with the introduction of Enginuity levels that supported this feature. The details of the DSE setup were omitted from the TechBook.
3.4 SRDF/Data Mobility (SRDF/DM) and adaptive copy modes

The SRDF/DM product offering permits operation in SRDF adaptive copy mode only and is designed for data replication or migration between two or more Symmetrix systems. SRDF/DM transfers data from primary volumes to secondary volumes permitting information to be shared, content to be distributed, and access to be local to additional processing environments. Adaptive copy mode enables applications using that volume to avoid propagation delays while data is transferred to the remote site. SRDF/DM supports all Symmetrix systems and all Enginuity levels that support SRDF, and can be used for local or remote transfers.

Adaptive copy modes facilitate data sharing and migration. These modes allow the primary and secondary volumes to be more than one I/O out of synchronization. There are two adaptive copying modes: adaptive copy write pending (AW) mode and adaptive copy disk (AD) mode. Both modes allow write tasks to accumulate on the local system before being sent to the remote system.

With adaptive copy write pending mode, write tasks accumulate in global memory. A background process moves, or destages, the write pending tasks to the primary volume and its corresponding secondary volume on the other side of the SRDF link. The advantage to this mode is that it is faster to read data from global memory than from disk, thus improving overall system performance. An additional advantage is that the unit of transfer across the SRDF link is the updated blocks rather than an entire track, resulting in more efficient use of SRDF link bandwidth. The disadvantage is that global memory is temporarily consumed by the data until it is transferred across the link. Consequently, adaptive copy write pending mode should only be used where detailed information about the host write workload is fully understood.

Adaptive copy disk mode is similar to adaptive copy write pending mode, except that write tasks accumulate on the primary volume rather than in global memory. A background process destages the write tasks to the corresponding secondary volume. The advantages and disadvantages of this mode are opposite from those of the adaptive copy write pending mode; that is, while less global memory is consumed it is typically slower to read data from disk than from global memory. Additionally, more bandwidth is used because the unit of transfer is the entire track. Furthermore, because it is slower to read data from disk than global memory, device resynchronization time will increase.
SRDF/AR is an automation solution that uses both SRDF and TimeFinder to provide a periodic asynchronous replication of a restartable data image. Use a single-hop SRDF/AR configuration, as shown in Figure 9, that permits controlled data loss (depending on the cycle time).

However, if greater protection is required, a multihop SRDF/AR configuration can provide long distance disaster restart with zero data loss at a middle or bunker site.

Figure 10 on page 48 illustrates the SRDF/AR multihop data flow.
Compared to traditional disaster recovery solutions with their long recovery time and high data loss, disaster restart solutions using SRDF/AR provide remote restart with a short restart time and low data loss. SRDF/AR offers data protection with dependent write consistency across a distance. This protection is accomplished by using geographically separated replicas with hardware and software products from EMC Corporation. The SRDF/AR process can be implemented with TimeFinder/Mirror in a mainframe z/OS environment.
3.6 Concurrent SRDF

Enginuity 5567 and later support the ability for a single primary volume to be remotely mirrored to two secondary volumes concurrently. This feature is called concurrent SRDF. Concurrent SRDF can be both SRDF/S, both SRDF Adaptive Copy, or mixed, one SRDF/S and the other either SRDF/A or SRDF Adaptive Copy. Normal operating rules for SRDF also apply to concurrent SRDF configurations. When operating in synchronous mode, ending status for an I/O is not presented until the remote Symmetrix system acknowledges receipt of the I/O to the primary Symmetrix system. If both secondary volumes are operating in synchronous mode, ending status is not presented until both volumes acknowledge receipt of the I/O. If only one remote mirror is in synchronous mode, ending status is presented to the host when the synchronous volume acknowledges receipt of the I/O.

Figure 11 shows a concurrent SRDF configuration in which the primary volume is communicating with one secondary volume in synchronous mode. Concurrently, the same primary volume is communicating with its other secondary volume in SRDF/A mode.

Figure 11  Concurrent SRDF
3.7 Cascaded SRDF

Cascaded SRDF is a three-site, no data loss disaster recovery configuration where data from a primary site is synchronously replicated to a secondary site, and then asynchronously replicated to a tertiary site. The core benefit behind a cascaded configuration is its inherent capability to continue replicating from the secondary site to the tertiary sites in the event that the primary site goes down. This enables a faster recovery at the tertiary site, provided that is where the customer is looking to restart their operation. Cascaded SRDF uses a dual role SRDF R2/R1 device (R21 device) on the secondary site, which simultaneously acts as both an R2 to the primary site and an R1 to the tertiary site. SRDF R2/R1 devices require Enginuity 5773 or later; therefore, the secondary site Symmetrix system must be at this level. The primary or tertiary Symmetrix systems may run other Enginuity levels that can interoperate with the secondary Symmetrix via SRDF. The cascaded SRDF solution complements and offers additional capabilities and options to EMC’s existing three-site configurations, concurrent RDF, SRDF/AR multihop, and SRDF/Star.

Figure 12 illustrates a three-site cascaded SRDF configuration.
3.8 SRDF/Extended Distance Protection (SRDF/EDP)

Available at Enginuity level 5874, SRDF/EDP is an extension of cascaded RDF that uses a new diskless R21 device referred to as a DLDEV. The DLDEV device has no disk storage and temporarily stores writes received from the R1 and owed to the R2 in Symmetrix cache. The R21 DLDEV device must be on a Symmetrix running Enginuity 5874. The R1 and R2 devices can be on a Symmetrix running either Enginuity 5874 or 5773.

The name "Extended Distance Protection" denotes how the remote R2 is beyond the distance where SRDF/S would be used, yet still contains a replica of the R1 at a lower hardware resource cost than other three-site SRDF solutions. As far as disk storage goes, Extended Distance Protection is effectively a two-site SRDF solution. Using a DLDEV R21 in place of a standard R21 device alters the migration environment requirements and capabilities affecting the options for choosing a data migration solution. A DLDEV R21 device does not require any associated disk storage, thereby freeing up the R21 site Symmetrix from needing that resource. However, DLDEV R21 devices will utilize more cache and the SRDF mode between the R21 and R2 must be either SRDF/A or Adaptive Copy Write Pending (Adaptive Copy Disk Mode is not supported). In addition, secondary use of the DLDEV R21 device by a host local to the Symmetrix that contains it is not possible because DLDEV devices cannot be presented to a host.

**Note:** The secondary Symmetrix does require a minimum of disk drives in order to support vault and SFS devices.

Figure 13 illustrates a three-site SRDF/EDP configuration.
3.9 SRDF/Star

Available at Enginuity level 5x71, SRDF/Star provides advanced multisite business continuity protection for mainframe and open systems environments. It enables concurrent SRDF/S with consistency groups and SRDF/A with MSC operations from the same source volumes with the ability to incrementally establish an SRDF/A session between the two remote sites in the event of a primary site outage, a capability only available through SRDF/Star software.

This capability takes the promise of concurrent or cascaded (including SRDF/EDP) synchronous and asynchronous operations (from the same source device) to its logical conclusion. SRDF/Star allows you to quickly re-establish protection between the two remote sites in the event of a primary site failure, and then just as quickly restore the primary site when conditions permit. With SRDF/Star, enterprises can quickly resynchronize the SRDF/S and SRDF/A copies by replicating only the differences between the sessions, allowing for much faster resumption of protected services after a source site failure. Used in a data migration scenario, a planned switch can be used to quickly maintain disaster recovery protection at the migrated site.

Figure 14 illustrates a three-site concurrent SRDF/Star configuration showing the standby recovery links between the B and C sites as a dashed line.

![Figure 14 Concurrent SRDF/Star](ICO-IMG-000432)
3.10 SRDF and data migration

Two additional features of SRDF are important to understand for data migration. First is understanding that SRDF allows the swapping of the R1 and R2 roles. Second is that data will be remotely accessed from the R2 device if it is not available on the R1 device. Together with the features previously defined, SRDF can be configured in a way that the *new, target* Symmetrix pulls data from the original Symmetrix:

1. Bring in the new array and configure it to act as the R2 remote of the production R1 devices:
   - Because of concurrent RDF it is possible to do this even if the production R1 devices already have corresponding R2 devices for disaster recovery.
   - This step is not absolutely required, but for performance reasons and to ensure a correct configuration, is almost always done.
   - Due to large amounts of data it may take extensive time for the synchronization to the new devices to complete. For performance reasons, this initial synchronization is usually conducted in adaptive copy disk mode.

2. Swap the personality of the R1 and R2 devices:
   - This is conducted similarly to a disaster failover, where the applications must be restarted at the disaster site.
   - This swap cannot occur for only one leg of a concurrent SRDF configuration. If it is necessary to maintain disaster protection without delay in the new site, then the SRDF device migration feature, the four-site SRDF data migration feature, or an SRDF/Star planned switch should be used.
   - It is not necessary to complete the synchronization in step 1 before moving on to step 2, because any data not yet in the new R1 can be accessed remotely from the R2 (old R1). However, in order to avoid loss of data from multiple failures, best practice is to wait for synchronization to complete before executing the swap.

3. When the synchronization is complete for all the devices, then the SRDF definition can be removed and the old Symmetrix array can be disconnected.
Chapter 4, “SRDF Four-Site Migration,” describes the combination of SRDF features (described in this chapter) that were used to build a four-site SRDF migration scenario, along with the TimeFinder integration that was used to preserve a gold copy of the consistent SRDF copy before initiating a resynchronization.
Chapter 3, “Symmetrix Remote Data Facility (SRDF),” provided a detailed introduction of SRDF features including concurrent SRDF and cascaded SRDF. This chapter describes the combination of features needed to build the example SRDF four-site migration scenario, along with additional details on permissible SRDF modes available when using this combination. Additionally, the integration with TimeFinder used to preserve a gold copy of the consistent SRDF copy before initiating a resynchronization is described.

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- 4.9 Remove original production site ...................................................... 65
4.1 Customer's initial production environment

The initial customer production environment can be represented by the illustration shown in Figure 15 with the production applications running in Site A Production, and remote disaster recovery (DR) protection provided by Site B DR. Note that for this example, SRDF/Asynchronous mode is used to support longer distances between the production and DR sites without impacting the production application. The BCV present in Site B is available to preserve a consistent restartable image of the R2, when an SRDF resynchronization is invoked, and is also used by the customer for DR testing at Site B.

Figure 15 Initial Production with Remote SRDF Protection
4.2 Add concurrent SRDF to the new production site

The next step to building the four-site migration scenario is to define an SRDF link to migrate the data from the initial production Site A to what will become the new production Site C as seen in Figure 16. Since Site A is already using SRDF to remotely replicate to Site B, replicating to Site C at the same time will be an instance of concurrent SRDF. The Site A SRDF source volume is changed from an R1 replicating to a single R2, to an R11 replicating to two distinct R2s at different sites. SRDF adaptive copy disk mode (SRDF/ACP Disk) is used for the replication from Site A to Site C for a number of reasons. SRDF/ACP has no impact on the production application and using disk mode instead of write pending mode reduces the demand for cache resources on Site A in exchange for a slower synchronization time to the remote site. Additionally, at current Enginuity releases, a concurrent SRDF device can have only one SRDF/A leg, so if Site A and Site C are too far apart for synchronous (SRDF/S) replication, SRDF/ACP is the only viable choice.

Figure 16  Add concurrent SRDF to the new production site
4.3 Add cascaded SRDF to the new DR site

The next step to building the four-site migration scenario is to define an SRDF link to migrate the data from Site C New Production to Site D New DR as seen in Figure 17. Since Site C is already using SRDF to be the remote replica of Site A, replicating to Site D at the same time will be an instance of cascaded SRDF. The Site C SRDF target volume is changed from an R2, to an R21 propagating the contents of the Site A source device through Site C to Site D. An R21 device acts as both a SRDF target device and SRDF source device concurrently. SRDF adaptive copy disk mode is used for the replication from Site C to Site D to minimize resource use for the migration of Site A data to Site D. In Figure 17, Site B is partially obscured to emphasize the three-site nature of cascaded SRDF.

![Figure 17: Add cascaded SRDF to the new DR site](ICO-IMG-00807)
4.4 SRDF four-site migration

Figure 18 shows the SRDF four-site migration scenario that was built dynamically from the original two-site SRDF disaster recovery configuration by first adding concurrent SRDF and then cascaded SRDF. The production devices on Site A are replicated to three other sites, B, C and D. The use of SRDF adaptive copy disk mode for the migration of data limits the impact on the production Site A and its required disaster Site B. The SRDF four-site migration is sometimes referred to as SRDF dual-site migration, because it involves migrating from one pair of sites (A, B) to a new pair of sites (C, D).
4.5 New migration sites testing

Figure 19 on page 61 shows the use of an SRDF suspend operation to isolate the new migration sites C and D for full disaster recovery testing. Site A Production and Site B DR are partially obscured to emphasize the new migration sites C and D isolated for testing, while sites A and B are continuing to operate independently with full production disaster recovery protection in place. In order to emulate the way in which Site C and D will be configured once they become the new production and disaster recovery site, it is necessary to dynamically change both the Site C SRDF device type and the SRDF mode between Sites C and D. Site C devices cannot remain R21 devices, which expect the source data to be originating from the initial Site A R1 devices. The relationship between Site A and Site C is half-swapped so that Site C becomes a concurrent R11. As an R11 device it is no longer waiting for data from the Site A R1 in order to propagate to the Site D R2. It is important to remember that there has been no change made to Site A and that the suspended SRDF links between Site A and Site C means that no data is sent to Site A. Changing the Site C devices to R11s also enables the devices for host read/write access permitting testing of production applications at Site C. In order to fully to emulate normal the customer’s standard disaster recovery configuration, the C→D SRDF mode is changed to SRDF/A.
Figure 19  New migration sites testing
4.6 New migration sites disaster recovery testing

Figure 20 shows the effect of stopping SRDF replication between Site C and Site D to simulate the environment for disaster recovery testing at Site D.

Site D devices remain SRDF R2 devices, but can be made read-write enabled to a Site D recovery host in order to support disaster recovery production running on Site D. Once, the disaster recovery testing is complete it is necessary to resume the SRDF C to Site D link. If this was a real disaster and the production work conducted on Site D was to be restored to Site C, it is a best practice to save the restartable image on the Site D R2 devices in the BCVs on Site D using TimeFinder, prior to resuming SRDF synchronization between Site C and Site D.
4.7 Resume SRDF four-site migration

Now that migration pilot testing is complete, it is necessary to resume the SRDF four-site migration configuration to update Sites C and D with all of the data on Site A, which has continued to be updated by the production application during the testing as shown in Figure 21. The sites remain in this configuration iterating additional migration pilot tests if needed, until it is time for the final migration cutover. For the final migration cutover, production host writes to Site A will be suspended, so that the data propagated to Site C and Site D will be fully up-to-date.

![Figure 21 Resume SRDF four-site migration](image-url)
4.8 Migration cutover

The migration cutover step shown in Figure 22 is very similar to the step shown in “New migration sites testing,” on page 60. The key difference for cutover is that production I/O at Site A has been stopped, and the intention is not to return to Site A, but to permanently move production to Site C. However, if any confirmation testing determines it is necessary to move back to Site A, the capability to do so is still present. Once all tests confirm that it is safe to make the move permanent, then the original production Site A and Site B configuration can be removed.
4.9 Remove original production site

Now that production and disaster recovery have been fully migrated and tested to Site C and its DR replica Site D, there is no longer any need to retain the original production Site A and its DR replica Site B. The sample configuration now returns to a standard SRDF two-site configuration as shown in Figure 23.

Figure 23  Remove original production site
As is often the case when migrating data centers, the goals of the migration are not restricted to just moving data from one place to another. Customers frequently perform a technical refresh as part of a migration and modernize their storage arrays to gain the feature, cost, and performance benefits available with updated hardware and software. Often, they seek to capitalize on those benefits by consolidating multiple old storage arrays into one or fewer newer arrays. In order to ensure that they also maintain or achieve desired performance improvements, it is necessary to conduct a formal performance analysis. This chapter describes key parts of the performance analysis conducted for the example case described in this TechBook.

The topics covered include:

- 5.1 Introduction ................................................................. 68
- 5.2 Consolidated storage goals.................................................. 70
- 5.3 Performance analysis examples for 3-1 consolidation........... 72
- 5.4 Conclusion...................................................................... 79
5.1 Introduction

The example migration presented in this TechBook consolidated 16 older Symmetrix arrays into seven new arrays. The Site A Production data center was relocated with new SRDF R1 (source) arrays in the new location Site C. The disaster recovery (DR) location remained the same with new SRDF R2 (target) arrays in the existing DR location Site D. The customer had three business units that consolidated old to new arrays in the ratios of 3-1, 2-1 and 11-5. The 2-1 consolidation performance analysis is presented in this chapter as representative of the full analysis.

The customer migration environment, represented in Figure 24, shows the original three production arrays at Site A disaster protected by three arrays at Site B. The migrated environment shows the consolidated single arrays at Site C New Production and Site D New DR.

Note: For the example shown, DR sites B and D were actually physically located in the same data center, using separate physical arrays. The diagrams have not been drawn to reflect the actual co-location.
5.1.1 Consolidation tests

The key outcome of the performance analysis was to prove that the consolidated systems would be able to handle the consolidated I/O load. I/O load was measured for front-end (host to array) read and write I/Os and SRDF (disaster recovery Symmetrix to Symmetrix) I/Os.
5.2 Consolidated storage goals

Consolidations are designed to meet key business goals. In this example: the RAID protection was changed to make more storage available for customer data.

5.2.1 RAID protection change

The original Symmetrix arrays at Site A Production used RAID 1/0 (also listed as RAID 10 or STRIPED CKD). At the new Symmetrix arrays at Site B New Production use RAID 5 (7+1) instead. RAID 1/0 combines the features of a stripe set and RAID 1; EMC implements a one-cylinder stripe across four RAID 1 pairs. Striping increases performance by spreading data across multiple disk drives, so I/Os will be spread to multiple independent disks. RAID 1 provides disk mirroring which duplicates data, providing a level of fault tolerance.

RAID 5 helps to increase performance by striping volume data across multiple disk drives and provides data protection through distributed parity (or interleave parity). Distributed parity requires all drives but one to be present to operate. Upon drive failure, any subsequent reads can be calculated from the distributed parity such that the drive failure is masked from the end user. The array will have data loss in the event of a second drive failure and is vulnerable until the data that was on the failed drive is rebuilt on a replacement drive. A single drive failure in the set will result in reduced performance of the entire set until the failed drive has been replaced and rebuilt. RAID 5 (7+1) can increase throughput on sequential workloads, particularly sequential read workloads, due to wider striping.

RAID 1/0 is a higher level of data protection and gives better performance for a random write workload. For random writes RAID 1/0 requires only two back-end operations, while RAID 5 requires four back-end operations (must calculate and write parity). RAID 1/0 also gives very good sequential performance. RAID 5 is a lower level of data protection and yields lower random write performance. RAID 5 7+1 gives excellent sequential read and write performance.

RAID 5 provides greater disk utilization for user data. RAID 1/0 uses 200% of the required data space to provide for the second full copy. RAID 5 (7+1) uses only 112.5% to provide for similar data protection of a single failed drive.

The performance analysis will verify that the new arrays configured with RAID 5 protection can perform to the levels required for the customer applications.
5.2.2 Disk size change

The disks on the old Symmetrix arrays were 73 GB disks. The new arrays will use approximately half as many 146 GB disks to provide the same amount of space and allow for 10% growth. Larger disks are both less expensive to purchase and to operate. However, there is a potential performance advantage to having more drive spindles due to the ability of more disk drives to be seeking at the same time. The I/O rate itself may not be all that different because sets of multiple drives share a single Symmetrix front-end director, which can only be transferring data from one of them at a time. Performance testing will ensure that performance goals are met despite a reduction in the number of drive spindles.

5.2.3 Average and peak utilization limits

Although from a theoretical point of view 100% utilization may seem desirable, in actual practice best performance results from levels below full saturation. As levels approach saturation, performance drops due to extra work that must be done to free up old use of resources to allow for current use of resources. This would typically show up in metrics like response time which rise dramatically as utilization approaches 100%.

In order to meet business performance goals including response time the plan is to:

◆ Keep average DMX resources below 75% utilization
◆ Keep peak DMX resources below 90% utilization

In consolidating multiple arrays into one, the choice of which workloads to combine matters. When possible, high utilization arrays are combined with low utilization arrays, so the resulting consolidated workload meets the business performance goals.

5.2.4 Common platform

One business goal of the consolidation is to build eight identical configurations to allow for the most flexibility in moving workloads around after the migration, as may be needed to balance the workload performance on the arrays at Site C New Production.
5.3 Performance analysis examples for 3-1 consolidation

The key outcome of the performance analysis is to prove that the consolidated systems, as designed, will be able to handle the consolidated I/O workload. If the analysis fails to prove this, then it would be necessary to redesign the consolidation to an alternate plan that meets all performance goals.

I/O load was measured for front-end (host to array) read and write I/Os and SRDF (disaster recovery Symmetrix to Symmetrix) I/Os. Additionally back-end disk I/O heat maps are presented to show a more balanced consolidated back end.

5.3.1 Front-end read I/O

Table 1 lists the front-end read I/O processing before and after consolidation. The new array dmx_consol shows fewer I/Os per second at the new peak time because the workload peaks of the initial three arrays is not at the same time. The lower peak for array dmx_consol than the single high peak for original array dmx02 can be attributed to an unusual peak for the original data collection. Array dmx03 has very low utilization so it does not contribute too much to the consolidated peak I/Os even though its peak time is close to the peak time for array dmx02.

Table 1 Consolidated front-end read I/O processing

<table>
<thead>
<tr>
<th>Site</th>
<th>Array</th>
<th>Peak Time</th>
<th>I/Os per Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>dmx01</td>
<td>03:20</td>
<td>4,000</td>
</tr>
<tr>
<td>A</td>
<td>dmx02</td>
<td>21:50</td>
<td>10,500</td>
</tr>
<tr>
<td>A</td>
<td>dmx03</td>
<td>21:40</td>
<td>1,200</td>
</tr>
<tr>
<td>C</td>
<td>dmx_consol</td>
<td>02:50</td>
<td>7,900</td>
</tr>
</tbody>
</table>

5.3.2 Front-end write I/O

Table 2 on page 73 lists the front-end write I/O processing before and after consolidation. The new array dmx_consol shows fewer I/Os per second at the new peak time because the workload of the initial three arrays does not peak at the same time. The lower peak for array dmx_consol than the single high peak for original array dmx02 can be attributed to an unusual peak for the original data collection. Array
dmx03 has very low utilization so it does not contribute too much to the consolidated peak I/Os even though its peak time is close to the peak time for array dmx02.

Table 2 Consolidated front-end write I/O processing

<table>
<thead>
<tr>
<th>Site</th>
<th>Array</th>
<th>Peak Time</th>
<th>I/Os per Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>dmx01</td>
<td>03:20</td>
<td>2,600</td>
</tr>
<tr>
<td>A</td>
<td>dmx02</td>
<td>21:50</td>
<td>9,500</td>
</tr>
<tr>
<td>A</td>
<td>dmx03</td>
<td>21:40</td>
<td>1,200</td>
</tr>
<tr>
<td>C</td>
<td>dmx_consol</td>
<td>02:50</td>
<td>5,200</td>
</tr>
</tbody>
</table>

5.3.3 SRDF/A throughput

SRDF was configured with two SRDF groups used by two applications in the old arrays. Two SRDF groups were configured in the new arrays to help minimize the number of changes to the customer’s replication management procedures.

Table 3 lists the SRDF/A throughput before and after consolidation. The new array dmx_consol shows fewer MBs at the new peak time because the workload from the initial three arrays does not peak at the same time. The peak for array dmx_consol is only slightly higher than the single high peak for original array dmx02. Array dmx03 has very low utilization so does not contribute too much to the consolidated peak I/Os even though its peak time is close to the peak time for array dmx02.

Table 3 Consolidated SRDF/A throughput

<table>
<thead>
<tr>
<th>Site</th>
<th>Array</th>
<th>Peak Time</th>
<th>Group A MBs</th>
<th>Group B MBs</th>
<th>Total SRDF/A MBs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>dmx01</td>
<td>03:20</td>
<td>70.0</td>
<td>35.0</td>
<td>105.0</td>
</tr>
<tr>
<td>A</td>
<td>dmx02</td>
<td>21:45</td>
<td>210.0</td>
<td>105.5</td>
<td>315.5</td>
</tr>
<tr>
<td>A</td>
<td>dmx03</td>
<td>21:40</td>
<td>12.0</td>
<td>6.0</td>
<td>18.0</td>
</tr>
<tr>
<td>C</td>
<td>dmx_consol</td>
<td>02:50</td>
<td>110.0</td>
<td>225.0</td>
<td>335.0</td>
</tr>
</tbody>
</table>
5.3.4 Back-end write I/O

Table 4 lists the back-end write I/O processing before and after consolidation. The new array dmx_consol shows fewer I/Os per second at the new peak time because the workload of the initial three arrays does not peak at the same time. The lower peak for array dmx_consol than the single high peak for original array dmx02 can be attributed to an unusual peak for the original data collection. Array dmx03 has very low utilization so does not contribute too much to the consolidated peak I/Os even though its peak time is close to the peak time for array dmx02.

**Table 4** Consolidated back-end write I/O processing

<table>
<thead>
<tr>
<th>Site</th>
<th>Array</th>
<th>Peak Time</th>
<th>I/Os per Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>dmx01</td>
<td>03:20</td>
<td>4,200</td>
</tr>
<tr>
<td>A</td>
<td>dmx02</td>
<td>21:50</td>
<td>12,620</td>
</tr>
<tr>
<td>A</td>
<td>dmx03</td>
<td>21:40</td>
<td>1,420</td>
</tr>
<tr>
<td>C</td>
<td>dmx_consol</td>
<td>02:50</td>
<td>13,400</td>
</tr>
</tbody>
</table>

5.3.5 Back-end disk I/O heat maps

Figure 25 on page 75, Figure 26 on page 76 and Figure 27 on page 77 show the SymmMerge heat maps for the three Site A arrays. The old arrays dmx01 and dmx02 showed many back-end disks at rates exceeding 75% utilization. Figure 28 on page 78 shows the SymmMerge heat map for dmx_consol at Site C, which consolidates the three Site A arrays, showing a far more balanced back end with disk utilization rates consistently at 45% or less.
Performance analysis examples for 3-1 consolidation

Figure 25  dmx01 SymmMerge back-end heat map
Figure 26  dmx02 SymmMerge back-end heat map
Figure 27  dmx03 SymmMerge back-end heat map
Figure 28  dmx_consol consolidated array SymmMerge back-end heat map
5.4 Conclusion

The subset of the full performance analysis presented in this chapter should provide some insight into the whole process. The key outcome was met with an analysis that concluded the planned consolidation will be able to handle the current workload with ample room for at least 10% growth.
This chapter begins the example SRDF four-site migration by ensuring that the configuration is upgraded to fully support concurrent and cascaded SRDF. Examples of the commands to define and initiate migration to the new data centers are also presented. The topics covered include:

- 6.1 Introduction ................................................................. 82
- 6.2 Upgrades to support concurrent and cascaded SRDF ......... 83
- 6.3 Standard Symmetrix configuration (bin file) ...................... 86
- 6.4 EMC storage configuration software levels ....................... 88
- 6.5 Scripting to add concurrent and cascaded SRDF ............... 89
- 6.6 Resume replication from Site A to Site C to Site D ............... 96
6.1 Introduction

This chapter begins the description of an actual customer SRDF four-site migration. The full complexity of the customer sites is described below, but will be simplified in the example operations that follow.

The purpose of this migration is to migrate from two existing data centers, Site A Production disaster protected by Site B DR, to a new pair of data centers, which we will call Site C New Production and Site D New DR. There are many parts to a full data center move, but this TechBook concentrates on the steps to migrate the production data and disaster recovery data from the Symmetrix storage at the original two data centers to Symmetrix storage at the two new data centers. This data migration will be conducted as described in Chapter 4, “SRDF Four-Site Migration.”

The use of concurrent and cascaded SRDF requires certain upgrades necessary in production Site A and the build out for sites C and D with new storage arrays.
6.2 Upgrades to support concurrent and cascaded SRDF

Chapter 5, “Performance Analysis,” discussed the performance analysis specific to the customer site. Part of this analysis identified the necessary upgrades for production environments EMC hardware and software.

6.2.1 Current sites A and B required Enginuity levels

The current production storage environment consists of the following shown in *Figure 29*:

- Site A Production, the production data center located in New Jersey. The R1 data here is protected by Site B.
- Site B DR, the production disaster recovery data center located in Texas. The R2 data here protects Site A.

![Site A Production Diagram](image)

*Figure 29  Initial Production with Remote SRDF Protection*

Site A Production has 12 DMX2000 and three DMX-3 1500 SRDF R1 source arrays. Site B DR has 12 DMX3000 and three DMX-3 1500 SRDF R2 target arrays. Site A also has two DMX3000 arrays used by development that are not remotely replicated. The current mainframe storage configurations will remain the same, but the microcode and software levels will need to be upgraded to support dynamic SRDF.
Dynamic SRDF will enable new RDF Groups and Pairs to be defined by host software after a single online bin file change is made to enable Dynamic RDF.

The 12 DMX2000 arrays are already at Enginuity level 5671.69.71 with Epack #7593. This code level and Epack support all of the required SRDF features. An Epack is a set of verified additional microcode fixes beyond the base Enginuity level. The three DMX-3 1500 arrays are at Enginuity level 5772.88.80 with Epack #7594 and need to be upgraded to Enginuity level 5772.88.80 with Epack #0091 which includes a fix for Cascaded SRDF. Note that SRDF requires that both the R1 and R2 arrays have matching microcode levels, so the arrays at Site B will require the same upgrades even though they will not be utilizing the Concurrent or Cascaded SRDF features.

The Enginuity upgrades and Epack are loaded online to the Symmetrix arrays by EMC customer service engineers. The bin file changes described in Section 6.3, "Standard Symmetrix configuration (bin file)," on page 86 will be made at the same time.

6.2.2 New sites C and D minimum requirements

The new Production and DR storage environments will use newer DMX-4 (Symmetrix 6.5) models. The hardware model upgrades was determined as part of the performance analysis.

New equipment is shipped with the latest microcode levels available for the Symmetrix DMX-4 which at the time of this migration was 5773.123-83 using Epack #0009, which includes support for both concurrent and cascaded SRDF. It is important to check and verify that there are no Epacks that may need to be loaded to support features used by the customer; in this case none were required.

As part of the consolidation there are fewer newer arrays than old arrays, so each of the new DMX-4 arrays need to be configured with the additional capacity to support the applications of multiple old arrays. There are nine DMX-4
arrays configured at Site C New Production and seven DMX-4 arrays configured at Site D New DR (two of the arrays at Site C will be used by development and will not be remotely replicated).
6.3 Standard Symmetrix configuration (bin file)

All of the arrays will be configured to the same standard except for select features that are only supported on the newer DMX-3 and DMX-4 arrays running Enginuity 5772 and 5773. Initial bin file parameters will be set up to support both features used for the migration and features needed in the final configuration after cutover. The bulleted lists in this section describe the configuration bin file flag parameter settings for the new DMX-4 arrays at sites C and D.

Initial bin file parameters:

- STD are RAID 5 (7+1)
- 15K Drives
- Enable Permanent Sparing
- Set CJOBs 240 max
- Use Microcode 5773.123-83 / 0005 1
- Hyper PAVs are enabled 1
- Define IODEF definition control unit image type = 2107 1
- Switched SRDF = YES
- Prevent Auto Recovery after Link Drop = Yes
- Links Domino = No
- Enable RDF Dynamic Mode
- Concurrent RDF device (DRX)
- Enable Concurrent DRDF
- Allow SRDFA = YES
- Link Limbo set to 10 sec
- Transmit Idle enabled
- Delta Set Extension enabled 1

Special Instructions:

- Configure the remaining capacity as all Mod 27s. You can put the additional devices on any ranges that have room, typically fill out the last CUADD on each LCU with any “incomplete” strings.
- Create one, 3 GB, RAID 1 protected DSE volumes on each physical disk 1

---

1. These parameters are not supported for DMX2000 arrays at sites A and B
Director Configuration (dependent on host configuration):

- 8 x Ficon Cards for 24 Host Connections
- Available (EF): 3a, 3b, 3c, 3d, 4a, 4b, 4c, 4d, 7a, 7b, 7c, 7d, 10a, 10b, 10c, 10d, 13a, 13b, 13c, 13d, 14a, 14b, 14c, 14d
- 2 x FC Cards for 8 SRDF Connections AD/CPY to Site D New DR
- RA Ports Available: Permanent Boards in slots 8, and 9
- RA Ports Available: Loaner Boards for migration in slots 6 and 11

Drive Configuration (dependent on host configuration):

- 240 x 146 GB Drives, RAID 5 (7x1),
- 8 x spares
- 248 total

Volume Configuration (dependent on host configuration):

- 528 Mod 3
- 1696 Mod 9
- 480 Mod 27
6.4 EMC storage configuration software levels

Just as the most current Enginuity level was required in Section 6.2, “Upgrades to support concurrent and cascaded SRDF,” on page 83 the host software products must also be upgraded. As new features are added with each Enginuity microcode level, EMC software layered on top of Enginuity must also be upgraded both to take advantage of the new features in the microcode, and to be compatible with the Enginuity microcode level. All software ptf fixes can be downloaded from EMC’s Powerlink website.

Upgraded EMC software levels:

- EMC ResourcePak Base for z/OS version 5.8
- EMC SRDF Host Component for z/OS version 5.6
- TimeFinder/Mirror product set for z/OS version 5.6
- TimeFinder/Clone Mainframe Snap for z/OS version 5.8
- ConGroup 6.4
6.5 Scripting to add concurrent and cascaded SRDF

After all of the Enginuity and EMC software products have been upgraded, the dynamic SRDF configuration for migrating to Site C New Production and Site D New DR can be scripted. Each R1 source array requires a similar configuration. Because this migration includes consolidation, multiple Site A R1 source arrays will be migrated to a single Site C DR target array. The following scripting examples will illustrate the consolidation concept from two Site A R1 source arrays to one Site C R21 target array cascaded to one Site D R2 target array. The full data center migration scripting for all 18 Site A source arrays to the nine Site C and seven Site D target arrays use the same set of commands with different Symmetrix IDs, RDF Group numbers, RDF director numbers and Symmetrix device numbers.

6.5.1 Add concurrent SRDF to the new production site

Adding concurrent SRDF is performed in two steps, first by adding dynamic RDF groups between Site A and Site C, then by adding dynamic SRDF pairs in those groups. Because the R1 source devices in these new Site A to Site C pairs are already R1 source devices for Site A to Site B replication, this will be an instance of concurrent SRDF.

![Figure 30 Add concurrent SRDF to the new production site](image-url)
Note: When using concurrent SRDF, both SRDF legs have to be configured the same way. Since this migration plan will use dynamic SRDF configuration, it may be necessary to first convert the Site A to Site B leg to be dynamic if it was configured statically. A static SRDF configuration is defined in the bin file and can be changed by an EMC Customer Engineer. The Solutions Enabler symconfigure command with the convert rdf operation can also be used to convert from static to dynamic SRDF.

6.5.1.1 List RDF directors

The Host Component SC RDFGRP command needs the RDF Group numbers in hexadecimal. The SC CNFG command can be used to display local RDF group director port numbers (rdfgroup#) in hexadecimal. After the first RDF group is created and SRDF is active to the remote Symmetrix, commands can be issued to the remote frames to obtain this information. This information can be obtained for the remote frame before the first RDF group is created either through a host attached to the remote Symmetrix or by obtaining the RDF port assignments for all remote frames from EMC customer service.

For example, the following SQ CNFG command lists the local RF (SRDF) directors (51 and 62) for Symmetrix serial number 000187001111:

```
#SQ CNFG,3018
EMCGM11I SRDF-HC DISPLAY FOR (1) @SQ CNFG,3018
SERIAL NUMBER: 000187001111 MEM:256GB TYPE:2105 MODEL: DMX2000P
MICROCODE LEVEL: 5671-69 CONCURRENT-RDF
CONCURRENT DRDF: YES
SWITCHED-RDF DYNAMIC-RDF NO-AUTO-LINKS RDFGRP LINKS-OFF-ON-POWERUP
LINKS-DOMINO: RDFGRP SYNCH_DIRECTION: GLOBAL LINK: LOCAL
SSID(S): 3000 3001 3002 3003 3004 014E
D01: DF D02: __ D03: SF D04: EF D05: __ D06: __ D07: __ D08: __
END OF DISPLAY
```
6.5.1.2 Create RDFGRP from Site A to Site C

The Host Component SC RDFGRP command parameters in order are:

1. **CUU** for a device on the local R1 Symmetrix
2. rdfgroup# in hexadecimal is the second positional parameter
3. **ADD** is the action to create a new RDF Group
4. **LDIR** - local RDF director ports in hexadecimal
5. **RDIR** - remote RDF director ports in hexadecimal (not required to be the same as the LDIR ports)
6. **RSER** - remote Symmetrix serial number
7. **LABEL** - user defined text name for the RDF Group
8. **RGRP** - remote RDF Group number in hexadecimal (not required to be the same as the local RDF Group, though less confusing if the same)

This example shows consolidation from two local Symmetrix arrays, serial numbers 000187001111 and 000187002222, being replicated to the same remote Symmetrix array 000190104444. RDF groups 2A and 2F are used for array 000187001111 and RDF groups 1A and 1F are used for array 000187002222. In this example both source arrays and the remote array are using the same RDF director ports (LDIR and RDIR), though these could be different on each array. In fact the separate RDF groups on the same array could also use different RDF director ports if they are available. The commands to create the four RDF groups are:

```bash
#SC RDFGRP,E9D0,2A,ADD,LDIR(51,62),RDIR(51,62),RSER(000190104444),LABEL(MIG_RDF1),RGRP(2A)
#SC RDFGRP,E9D0,2F,ADD,LDIR(51,62),RDIR(51,62),RSER(000190104444),LABEL(MIG_RDF1),RGRP(2F)
#SC RDFGRP,23D0,1A,ADD,LDIR(51,62),RDIR(51,62),RSER(000190104444),LABEL(MIG_RDF1),RGRP(1A)
#SC RDFGRP,23D0,1F,ADD,LDIR(51,62),RDIR(51,62),RSER(000190104444),LABEL(MIG_RDF1),RGRP(1F)
```

6.5.1.3 Set Quality of Service (QOS) to ensure low priority SRDF copy speed

As a precautionary measure to avoid any production performance issues when executing the remote data copy, Quality of Service (QOS) is set to 4 to slow the RDF Propagation (RDFP). The ResourcePak Base for z/OS Product Guide includes more details on setting QOS.

Set QOS for Symmetrix 000187001111 R1 device CUUs:

```
QOSSET CUU=F700-F70F,RDFP=4,BCVP=0,SERP=0
QOSSET CUU=EE00-EE0F,RDFP=4,BCVP=0,SERP=0
```

Set QOS for Symmetrix 000187002222 R1 device CUUs:

```
QOSSET CUU=2000-200F,RDFP=4,BCVP=0,SERP=0
QOSSET CUU=2300-230F,RDFP=4,BCVP=0,SERP=0
```
6.5.1.4 Create RDF pairs from Site A to Site C

You will need to know the Symmetrix device numbers for source (R1) and target (R2) devices. SRDF requires that source and target devices must be configured alike. For example, they must both be the same size and use the same protection type, CKD - Mod 3 and RAID 5 (7+1) respectively.

The Host Component SC VOL command parameters for the CREATEPAIR action are:

1. LCL(CUU, rdfgroup) for the local R1 Symmetrix
2. CREATEPAIR is the action to create SRDF pairs in Adaptive Copy Disk mode (ADCOPY_DISK) leaving the new pair in the suspended (SUSPEND) non-synchronizing state
3. r1dv-r1dv, r2dv specifies a contiguous range of source R1 Symmetrix device numbers followed by the first R2 Symmetrix device number in a contiguous range.

(This command is specified multiple times to account for non-contiguous ranges)

Create SRDF pairs for Symmetrix 000187001111 R1 Symmetrix devices in RDF Group 2A:

```bash
#SC VOL,LCL(E9D0,2A),CREATEPAIR(ADCOPY_DISK,SUSPEND), 0100-010F,0200
#SC VOL,LCL(E9D0,2A),CREATEPAIR(ADCOPY_DISK,SUSPEND), 0160-016F,0210
```

Create SRDF pairs for Symmetrix 000187001111 R1 Symmetrix devices in RDF Group 2F:

```bash
#SC VOL,LCL(E9D4,2F),CREATEPAIR(ADCOPY_DISK,SUSPEND), 0122-0131,0280
#SC VOL,LCL(E9D4,2F),CREATEPAIR(ADCOPY_DISK,SUSPEND), 0192-01A1,0290
```

Create SRDF pairs for Symmetrix 000187002222 R1 Symmetrix devices in RDF Group 1A:

```bash
#SC VOL,LCL(23D0,1A),CREATEPAIR(ADCOPY_DISK,SUSPEND), 0110-011F,0220
#SC VOL,LCL(23D0,1A),CREATEPAIR(ADCOPY_DISK,SUSPEND), 0150-015F,0230
```

Create SRDF pairs for Symmetrix 000187002222 R1 Symmetrix devices in RDF Group 1F:

```bash
#SC VOL,LCL(23D5,1F),CREATEPAIR(ADCOPY_DISK,SUSPEND), 0140-014F,02A0
#SC VOL,LCL(23D5,1F),CREATEPAIR(ADCOPY_DISK,SUSPEND), 01B3-01C2,02B0
```
6.5.1.5 Add cascaded SRDF for data to be replicated to the new DR site

Adding cascaded SRDF is performed in two steps: first by adding dynamic RDF groups between Site C and Site D, and then by adding dynamic SRDF pairs in those groups. Because the R1 source devices in these new Site C to Site D pairs are already R2 target devices for Site A to Site C replication, this will be an instance of cascaded SRDF, and these become R21 devices (simultaneously target and source) as shown in Figure 31.

![Figure 31: Add cascaded SRDF to the new disaster recovery site](ICO-MG-000826)

6.5.1.6 Create RDF Group from Site C to Site D

This example shows a one-to-one SRDF relationship between the Site C New Production and Site D New DR arrays because both consolidate two-to-one from the Site A arrays. In the old data center, SRDF Multi-Session Consistency (MSC) was used to achieve consistency across multiple RDF Groups and across multiple Symmetrix arrays. In this way the devices in RDF groups 2A and 1A, although on different Symmetrix arrays, were part of the same application. Because both of these groups have been consolidated into a single array at Site C, only one RDF group (40) will be needed to cascade these devices to Site D. Similarly the devices in RDF Groups 2F and 1F are part of the same application and will be consolidated into a single RDF group (50).
this example, both the source and target arrays use the same RDF director ports (LDIR and RDIR), though these could be different on each array.

As part of the data center migration there is a new stand alone host at Site C for executing EMC Software commands (ultimately to replace the role of the existing stand alone host at Site A). The commands listed below will work when run from Site C. It is also possible to execute these commands from Site A by adding a route-rdf-group parameter to the #SC RDFGRP command to route the command to execute on the Site C array; see the SRDF Host Component for z/OS Product Guide for more information.

The commands to create the two RDF groups are:

```
#SC RDFGRP,EBD1,40,ADD,LDIR(12,28),RDIR(12,28),RSER(000190108888),LABEL(PROD_40),RGRP(40)
#SC RDFGRP,EBD1,50,ADD,LDIR(12,28),RDIR(12,28),RSER(000190108888),LABEL(PROD_50),RGRP(50)
```

## 6.5.1.7 Create RDF pairs from Site C to Site D

The following example shows the use of the RMT (remote) option to run the createpair operation from Site A. In this case the RMT option specifies:

1. A CUU for a device on Site A
2. The mhlist (multihop list) in this case the rdfgroup# linked to Site B where the SC VOL command will execute
3. The RDF Group for the Site C to Site D link

In this example, the RDF mode is set to Adaptive Copy Disk mode. The device numbers for the source R21 devices are the same as the R2 targets for the Site A to Site C pairs; these become R21 devices acting as both target (from Site A) and source (to Site D) SRDF devices. Since the Symmetrix arrays at Site C and Site D are new, it was possible to match the device numbers for the R1s and R2s in the Site C and D arrays as well as having broader contiguous ranges of devices. Notice the combination of Site A devices from both Symmetrix 000187001111-rdfgroup# 2A and Symmetrix 000187002222-rdfgroup# 1A are put in the same Symmetrix 000190104444-rdfgroup# 40. There are still two RDF Groups to support the two separate applications (40 and 50).

Create SRDF pairs for Symmetrix 000190104444 R21 Symmetrix devices in RDF Group 40:

```
SC VOL, RMT(E9D1,2A,40), CREATEPAIR(ADCOPY_DISK,SUSPEND), 0200-021F, 0200
SC VOL, RMT(23D1,1A,40), CREATEPAIR(ADCOPY_DISK,SUSPEND), 0220-023F, 0220
```
Create SRDF pairs for Symmetrix 000190104444 R21 Symmetrix devices in RDF Group 50:

SC VOL,RMT(E9D1,2F,50),CREATEPAIR(ADCOPY_DISK,SUSPEND),0280-029F,0280
SC VOL,RMT(23D1,1F,50),CREATEPAIR(ADCOPY_DISK,SUSPEND),02A0-02BF,02A0
6.6 Resume replication from Site A to Site C to Site D

Now with the concurrent and cascaded SRDF groups and pairs created, remote replication to Site C and Site D can be started. The RDF mode is set to Adaptive Copy Disk mode and the quality of service (QOS) for SRDF replication is set to ensure low impact on the production application.

6.6.1 Resume replication from Site A to Site C

The Host Component `SC VOL` command is used with the RDF-RSUM action to resume SRDF, starting the flow of remote replication data. The LCL option specifying the CUU and rdfgroup# is used to direct the resume to the desired leg of the concurrent SRDF device. There is one command line for each of the two RDF Groups for the two Site A arrays:

```
#SC VOL, LCL(E9D2, 2A), RDF-RSUM, ALL
#SC VOL, LCL(E9D2, 2F), RDF-RSUM, ALL
#SC VOL, LCL(23D2, 1A), RDF-RSUM, ALL
#SC VOL, LCL(23D2, 1F), RDF-RSUM, ALL
```

The Host Component `SQ VOL` command can be used to verify that all devices in each of the four RDF Groups are in the R/W-AD mode. R/W indicates that the R1 device is read and write enabled to the host. AD indicates the adaptive copy disk mode. For the Site A to Site B SRDF leg, the devices will be in the R/W-AS mode; AS indicates asynchronous mode or SRDF/A.

```
#SQ VOL, LCL(E9D2, 2A), ALL
#SQ VOL, LCL(E9D2, 2F), ALL
#SQ VOL, LCL(23D2, 1A), ALL
#SQ VOL, LCL(23D2, 1F), ALL
```

The `SQ VOL` command output for concurrent or cascaded SRDF devices will display one line for each SRDF leg. Sample `SQ VOL` command output for five devices in rdfgroup# 2A starting at device 100 displays both the Site A to Site B information (rdfgroup# 20) and Site A to Site C information (rdfgroup# 2A):

```
EMCQV001 SRDF-HC DISPLAY FOR (9076) EMC SQ VOL, LCL(E9D2, 2A), 5, 100  794
DV_ADDR   _SYM_   | TOTAL| SYS | DCB | CNTLUNIT |  |  R1  |  R2  |SY
SYS  CH|DEV  RDEV GP|VOLSER| CYLS|STAT|OPN|STATUS  |MR|INVTRK|INVTRK|%
F700 00 0100 0100 20 OFFLIN 3339 OFFL 0 R/W-AS L1 0 31,562 37
0200 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 508 98
0201 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 27,498 45
F702 02 0102 0102 20 OFFLIN 3339 OFFL 0 R/W-AS L1 0 437 99
0202 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 35,440 29
F703 03 0103 0103 20 OFFLIN 3339 OFFL 0 R/W-AS L1 0 0 **
0203 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 25,079 49
```
Resume replication from Site A to Site C to Site D

The status for all devices begins with R/W indicating that the R1 device is read and write enabled to the host (L1 is an R1 also locally protected). The second part of the status reflects the SRDF mode, asynchronous (AS) for rdfgroup# 20 and adaptive copy disk mode (AD) for rdfgroup# 2A.

6.6.2 Resume replication from Site C to Site D

The SC VOL command is used again with the RDF-RSUM action to resume SRDF, starting the flow of remote replication data. Because of the consolidation of arrays, there is now only two RDF Groups between the arrays to account for the two separate application streams:

```
#SC VOL,RMT(23D1,2A,40),RDF-RSUM,ALL
#SC VOL,RMT(23D1,2F,50),RDF-RSUM,ALL
```

The Host Component SQ VOL command can again be used to verify the status of the devices. The Site C to Site A devices should be in R/O-AD status and the Site C to Site D devices should be in CAS-AD status. The AD in both cases indicates adaptive copy disk mode. The R/O status indicates read only mode, normal for an R2 (or R2 leg of an R21). The CAS status indicates cascading mode, normal for the R1 leg of an R21.

```
#SQ VOL,RMT(23D1,2A,40),ALL
#SQ VOL,RMT(23D1,2F,50),ALL
```

Sample SQ VOL command using the RMT option shows 5 devices in rdfgroup# 40 starting at device 200 displaying both the Site C to Site A information (rdfgroup# 2A) and Site C to Site D information (rdfgroup# 40):

```
EMCQV00I SRDF-HC DISPLAY FOR (11) EMC SQ VOL,RMT(23D1,2A,40),5,200
DV_ADDR|_SYM_|TOTAL|SYS DCB CNTLUNIT| R1 | R2 | SY
SYS CH|DEV RDEV GP|VOLSER|CYLS|STAT|OPN|STATUS|MR|INVTRK|INVTRK| %
E900 00 0200 0100 2A OFFLIN 3339 N/A 0 R/O-AD L2 0 4 99
 0200 40 OFFLIN 3339 N/A 0 CAS-AD L1 22,226 39
E901 01 0201 0101 2A OFFLIN 3339 N/A 0 R/O-AD L2 0 18,403 96
 0201 40 OFFLIN 3339 N/A 0 CAS-AD L1 34,687 96
E902 02 0202 0102 2A OFFLIN 3339 N/A 0 R/O-AD L2 0 26,962 94
 0202 40 OFFLIN 3339 N/A 0 CAS-AD L1 27,041 94
```

The N/R (Not Ready) status is normal for R2 devices (L2 is an R2 also locally protected). The CAS state indicates cascading mode for rdfgroup# 40.
This chapter will show an example of suspending the cascaded replication that was just set up in Chapter 6, “Data Migration Storage Configuration,” in order to pilot test the new production disaster recovery data centers. Since it is a pilot test, the configuration will return to its starting point after the testing. The topics covered include:

- **7.1 Introduction** ................................................................. 100
- **7.2 Migration pilot flowchart** ........................................... 101
- **7.3 Isolate Site C and Site D** ............................................. 102
- **7.4 Disaster recovery testing between Site C and Site D** ........ 106
- **7.5 Testing disaster recovery procedures on Site D** .......... 111
- **7.6 Return to migration SRDF configuration** ......................... 114
- **7.7 Conclusion** ............................................................. 118
7.1 Introduction

After dynamic SRDF groups and pairs were set up in Chapter 6, “Data Migration Storage Configuration,” the remote replication from Site A Production to Site C New Production that gets cascaded to Site D New DR can be started. Since production is still running on Site A (with Site B DR), this replication is conducted in SRDF adaptive copy mode to limit the impact on the production application. As a result, the migration will take longer and additional actions to achieve a testable synchronization point for the migration pilot and cutover will be needed. The steps for pilot testing the migration on Site C and Site D are very similar to the steps that will be used for final cutover. The key difference is that production and DR on Sites A and B are not stopped, and therefore the SRDF configuration changes for the pilot testing are reversed in order to synchronize Sites C and D again with the real production data before the final cutover.
7.2 Migration pilot flowchart

In order to complete disaster recovery testing of the new data centers, it will be necessary to isolate Site C and Site D from Site A. In the case of the migration pilot, this is a temporary separation that will be reversed later to synchronize production application updates that continued during pilot testing. Figure 32 illustrates the steps used to pilot test the migration.

Figure 32 Migration pilot steps
7.3 Isolate Site C and Site D

In order to test Site C as the new production site, it cannot continue as the target of replication from Site A. After the RDF link from Site A to Site C is suspended, Site C can be reconfigured as the production site replicating to Site D in the same way as Site A replicates to Site B.

For testing purposes the Site A to Site C RDF groups for all storage arrays active in this migration will simply be suspended. Since the RDF links are in adaptive copy mode, the R21 copy is not a truly consistent copy. In order to minimize how much out of synchronization the R21 copy will be, the suspension and testing will be conducted during normal maintenance windows when there should be minimal production I/O. In Chapter 8, “Migration Cutover,” the devices will be switched into synchronous mode prior to suspending the links to ensure that all the data from Site A has successfully arrived at Site C.

Note: Once the SRDF link has been suspended, production I/Os to Site A can no longer be propagated to Site C. The Symmetrix marks these missed replication I/Os as invalid R2 tracks on the source (R1) volume. When the SRDF link is resumed, the owed tracks will be copied at that time.

Testing Site C disaster recovery is done from hosts local to Site C and Site D.

7.3.1 Suspend replication from Site A to Site C

The amount that the Site C R21 devices are out of synchronization from the Site A R1 devices can be displayed with the SQ VOL command using the INV_TRKS filter to only display devices out of synchronization.

```
#SQ VOL, LCL(EBD1, 2A), INV_TRKS
#SQ VOL, LCL(EBD1, 2F), INV_TRKS
#SQ VOL, LCL(EBD1, 1A), INV_TRKS
#SQ VOL, LCL(EBD1, 1F), INV_TRKS
```
The `SQ VOL` command is now displayed from a host at Site C, and the devices in rdfgroup# 2A (Site A to Site C SRDF leg) of the R21 device, acting as an R2 (L2) for this SRDF leg, show Read Only Adaptive copy Disk mode (R/O-AD) `STATUS`. The `STATUS` for the Site C to Site D SRDF leg (rdfgroup# 40) shows Cascaded Adaptive copy Disk mode (CAS-AD). The `SQ VOL` command option `INV_TRKS` limits the output to only display devices that have non-zero invalid track counts:

<table>
<thead>
<tr>
<th>SYSC</th>
<th>SYSC</th>
<th>SYSC</th>
<th>SYSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>E900</td>
<td>00</td>
<td>0200</td>
<td>0100</td>
</tr>
<tr>
<td>E901</td>
<td>01</td>
<td>0201</td>
<td>0101</td>
</tr>
<tr>
<td>E902</td>
<td>02</td>
<td>0202</td>
<td>0102</td>
</tr>
<tr>
<td>E903</td>
<td>03</td>
<td>0203</td>
<td>0103</td>
</tr>
<tr>
<td>RDEV GP</td>
<td>VOLSER</td>
<td>CYLS</td>
<td>STAT</td>
</tr>
<tr>
<td>OFFLIN</td>
<td>3339 N/A</td>
<td>0</td>
<td>R/O-AD</td>
</tr>
<tr>
<td>OFFLIN</td>
<td>3339 N/A</td>
<td>0</td>
<td>TNR-AD</td>
</tr>
<tr>
<td>OFFLIN</td>
<td>3339 N/A</td>
<td>0</td>
<td>TNR-AD</td>
</tr>
<tr>
<td>OFFLIN</td>
<td>3339 N/A</td>
<td>0</td>
<td>TNR-AD</td>
</tr>
</tbody>
</table>

In this example only three devices are displayed, and even these are from 94 percent to 99 percent synchronized. If the production I/O rate is slowed or stopped, waiting a little longer may further reduce the R2 INVTRK count.

The `SC VOL` command using the RDF-SUSP action will logically suspend the RDF links for all the devices in the specified RDF group:

```
#SC VOL,LCL(EBD1,2A),RDF-SUSP,ALL
#SC VOL,LCL(EBD1,2F),RDF-SUSP,ALL
#SC VOL,LCL(EBD1,1A),RDF-SUSP,ALL
#SC VOL,LCL(EBD1,1F),RDF-SUSP,ALL
```

The `SQ VOL` command can be used to verify that all devices in each of the suspended RDF Groups are in the TNR-AD (Target Not Ready) mode.

```
#SQ VOL,LCL(EBD1,2A),ALL
#SQ VOL,LCL(EBD1,2F),ALL
#SQ VOL,LCL(EBD1,1A),ALL
#SQ VOL,LCL(EBD1,1F),ALL
```

Isolate Site C and Site D
7.3.2 Suspend replication from Site C to Site D

Since Site C is going to be reconfigured to be an R1 replicating to Site D, the RDF links between Site C and Site D must be suspended to allow the SRDF reconfiguration.

```
#SC VOL,LCL(EBD1,40),RDF-SUSP,ALL
#SC VOL,LCL(EBD1,50),RDF-SUSP,ALL
```

The `SQ VOL` command could be used to verify that all devices in both RDF Groups are in the `TNR-AD` (Target Not Ready) mode.

```
#SQ VOL,LCL(EBD1,40),ALL
#SQ VOL,LCL(EBD1,50),ALL
```

7.3.3 Reconfigure SRDF replication on Site C

The half swap action will be used to reconfigure the Site C devices from R21 devices in the middle of a cascaded SRDF relationship to R11 devices as the source of concurrent SRDF operations. Because the A to C link will stay suspended, the Site C device will effectively be an SRDF R1 device replicating only to Site D New DR.

The `SC VOL` command half swap (HSWAP) action swaps the SRDF relationship for only one side of the RDF pair, leaving the remote partner unchanged. The `FORCE` option is specified, just in case any eligible devices are found to have invalid tracks, otherwise the command will fail and have to be reissued with the `FORCE` option.

```
#SC VOL,LCL(EBD1,2A),HSWAP(FORCE),ALL
#SC VOL,LCL(EBD1,2F),HSWAP(FORCE),ALL
#SC VOL,LCL(EBD1,1A),HSWAP(FORCE),ALL
#SC VOL,LCL(EBD1,1F),HSWAP(FORCE),ALL
```

**CAUTION**

HSWAP can result in an invalid SRDF configuration. In this example, after the HSWAP command completes the configuration will be invalid with a R11 at Site A partnered with a R11 at Site C. As long as no attempt is made to resume this mismatched SRDF configuration, each side will operate independently. Another HSWAP or an HDELETEPAIR command will be necessary to correct the invalid SRDF configuration.
Isolate Site C and Site D

Note: Just as Site A is marking tracks R2 invalid, Site C will do the same assuming it owes tracks to what it thinks of as its R2 at Site A. The key to the correct resynchronization of tracks between Site A and Site C (throwing away Site C changes and keeping Site A changes) results from the reconfiguration described in Section 7.6.3, “Half Swap (HSWAP) devices reconfiguring from R11 back to R21,” on page 114.

The SQ VOL command can be used to verify that for all the devices in each RDF Group, the concurrent R1 devices (R11) show up as L1/L1 devices in two lines of the display. Notice that the half swapped A-C link is now R/W-AD status, while the still suspended C-D link is still TNR-AD status.

```
#SQ VOL, LCL(EBD1, 2A), ALL
#SQ VOL, LCL(EBD1, 2F), ALL
#SQ VOL, LCL(EBD1, 1A), ALL
#SQ VOL, LCL(EBD1, 1F), ALL
```

Sample SQ VOL command output for five devices in rdfgroup# 2A starting at device 200 is:

```
EMCQV00I SRDF-HC DISPLAY FOR (39) EMC SQ VOL, LCL(EBD1, 2A), 5, 200
DV_ADDR | _SYM_ | | TOTAL | SYS | DCB | CNTLUNIT | | R1 | R2 | SY
SYS  CH|DEV  RDEV GP|VOLSER| CYLS|STAT|OPN|STATUS |MR|INVTRK|INVTRK| %
E900 00 0200 0100 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0200 40 OFFLIN 3339 OFFL 0 TNR-AD L1 0 0 **
E901 01 0201 0101 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0201 40 OFFLIN 3339 OFFL 0 TNR-AD L1 0 0 **
E902 02 0202 0102 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0202 40 OFFLIN 3339 OFFL 0 TNR-AD L1 0 0 **
E903 03 0203 0103 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0203 40 OFFLIN 3339 OFFL 0 TNR-AD L1 0 0 **
E904 04 0204 0104 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0204 40 OFFLIN 3339 OFFL 0 TNR-AD L1 0 0 **
```
7.4 Disaster recovery testing between Site C and Site D

From the stand alone host at Site C, the customer storage administration group should log on to the new application hosts and verify the data sent from Site A to Site C is usable for testing. Next, the Site C to Site D SRDF links should be reconfigured into a production disaster recovery scenario and tested.

7.4.1 Resume SRDF link between Site C and Site D

Now that the SRDF reconfiguration of Site C is complete the SRDF link to Site D can be resumed:

```
#SC VOL, LCL(EBD1, 40), RDF-RSUM, ALL
#SC VOL, LCL(EBD1, 50), RDF-RSUM, ALL
```

The `SQ VOL` command can be used to verify that all devices in rdfgroup# 40 for the C-D link is now R/W AD status.

```
#SQ VOL, LCL(EBD1, 40), ALL
#SQ VOL, LCL(EBD1, 50), ALL
```

Sample `SQ VOL` command output for five devices in rdfgroup# 40 starting at device 200 is:

```
EMCQV001I SRDF-HC DISPLAY FOR (9076) EMC SQ VOL, LCL(EBD1,40),5,200
DV_ADDR _SYM_ VOLSER CYLS STAT OPN STATUS MR | INVTRK | INVTRK |
SYS CH DEV RDEV GP VOLSER CYLS STAT | OPN | STATUS | MR | INVTRK | INVTRK | %
E900 00 0200 0100 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0200 40 PAGPAM 3339 ONPV 0 R/W-AD L1 0 0 **
E901 01 0201 0101 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0201 40 PAGPBW 3339 ONPV 0 R/W-AD L1 0 0 **
E902 02 0202 0102 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0202 40 PAGPCH 3339 ONPV 0 R/W-AD L1 0 0 **
E903 03 0203 0103 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0203 40 RYD903 3339 ONPV 0 R/W-AD L1 0 0 **
E904 04 0204 0104 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
0204 40 RYD904 3339 ONPV 0 R/W-AD L1 0 0 **
```

Now that Site C has been reconfigured as an R1 that is read/write enabled to the host, the new production hosts at Site C can be started as part of the recovery test.
7.4.2 Change to SRDF/A MSC mode

The example customer’s disaster recovery mode between Site A production and Site B DR is SRDF/A MSC. Therefore, Site C New Production and Site D New DR need to be changed to the same mode. This is now possible after isolating Site C from Site A. The current adaptive copy disk mode does not create a consistent R2 image unless the invalid track count goes to zero and there are no new I/Os to the source R1 volumes; an unlikely scenario in a production environment. SRDF/A mode provides a method to produce a consistent R2 image without impacting the production application; see Section 3.3, “SRDF/Asynchronous (SRDF/A),” on page 43.

7.4.2.1 Multi-Session Consistency (MSC) and the application

SRDF/A MSC coordinates multiple SRDF/A sessions running in multiple Symmetrix systems. The example used so far, consolidating two Symmetrix arrays in Site A Production to one Symmetrix array at Site C New Production, is a simplification. When considered from an application point of view, the data that was originally in multiple pairs of Symmetrix arrays at Site A has been consolidated into fewer arrays at Site C, but still multiple arrays at Site C. To ensure that data is consistent on the R2 side across multiple arrays when using SRDF/A, MSC must be used; see Section 3.3.1, “SRDF/A consistency protection using MSC,” on page 43.

In order to provide an MSC scenario, the following examples will be expanded from using a single RDF group from Symmetrix array 000190104444 at Site C to Symmetrix array 000190108888 at Site D to a second pair of Symmetrix arrays at Site C and Site D. The Site C host cuu EBD1 has been used in previous examples to reference Symmetrix 000190104444. The Site C host cuu DBD1 will be used as referencing a different Symmetrix at Site C. Both of these Site C hosts use rdfgroup# 40 for the SRDF/A MSC link to Site D. The use of the same rdfgroup# is often done for logical consistency but is not required.

The MSC_GROUP_NAME parameter is a required key word that starts the definition of an SRDF/A MSC group. The definition of this group provides a way to operate on all the devices in the group as a single unit. See the EMC SRDF Host Component for z/OS Product Guide for more information on MSC groups. Here is an example parameter list defining a group including the devices in rdfgroup# 40 on both Site C Symmetrix arrays:

```
**********************************************************
*****             MSC SRDFA  PRODUCTION TNK ****
**********************************************************
*****
* ****
***
```

Disaster recovery testing between Site C and Site D
7.4.2.2 Activate SRDF/A

The SC SRDFA command is used to activate SRDF/A:

```
#SC SRDFA,LCL(EBD1,40),ACT
#SC SRDFA,LCL(DBD1,40),ACT
```

**Note:** In order to avoid very long initial SRDF/A cycle times, it may be a best practice to use the `SQ VOL, INV_TRK` command to ensure that the number of invalid tracks owed to the R2 is less than 40,000 before activating SRDF/A.

Use the `SQ SRDFA` command to verify the SRDF/A status.

```
#SQ SRDFA,LCL(EBD1,40),ALL
#SQ SRDFA,LCL(DBD1,40),ALL
```

**Notice** SECONDARY CONSISTENT and MSC ACTIVE are both Y:

---

**MY SERIAL # MY MICROCODE**

```
000190104444 5773-123
```

**MY GRP ONL PC OS GRP OS SERIAL OS MICROCODE SYNCHDIR FEATURE**

```
---- --- -- ------ ------------ ------------ -------- ------------
LABEL  TYPE    AUTO-LINKS-RECOVERY    LINKS_DOMINO    MSC_GROUP
---------- ------- ---------------------- ---------------- ----------
04    Y   F   04   000190108888   5773-123   G(R1>R2) SRDFA A MSC
MSF6K2UD1  DYNAMIC    AUTO-LINKS-RECOVERY LINKS-DOMINO:NO (SRDFA0001)
```

---

**PRIMARY SIDE: CYCLE NUMBER**

```
16 MIN CYCLE TIME 30
```

**SECONDARY CONSISTENT ( Y ) TOLERANCE ( N )**

**CAPTURE CYCLE SIZE**

```
12,391 TRANSMIT CYCLE SIZE 59
```

**AVERAGE CYCLE TIME**

```
31 AVERAGE CYCLE SIZE 11,246
```

**TIME SINCE LAST CYCLE SWITCH**

```
22 DURATION OF LAST CYCLE 31
```

**MAX THROTTLE TIME**

```
0 MAX CACHE PERCENTAGE 94
```

**HA WRITES**

```
268,080 RPTD HA WRITES 267
```

**HA DUP. SLOTS**

```
1,032 SECONDARY DELAY 53
```

**LAST CYCLE SIZE**

```
10,478 DROP PRIORITY 9
```

**CLEANUP RUNNING ( N )**

```
MSC WINDOW IS OPEN ( N )
```

**SRDFA TRANSMIT IDLE ( Y )**

```
SRDF A DSE ACTIVE ( N )
```

**MSC ACTIVE ( Y )**

```
ACTIVE SINCE 07/19/2008 15:33:17
```

**CAPTURE TAG**

```
E0000000 00000005 TRANSMIT TAG E0000000 00000004
```

**GLOBAL CONSISTENCY ( Y )**

```
STAR RECOVERY AVAILABLE ( N )
```

---
7.4.3 Re-establish Remote BCVs in Site D

Best practice when using SRDF remote replication includes the use of TimeFinder Business Continuance Volumes (BCVs) to save a consistent copy of the R2 data before invoking SRDF resynchronization; this is also referred to as a gold copy. More information on TimeFinder can be found in the *EMC TimeFinder/Mirror for z/OS Product Guide*. In this example, the BCVs have already been defined on Site D and are currently in the SPLIT state. The `RE-ESTABLISH` command incrementally synchronizes previously split standard/BCV pairs. In this example, the command was executed from a host on Site C but affects pairing between the Site D R2 mirrors of the Site C R1 devices and BCV devices on Site D; the `RMT` option with the rdgroup# 40 indicates the remote Symmetrix to execute the command on. The BCV device range indicates the BCVs that will be acted on:

```
RE-ESTABLISH RMT(EBD1, 0300-033F, 40)
RE-ESTABLISH RMT(DBD1, 0320-035F, 40)
```

**Note:** The initial full synchronization would have been achieved with the `ESTABLISH` command that defines the standard/BCV pairs including the standard devices in the second range following the BCV device range:

```
ESTABLISH RMT(EBD1, 0300-033F, 0200-023F, 40)
ESTABLISH RMT(DBD1, 0320-035F, 0220-025F, 40)
```

The following example `QUERY` command displays five BCVs in the remote Symmetrix system, via cuu EBD1, rdgroup# 40 in extended (EX) format:

```
QUERY RMT(EBD1, 40), 5, EX(Y)
```

The sample `QUERY` command output shows the BCVs completely synchronized with the standards:

```
.SYMDV#. LAST TIME-FROM BCV BCV ...SPLIT.... CNFG STATE STATE STATE ACTION COUNT1 COUNT2 COUNT3
STD BCV BCV ... SPLIT ... STATE STATE STATE ACTION COUNT1 COUNT2 COUNT3
0200 0300 0300 142.20:36:17 NONE SYNC AVAIL INUSE EST N/A 0 N/A
0201 0301 0301 142.20:36:17 NONE SYNC AVAIL INUSE EST N/A 0 N/A
0202 0302 0302 142.20:36:17 NONE SYNC AVAIL INUSE EST N/A 0 N/A
0203 0303 0303 142.20:36:17 NONE SYNC AVAIL INUSE EST N/A 0 N/A
0204 0304 0304 142.20:36:18 NONE SYNC AVAIL INUSE EST N/A 0 N/A
```

7.4.4 Stop Site C to Site D SRDF/A to allow remote disaster recovery testing

The `MSC PENDDROP` command waits until the end of the SRDF/A cycle and then performs a `DROP` for all SRDF/A sessions in the MSC group. A `DROP` deactivates a SRDF/A session and makes all devices TNR. The R2 devices will have a restartable consistent copy of the R1 data as of the...
last cycle switch. The MSC group name defined in Section 7.4.2.1, “Multi-Session Consistency (MSC) and the application,” on page 107 is specified on the command line:

```
F EMCSCF, MSC PENDDROP, SRDFA001
```

The `SQ VOL` command can be used to verify that all devices in all of the MSC SRDF/A are now in TNR-AS status.

```
#SQ VOL, LCL(EBD1,40), ALL
#SQ VOL, LCL(DBD1,40), ALL
```

Sample `SQ VOL` command output for five devices in rdfgroup# 40 starting at device 200 is:

```
EMCQV001 SRDF-HC DISPLAY FOR (39) EMC SQ VOL, LCL(EBD1,2A), 5, 200
DV_ADDR  SYM_  TOTAL  SYS  DCB  CNTLUNIT  R1  R2  SY
SYS  CH  DEV  RDEV  GP  VOLSER  CYLS  STAT  OPN  STATUS  MR  INVTRK  INVTRK  %
E900 00 0200 0100 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
     200 40 OFFLIN 3339 OFFL 0 TNR-AS L1 0 **
E901 01 0201 0101 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
     201 40 OFFLIN 3339 OFFL 0 TNR-AS L1 0 **
E902 02 0202 0102 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
     202 40 OFFLIN 3339 OFFL 0 TNR-AS L1 0 **
E903 03 0203 0103 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
     203 40 OFFLIN 3339 OFFL 0 TNR-AS L1 0 **
E904 04 0204 0104 2A OFFLIN 3339 OFFL 0 R/W-AD L1 0 0 **
     204 40 OFFLIN 3339 OFFL 0 TNR-AS L1 0 **
```
7.5 Testing disaster recovery procedures on Site D

The scenario at this point emulates a disaster on Site C New Production requiring disaster recovery procedures to run on the surviving Site D New DR. Each customer defines their own set of disaster recovery procedures. These procedures need to be modified and tested with the new infrastructure prior to any data center cutover. Site D contains a consistent restartable copy of the data set on the SRDF/A R2 devices. In addition, the BCVs currently paired with the R2 devices can be split for an additional copy that can also be used for disaster recovery procedures.

7.5.1 Test disaster recovery procedures using Site D BCVs

The example customer uses remote site BCVs throughout the year for testing their disaster recovery solution. This allows them to maintain disaster protection using SRDF/A MSC on the R2 devices while testing disaster recovery procedures at the same time. Because this testing can occur without first dropping SRDF/A it is necessary to specify the CONS (consistent) option as part of the TimeFinder SPLIT command.

The steps below outline the JCL job execution steps used by the example customer to perform a disaster recovery test using the BCV devices throughout the year.

- DR-BCV Step 1 - Initiate Consistent BCV Split Procedure
- DR-BCV Step 2 - Disable Polling of SRDF Links
- DR-BCV Step 3 - Disable Polling of SRDF Volume Status
- DR-BCV Step 4 - TimeFinder Query for BCV Status
- DR-BCV Step 5 - Verify INUSE R2 Volumes
- DR-BCV Step 6 - Initiate BCV Consistent Split JCL
- DR-BCV Step 7 - Verify BCV Volumes Successfully Split
- DR-BCV Step 8 - Enable Polling of SRDF Links
- DR-BCV Step 9 - Enable Polling of SRDF Volume Status

Test disaster recovery procedures using Site D R2 devices

The disaster recovery procedures listed in this section are used by the example customer in the case of a real disaster. It is a best practice to test these procedures to ensure they work and meet business requirements for both the Recovery Point Objective (RPO, how old or out of step is...
the recovered data) and the Recovery Time Objective (RTO, how fast is the recovery data available). These disaster recovery procedures will consist of a mix of automated and possibly manual steps.

The outline below lists the JCL job execution steps for this example customer to perform a disaster recovery test using the R2 devices:

- DR-R2 Step 1 - Trip Occurs Split BCV Procedure
- DR-R2 Step 2 - Disable Polling of SRDF Links
- DR-R2 Step 3 - Disable Polling of SRDF Volume Status
- DR-R2 Step 4 - Disable Monitoring for MSC Drops
- DR-R2 Step 5 - Disable Monitoring for SRDF/A Drops
- DR-R2 Step 6 - Confirm EMC Host Component is Active
- DR-R2 Step 7 - Enable Host Components Commands
- DR-R2 Step 8 - Enables SRDF Traps
- DR-R2 Step 9 - TimeFinder Query for BCV Status
- DR-R2 Step 10 - Verify INUSE R2 Volumes
- DR-R2 Step 11 - EMC SRDF Query of Link Status
- DR-R2 Step 12 - Verify Links are Online
- DR-R2 Step 13 - Monitor Invalid Tracks
- DR-R2 Step 14 - Verify Number of Invalid Tracks
- DR-R2 Step 15 - Query Volume Status Before Replication Suspended
- DR-R2 Step 16 - Verify # of Volumes in R/W-AS when SRDF/A is Active
- DR-R2 Step 17 - Verify # of Volumes in R/W-AD when SRDF/A is Active
- DR-R2 Step 18 - Verify # of Volumes in R/W-TNR when SRDF/A is Active
- DR-R2 Step 19 - Verify # of Volumes in R/W-AS when SRDF/A is Not Active
- DR-R2 Step 20 - Verify # of Volumes in R/W-AD when SRDF/A is Not Active
- DR-R2 Step 21 - Verify # of Volumes in R/W-TNR when SRDF/A is Not Active
- DR-R2 Step 22 - De-activate MSC
DR-R2 Step 23 - Operator Confirmation of MSC Termination
DR-R2 Step 24 - Discontinue Adaptive Copy Replication
DR-R2 Step 25 - PEND_DROP
DR-R2 Step 26 - Suspend Replication for Resource Group 50
DR-R2 Step 27 - Query Volume Status after Adaptive Copy Disk Mode Set
DR-R2 Step 28 - Verify Number of Volumes in R/W-TNR when SRDF/A is Active
DR-R2 Step 29 - Cleanup MSC After PENDDROP
DR-R2 Step 30 - Review MSC Cleanup Report
DR-R2 Step 31 - Split BCV Volumes
DR-R2 Step 32 - Review Results of TimeFinder Splits
DR-R2 Step 33 - TimeFinder Query for BCV Status
DR-R2 Step 34 - Verify Available BCV Volumes

7.5.2 Additional disaster recovery tests

In the case of a real disaster, the production application would be started on Site D in a recovery mode. (Application testing is specific to each application and beyond the scope of this TechBook.) After the application has run on Site D in a real disaster, it would be necessary to restore the data from the disaster site to the production site. SRDF four-site data migration provides a unique opportunity to also test these restore procedures and then verify the data on the production site, since Site C is not yet the real production site and this type of testing will not disrupt the real production application.
7.6 Return to migration SRDF configuration

Once disaster recovery testing procedures are completed, it is necessary to return to the migration SRDF configuration in order to synchronize Site C and Site D with the Site A Production application writes that have been continuing during the testing. Since this has only been a disaster recovery test, there is no need to restore any data from Site D to Site C or from Site C back to Site A. Site A has been maintaining a list of invalid tracks owed to its Site C R2s and these tracks will be synchronized to Site C once it is reconfigured as an R21.

7.6.1 Change Site C to Site D configuration back to ADCOPY_DISK

From a Site C host we need to return the Site C to Site D configuration to ADCOPY_DISK mode. The `SC SRDFA` command with the `DEACT_TO_ADCOPY_DISK` action can be used to deactivate SRDF/A and reconfigure it to adaptive copy disk mode at the same time:

```
#SC SRDFA,LCL(EBD1,40),DEACT_TO_ADCOPY_DISK
#SC SRDFA,LCL(DBD1,40),DEACT_TO_ADCOPY_DISK
```

**Note:** Now that SRDF/A MSC is no longer in use, the example can return to using only the two Site A Symmetrix arrays and the one Site C Symmetrix array.

7.6.2 Suspend replication from Site C to Site D

Since Site C is going to be reconfigured to be an R21 cascading data from Site A through Site C to Site D, the RDF links between Site C and Site D must be suspended to allow the SRDF reconfiguration.

```
#SC VOL,LCL(EBD1,40),RDF-SUSP,ALL
#SC VOL,LCL(EBD1,50),RDF-SUSP,ALL
```

The `SQ VOL` command can be used to verify that all devices in both RDF Groups are in the TNR-AD (Target Not Ready) mode.

```
#SQ VOL,LCL(EBD1,40),ALL
#SQ VOL,LCL(EBD1,50),ALL
```

7.6.3 Half Swap (HSWAP) devices reconfiguring from R11 back to R21

From a Site C host, the `SC VOL` command half swap (`HSWAP`) action swaps the SRDF relationship for only one side of the RDF pair, leaving the remote partner unchanged. Site A is still configured as an R11, expecting Site C to be an R2 (or R21).
The `SQ VOL` command can be used to verify that the Site C devices are again cascaded SRDF devices (R21) showing up as L2/L1 devices in two lines of the display. Notice that all SRDF links are still suspended showing TNR-AD status.

Sample `SQ VOL` command output for five devices in rdfgroup# 2A starting at device 200 is:

```
EMCQV00I SRDF-HC DISPLAY FOR (39) EMC SQ VOL, LCL(EBD1,2A),5,200

<table>
<thead>
<tr>
<th>DV_ADDR</th>
<th><em>SYM</em></th>
<th>TOTAL</th>
<th>SYS</th>
<th>DCB</th>
<th>CNTLUNIT</th>
<th>R1</th>
<th>R2</th>
<th>SY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E900 00</td>
<td>0200</td>
<td>0100</td>
<td>2A</td>
<td>PAGPAI</td>
<td>3339 ONPV</td>
<td>0</td>
<td>TNR-AD</td>
<td>L2</td>
</tr>
<tr>
<td></td>
<td>0200</td>
<td>40</td>
<td>OFFLIN</td>
<td>3339</td>
<td>OFFL</td>
<td>0</td>
<td>TNR-AD</td>
<td>L1</td>
</tr>
<tr>
<td>E901 01</td>
<td>0201</td>
<td>0101</td>
<td>2A</td>
<td>PAGPBR</td>
<td>3339 ONPV</td>
<td>0</td>
<td>TNR-AD</td>
<td>L2</td>
</tr>
<tr>
<td></td>
<td>0201</td>
<td>40</td>
<td>OFFLIN</td>
<td>3339</td>
<td>OFFL</td>
<td>0</td>
<td>TNR-AD</td>
<td>L1</td>
</tr>
<tr>
<td>E902 02</td>
<td>0202</td>
<td>0102</td>
<td>2A</td>
<td>PAGPCP</td>
<td>3339 ONPV</td>
<td>0</td>
<td>TNR-AD</td>
<td>L2</td>
</tr>
<tr>
<td></td>
<td>0202</td>
<td>40</td>
<td>OFFLIN</td>
<td>3339</td>
<td>OFFL</td>
<td>0</td>
<td>TNR-AD</td>
<td>L1</td>
</tr>
<tr>
<td>E903 03</td>
<td>0203</td>
<td>0103</td>
<td>2A</td>
<td>RYD903</td>
<td>3339 ONPV</td>
<td>0</td>
<td>TNR-AD</td>
<td>L2</td>
</tr>
<tr>
<td></td>
<td>0203</td>
<td>40</td>
<td>OFFLIN</td>
<td>3339</td>
<td>OFFL</td>
<td>0</td>
<td>TNR-AD</td>
<td>L1</td>
</tr>
<tr>
<td>E904 04</td>
<td>0204</td>
<td>0104</td>
<td>2A</td>
<td>PAGPAI</td>
<td>3339 ONPV</td>
<td>0</td>
<td>TNR-AD</td>
<td>L2</td>
</tr>
<tr>
<td></td>
<td>0204</td>
<td>40</td>
<td>RYD904</td>
<td>3339</td>
<td>OFFL</td>
<td>0</td>
<td>TNR-AD</td>
<td>L1</td>
</tr>
</tbody>
</table>
```
7.6.4 Resume replication from Site A to Site C

Now that Site A is again an R21, it is possible to resume the replication from Site A including all production updates made to Site A while Site C was isolated. From a Site C host, the `SC VOL` command `RDF-RSUM` action resumes SRDF replication on the specified `rdfgroup#`:

```
#SC VOL, LCL(EBD1, 2A), RDF-RSUM, ALL
#SC VOL, LCL(EBD1, 2F), RDF-RSUM, ALL
#SC VOL, LCL(EBD1, 1A), RDF-RSUM, ALL
#SC VOL, LCL(EBD1, 1F), RDF-RSUM, ALL
```

The `SQ VOL` command can be used to verify that Site A to Site C SRDF replication is flowing with status again Read Only (R/O):

```
#SQ VOL, LCL(EBD1, 2A), ALL
#SQ VOL, LCL(EBD1, 2F), ALL
#SQ VOL, LCL(EBD1, 1A), ALL
#SQ VOL, LCL(EBD1, 1F), ALL
```

Sample `SQ VOL` command output for five devices in `rdfgroup# 2A` starting at device 200 is:

<table>
<thead>
<tr>
<th>DV_ADDR</th>
<th><em>SYM</em></th>
<th>TOTAL</th>
<th>DB</th>
<th>CNTLUNIT</th>
<th></th>
<th>R1</th>
<th>R2</th>
<th>SY</th>
</tr>
</thead>
<tbody>
<tr>
<td>E900 00 2000 0100 2A PAGPAI 3339 ONPV 0 R/O-AD L2 0 4,954 90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0200 40 OFFLIN 3339 OFFL 0 TNR-AD L1 9,947 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E901 01 2001 0101 2A PAGPBR 3339 ONPV 0 R/O-AD L2 0 3,221 93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0201 40 OFFLIN 3339 OFFL 0 TNR-AD L1 7,458 85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E902 02 2002 0102 2A PAGPCP 3339 ONPV 0 R/O-AD L2 0 2,305 95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0202 40 OFFLIN 3339 OFFL 0 TNR-AD L1 7,698 84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E903 03 2003 0103 2A RYD903 3339 ONPV 0 R/O-AD L2 0 3,022 93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0203 40 OFFLIN 3339 OFFL 0 TNR-AD L1 6,851 86</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E904 04 2004 0104 2A PAGPAI 3339 ONPV 0 R/O-AD L2 0 1,841 96</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0204 40 RYD904 3339 OFFL 0 TNR-AD L1 5,985 88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7.6.5 Resume replication from Site C to Site D

Now that data from Site A is being replicated to Site C, it is possible to again cascade that data from Site C to Site D. From a Site C host, the `SC VOL` command `RDF-RSUM` action resumes SRDF replication on the specified `rdfgroup#`:

```
# SC VOL, LCL (EBD1,40), RDF-RSUM, ALL
# SC VOL, LCL (EBD1, 50), RDF-RSUM, ALL
```

The `SQ VOL` command can be used to verify that Site C to Site D SRDF replication is flowing with status again Cascaded (`CAS`):

```
# SQ VOL, LCL (EBD1, 40), ALL
# SQ VOL, LCL (EBD1, 50), ALL
```

Sample `SQ VOL` command output for five devices in `rdfgroup# 40` starting at device `200` is:

```
EMCQV00I SRDF-HC DISPLAY FOR (39) EMC SQ VOL, LCL (EBD1, 40), 5, 200
DV_ADDR | _SYM_ | | TOTAL | | SYS | | DCB | | CNTLUNIT | | R1 | | R2 | | SY
SYS CH | DEV | RDEV | GP | VOLSER | CYLS | | STAT | | OPN | | STATUS | | MR | | INVTRK | | INVTRK | | %
E900 00 | 0200 | 0100 | 2A | PAGPAI | 3339 | ONPV | 0 | R/O-AD | L2 | 0 | 4,868 | 90
       | 0200 | 40 | OFFLIN | 3339 | OFFL | 0 | CAS-AD | L1 | 9,386 | 80
E901 01 | 0201 | 0101 | 2A | PAGPBR | 3339 | ONPV | 0 | R/O-AD | L2 | 0 | 3,108 | 93
       | 0201 | 40 | OFFLIN | 3339 | OFFL | 0 | CAS-AD | L1 | 7,333 | 85
E902 02 | 0202 | 0102 | 2A | PAGPCP | 3339 | ONPV | 0 | R/O-AD | L2 | 0 | 2,287 | 95
       | 0202 | 40 | OFFLIN | 3339 | OFFL | 0 | CAS-AD | L1 | 7,485 | 84
E903 03 | 0203 | 0103 | 2A | RYD903 | 3339 | ONPV | 0 | R/O-AD | L2 | 0 | 3,994 | 93
       | 0203 | 40 | OFFLIN | 3339 | OFFL | 0 | CAS-AD | L1 | 6,739 | 86
E904 04 | 0204 | 0104 | 2A | PAGPAI | 3339 | ONPV | 0 | R/O-AD | L2 | 0 | 1,774 | 96
       | 0204 | 40 | RYD904 | 3339 | OFFL | 0 | CAS-AD | L1 | 5,890 | 88
```
7.7 Conclusion

This entire pilot testing chapter may be repeated a number of times depending on what is discovered during the testing. Once the customer is satisfied that all procedures in place work satisfactorily, it is time to go to the final migration cutover step, which is very similar to the pilot testing with a few key differences.
This chapter will show an example of the completion of the data migration by permanently switching over application processing to the newly migrated sites. The topics covered include:

- 8.1 Introduction ................................................................. 120
- 8.2 Migration cutover flowchart ....................................... 121
- 8.3 Stop production application ......................................... 123
- 8.4 Save a consistent copy on Site B ................................. 124
- 8.5 Verify Site C data, stop replication from Site A to C ....... 126
- 8.6 Start production on Site C ............................................ 129
- 8.7 Reconfigure SRDF replication on Site C ....................... 130
- 8.8 Final testing before permanent reconfiguration .......... 133
8.1 Introduction

Site C New Production and Site D New DR have successfully passed all testing in Chapter 7, “Migration Pilot.” Migration cutover is very similar to the migration pilot with a few key differences. First, the production application on Site A will be stopped. Second, production on Site C will be started. The SRDF reconfiguration for cutover is the same as for the pilot. This allows for back-out procedures just in case a problem is discovered this late into the migration. Migration Cleanup will be covered next in Chapter 9, “Migration Cleanup.”
8.2 Migration cutover flowchart

In order to complete migration cutover to the new data centers, it will be necessary to isolate Site C and Site D from Site A just as was done for the migration pilot. Doing it the same way allows for a back-out procedure to return processing to Site A if necessary. There are some extra steps needed to stop Site A production application processing, ensure that all of the data has migrated successfully to Site C, and start production application processing on Site C. Figure 33 on page 122 summarizes the steps used to complete the final migration cutover.
Figure 33 Migration cutover steps

1. **Stop Production on Site A**
   - Stop application, flush modified data to disk
   - Save consistent Site B data for back-out

2. **Verify All Data Migrated to Site C**
   - Change SRDF mode to Synchronous (SRDF/S)
   - Ensure R2 invalid track count is zero

3. **Isolate Site C & D**
   - Suspend A to C replication
   - Suspend C to D replication
   - IPL all systems in Site C and validate all processing
   - Reconfigure site C (HSWAP from R21 to R11)

4. **Final Testing Before Permanent Change**
   - Resume C to D replication
   - Change to SRDF/A MSC mode
   - Re-establish remote BCVs at site D

5. **Additional Testing**
   - Y: Migration Cleanup
   - N: Return to Migration SRDF Config
   - Change C to D replication to ADCOPY_DISK
   - Suspend C to D replication
   - Reconfigure site C (HSWAP from R11 to R21)
   - Resume A to C replication
   - Resume C to D replication
8.3 Stop production application

In order to complete migration cutover to the new data centers, all of the data from Site A Production must be migrated to Site C New Production. Therefore the production application processing on Site A must be stopped. After stopping the application, host commands should be issued to ensure all data is written to disk and not cached in host memory. Since this operation will interrupt production briefly before it is restarted on Site C, this step of the migration should occur during a scheduled migration window when production application demand is low.
8.4 Save a consistent copy on Site B

Once a successful pilot test of the migration has been performed, there should be no reason to back out of the migration. However, as a precaution, a consistent copy of the production data will be saved on Site B. To save this copy, all that is needed is to stop the SRDF/A replication to Site B with an MSC PENDDROP action:

```
F EMCSCF,MSC PENDDROP, SRDFA001
```

**Note:** The MSC Group Name SRDFA001 was defined in Section 7.4.2.1, “Multi-Session Consistency (MSC) and the application,” on page 107.

The MSC environment of EMCSCF should perform automatic cleanup. If the SRDF link for at least one SRDF/A session in an MSC group is not available at the time that SRDF/A dropped, automatic cleanup will not succeed. You can check for this situation by issuing the `SQ SRDFA` command to the secondary side of all Symmetrix storage subsystems in the MSC group. If one or more Symmetrix storage subsystems have both the CLEANUP RUNNING and HOST INTERVENTION REQUIRED settings displayed as (Y), then you will need to run the stand-alone recovery utility.

```
#SQ SRDFA,RMT(57D1,20),ALL
#SQ SRDFA,RMT(7ED1,20),ALL
```
In this example CLEANUP RUNNING is (Y), but HOST INTERVENTION REQUIRED is set to (N).

<table>
<thead>
<tr>
<th>LABEL</th>
<th>TYPE</th>
<th>AUTO-LINKS-RECOVERY</th>
<th>LINKS_DOMINO</th>
<th>MSC_GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>Y</td>
<td>F</td>
<td>04 000187001111</td>
<td>5671-69</td>
</tr>
<tr>
<td>MSF6K2UD1</td>
<td>DYNAMIC</td>
<td>AUTO-LINKS-RECOVERY</td>
<td>LINKS-DOMINO: NO</td>
<td>(SRDFA0001)</td>
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</tbody>
</table>

SECONDARY SIDE: CYCLE NUMBER 45,785

<table>
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<tr>
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<td>(N)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECEIVE CYCLE SIZE</th>
<th>APPLY CYCLE SIZE</th>
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<tr>
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<table>
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<tr>
<th>MAX THROTTLE TIME</th>
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<tr>
<td>0</td>
<td>94</td>
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</table>

<table>
<thead>
<tr>
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<th>TOTAL MERGES</th>
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<tbody>
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<td>681</td>
</tr>
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</table>

<table>
<thead>
<tr>
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<th>NOT ACTIVE DROP PRIORITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLEANUP RUNNING</th>
<th>HOST INTERVENTION REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Y)</td>
<td>(N)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MSC ACTIVE</th>
<th>ACTIVE SINCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Y)</td>
<td>07/20/2008 06:01:23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECEIVE TAG</th>
<th>APPLY TAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>E00000000</td>
<td>E00000000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GLOBAL CONSISTENCY</th>
<th>STAR RECOVERY AVAILABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Y)</td>
<td>(N)</td>
</tr>
</tbody>
</table>

Save a consistent copy on Site B
8.5 Verify Site C data, stop replication from Site A to C

Before suspending replication from Site A to Site C, you must make certain that all tracks have been replicated to Site C. These operations can be run from a host at either Site A or Site C; in this example the commands are executed from Site C.

8.5.1 Verify all data from Site A is on Site C

The amount that the Site C R21 devices are out of synchronization from the Site A R1 devices can be displayed with the **SQ VOL** command using the **INV_TRKS** filter to only display devices out of synchronization.

```
#SQ VOL,LCL(EBD1,2A),INV_TRKS
#SQ VOL,LCL(EBD1,2F),INV_TRKS
#SQ VOL,LCL(EBD1,1A),INV_TRKS
#SQ VOL,LCL(EBD1,1F),INV_TRKS
```

The **SQ VOL** command is now displayed from a host at Site C. Since there are no invalid tracks still owed to Site C, no devices are displayed.

EMCQV00I SRDF-HC DISPLAY FOR (11) EMC SQ VOL,LCL(EBD1,2A),INV_TRKS

| DV ADDR | _SYM_ | | TOTAL | SYS | DCB | CNTLUNIT | | R1 | R2 | SY |
| SYS CH | DEV | RDEV | GP | VOLSER | CYLS | STAT | OPN | STATUS | MR | INVTRK | INVTRK | % |

If there were a large number of tracks still to be synchronized, switching to synchronous (**SYNC**) mode would speed up the synchronization. Since the production application has been stopped, this will not have any performance implication on the production application. The **SC VOL** command with the **NADCOPY** action will stop the adaptive copy mode and return the SRDF link to the default synchronous mode.

```
#SC VOL,LCL(EBD1,2A),NADCOPY
#SC VOL,LCL(EBD1,2F),NADCOPY
#SC VOL,LCL(EBD1,1A),NADCOPY
#SC VOL,LCL(EBD1,1F),NADCOPY
```

8.5.2 Suspend replication from Site A to Site C

The **SC VOL** command using the **RDF-SUSP** action will logically suspend the RDF links for all the devices in the specified RDF group:

```
#SC VOL,LCL(EBD1,2A),RDF-SUSP,ALL
#SC VOL,LCL(EBD1,2F),RDF-SUSP,ALL
#SC VOL,LCL(EBD1,1A),RDF-SUSP,ALL
#SC VOL,LCL(EBD1,1F),RDF-SUSP,ALL
```
Verify Site C data, stop replication from Site A to C

The **SQ VOL** command can be used to verify that all devices in each of the suspended RDF Groups are in the **TNR-AD** (Target Not Ready) mode.

```
#SQ VOL,LCL(EBD1,2A),ALL
#SQ VOL,LCL(EBD1,2F),ALL
#SQ VOL,LCL(EBD1,1A),ALL
#SQ VOL,LCL(EBD1,1F),ALL
```

Sample **SQ VOL** command output for five devices in rdfgroup# 2A starting at device 200 is:

```
EMCQV001I SRDF-HC DISPLAY FOR (20) EMC SQ VOL, LCL(EBD1,2A),5,200
DV_ADDR | _SYM_ | TOTAL | SYS | DCB | CNTLUNIT | R1 | R2 | SY
SYS CH|DEV RDEV GP|VOLSER| CYLS|STAT|OPN|STATUS|MR|INVTRK|INVTRK|
E900 00 0200 0100 2A OFFLIN 3339 N/A 0 TNR-AD L2 0 0 **
100 0200 40 OFFLIN 3339 N/A 0 CAS-AD L1 0 **
E901 01 0201 0101 2A OFFLIN 3339 N/A 0 TNR-AD L2 0 0 **
0201 40 OFFLIN 3339 N/A 0 CAS-AD L1 0 **
E902 02 0202 0102 2A OFFLIN 3339 N/A 0 TNR-AD L2 0 0 **
0202 40 OFFLIN 3339 N/A 0 CAS-AD L1 0 **
E903 03 0203 0103 2A OFFLIN 3339 N/A 0 TNR-AD L2 0 0 **
0203 40 OFFLIN 3339 N/A 0 CAS-AD L1 0 **
E904 04 0204 0104 2A OFFLIN 3339 N/A 0 TNR-AD L2 0 0 **
0204 40 OFFLIN 3339 N/A 0 CAS-AD L1 0 **
```

**8.5.3 Suspend replication from Site C to Site D**

Since Site C is going to be reconfigured to be an R1 replicating to Site D, the RDF links between Site C and Site D must be suspended to allow the SRDF reconfiguration. It is not necessary to first verify that all of the data from Site C has made it to Site D, because this link will be resumed after the reconfiguration.

```
#SC VOL,LCL(EBD1,40),RDF-SUSP,ALL
#SC VOL,LCL(EBD1,50),RDF-SUSP,ALL
```

The **SQ VOL** command can be used to verify that all devices in both RDF Groups are in the **TNR-AD** (Target Not Ready) mode.

```
#SQ VOL,LCL(EBD1,40),ALL
#SQ VOL,LCL(EBD1,50),ALL
```
Sample `SQ VOL` command output for five devices in rdfgroup# 40 starting at device 200 is:

<table>
<thead>
<tr>
<th>DV_ADDR</th>
<th><strong>SYM</strong></th>
<th>TOTAL</th>
<th>SYS</th>
<th>DCB</th>
<th>CNTLUNIT</th>
<th>R1</th>
<th>R2</th>
<th>SY</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>E900</td>
<td>00 0200</td>
<td>0100 2A OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L2</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0200 40</td>
<td>OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L1</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E901</td>
<td>01 0201</td>
<td>0101 2A OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L2</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0201 40</td>
<td>OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L1</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E902</td>
<td>02 0202</td>
<td>0102 2A OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L2</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0202 40</td>
<td>OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L1</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E903</td>
<td>03 0203</td>
<td>0103 2A OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L2</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0203 40</td>
<td>OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L1</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E904</td>
<td>04 0204</td>
<td>0104 2A OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L2</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0204 40</td>
<td>OFFLIN</td>
<td>3339 N/A</td>
<td>0 TNR-AD</td>
<td>L1</td>
<td>0</td>
<td>0 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Setting the Symmetrix RDF director offline stopping all communication with Site A will ensure the link remains off after the half swap action reconfiguring Site C to be an R1 replicating to Site D, without making any changes to Site A.
8.6 Start production on Site C

The devices at Site C need to be made ready to the host(s). This will make them available for IPL. The `SC VOL` command using the `RDY` action will set volumes (R1 or R2) ready to the host. The `SC VOL` command using the `R/W` action will make target (R2) volumes read and write enabled. This allows a target (R2) volume to be written to from the channel:

```
#SC VOL, LCL (EBD1, 2A), RDY, ALL
#SC VOL, LCL (EBD1, 2A), R/W, ALL
#SC VOL, LCL (EBD1, 2F), RDY, ALL
#SC VOL, LCL (EBD1, 2F), R/W, ALL
#SC VOL, LCL (EBD1, 1A), RDY, ALL
#SC VOL, LCL (EBD1, 1A), R/W, ALL
#SC VOL, LCL (EBD1, 1F), RDY, ALL
#SC VOL, LCL (EBD1, 1F), R/W, ALL
```

8.6.1 IPL systems in Site C and validate processing

When the customer is ready for system processing, all systems will be activated and brought online, all data will need to be validated, and all processing needs to be started. Once confirmed, cutover will be completed. If a problem is discovered at a later time, it is still possible to back out, but any processing that took place on Site C will be discarded, and the data will return to the point it was saved (refer to Section 8.4, “Save a consistent copy on Site B,” on page 124). The old data is available in three places: the Site A R1 volumes, the Site B R2 volumes, and the Site B BCV volumes.
8.7 Reconfigure SRDF replication on Site C

The `SC VOL` command half swap (HSWAP) action will be used again as in the pilot migration to swap the SRDF relationship for only the Site C side of the RDF pair, leaving the Site A remote partner unchanged.

```
#SC VOL, LCL(EBD1, 2A), HSWAP (FORCE), ALL
#SC VOL, LCL(EBD1, 2F), HSWAP (FORCE), ALL
#SC VOL, LCL(EBD1, 1A), HSWAP (FORCE), ALL
#SC VOL, LCL(EBD1, 1F), HSWAP (FORCE), ALL
```

**Note:** HSWAP will again result in an invalid SRDF configuration. In this example, after the HSWAP action completes, the configuration will be invalid with an R11 at Site A partnered with an R11 at Site C. Instead of correcting the invalid SRDF configuration with another HSWAP as in the migration pilot, the `HDELETEPAIR` action will be used in Chapter 9, “Migration Cleanup,” to correct the invalid SRDF configuration.

The `SQ VOL` command can be used to verify that for all devices in each RDF Group, the concurrent R1 devices (R11) show up as L1/L1 devices in two lines of the display. Notice that all of the suspended SRDF links show TNR-AD status (or TNR-SY status if the change to synchronous mode had been made).

```
#SQ VOL, LCL(EBD1, 2A), ALL
#SQ VOL, LCL(EBD1, 2F), ALL
#SQ VOL, LCL(EBD1, 1A), ALL
#SQ VOL, LCL(EBD1, 1F), ALL
```

Sample `SQ VOL` command output for five devices in rdfgroup# 2A starting at device 200 is:

```
EMCQV001 SRDF-HC DISPLAY FOR (39) EMC SQ VOL, LCL(EBD1,2A), 5, 200
DV_ADDR | _SYM_ | TOTAL | SYS | DCB | CNTLUNIT | R1 | R2 | SY
SYS CH | DEV | RDEV GP | VOLSER | CYLS | STAT | OPN | STATUS | MR | INVTRK | INVTRK | %
E900 00 | 0200 | 0100 | 2A | PAGPAI | 3339 | OAPV | 0 | TNR-AD | L1 | 0 | 480 | 99
0200 | 40 | PAGPAI | 3339 | OAPV | 0 | TNR-AD | L1 | 480 | 99
E901 01 | 0201 | 0101 | 2A | PAGPBR | 3339 | OAPV | 0 | TNR-AD | L1 | 0 | 372 | 99
0201 | 40 | PAGPBR | 3339 | OAPV | 0 | TNR-AD | L1 | 372 | 99
E902 02 | 0202 | 0102 | 2A | PAGPCP | 3339 | OAPV | 0 | TNR-AD | L1 | 0 | 512 | 98
0202 | 40 | PAGPCP | 3339 | OAPV | 0 | TNR-AD | L1 | 512 | 98
E903 03 | 0203 | 0103 | 2A | RYD903 | 3339 | OAPV | 0 | TNR-AD | L1 | 0 | 245 | 99
0203 | 40 | RYD903 | 3339 | OAPV | 0 | TNR-AD | L1 | 245 | 99
E904 04 | 0204 | 0104 | 2A | RYD904 | 3339 | OAPV | 0 | TNR-AD | L1 | 0 | 407 | 99
0204 | 40 | RYD904 | 3339 | OAPV | 0 | TNR-AD | L1 | 407 | 99
```
8.7.1 Resume the SRDF link between Site C and Site D

Now that the SRDF reconfiguration of Site C is complete the SRDF link to Site D can be resumed.

```
#SC VOL, LCL(EBD1, 40), RDF-RSUM, ALL
#SC VOL, LCL(EBD1, 50), RDF-RSUM, ALL
```

The `SQ VOL` command can be used to verify that all devices in rdfgroup# 40 for the C-D link is now R/W AD status.

```
#SQ VOL, LCL(EBD1, 40), ALL
#SQ VOL, LCL(EBD1, 50), ALL
```

Sample `SQ VOL` command output for five devices in rdfgroup# 40 starting at device 200 is:

```
EMCQV00I SRDF-HC DISPLAY FOR (9076) EMC SQ VOL, LCL(EBD1,40), 5, 200
DV_ADDR | _SYM_ | SYST | TOTAL | DCB | CNTLUNIT |  |  | R1  | R2  | SY
SYS  | CH | DEV | RDEV | GP | VOLSER | CYLS | STAT | OPN | STATUS | MR | INVTRK | INVTRK | %
E900 00 0200 0100 2A PAGPAI 3339 OAPV 0 TNR-AD L1 0 492 99
   0200 40 PAGPAI 3339 OAPV 0 R/W-AD L1 0 464 99
E901 01 0201 0101 2A PAGPBR 3339 OAPV 0 TNR-AD L1 0 395 99
   0201 40 PAGPBR 3339 OAPV 0 R/W-AD L1 0 350 99
E902 02 0202 0102 2A PAGPCP 3339 OAPV 0 TNR-AD L1 0 530 98
   0202 40 PAGPCP 3339 OAPV 0 R/W-AD L1 0 488 98
E903 03 0203 0103 2A RYD903 3339 OAPV 0 TNR-AD L1 0 268 99
   0203 40 RYD903 3339 OAPV 0 R/W-AD L1 0 220 99
E904 04 0204 0104 2A RYD904 3339 OAPV 0 TNR-AD L1 0 439 99
   0204 40 RYD904 3339 OAPV 0 R/W-AD L1 0 391 99
```

8.7.2 Change to SRDF/A MSC mode

Now, Site C New Production and Site D New DR need to be changed to the production SRDF/A MSC mode. This is now possible after isolating Site C from Site A.

The SC SRDFA command is used to activate SRDF/A:

```
#SC SRDFA, LCL(EBD1, 40), ACT
#SC SRDFA, LCL(DBD1, 40), ACT
```

**Note:** In order to avoid very long initial SRDF/A cycle times, it may be a best practice to use the `SQ VOL, INV_TRK` command to ensure that the number of invalid tracks owed to the R2 is less than 40,000 before activating SRDF/A.
Use the `SQ SRDFA` command to verify the SRDF/A status.

```
#SQ SRDFA, LCL(EBD1,40), ALL  
#SQ SRDFA, LCL(DBD1,40), ALL  
```

Notice `SECONDARY CONSISTENT` and `MSC ACTIVE` are both `Y`.

```
MY SERIAL # MY MICROCODE
------------ ------------
000190104444 5773-123
```

```
MY GRP ONL PC OS GRP OS SERIAL OS MICROCODE SYNCHDIR FEATURE
--------- --- -- ------ ------------ ------------ -------- ------------
```

<table>
<thead>
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<th>LABEL</th>
<th>TYPE</th>
<th>AUTO-LINKS-RECOVERY</th>
<th>LINKS_DOMINO</th>
<th>MSC_GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>04 Y F 04</td>
<td>000190108888</td>
<td>5673-123 G(R1&gt;R2) SRDFA A MSC</td>
<td>MSF6K2UD1 DYNAMIC AUTO-LINKS-RECOVERY LINKS-DOMINO:NO (SRDFA0001)</td>
<td></td>
</tr>
</tbody>
</table>

```
PRIMARY SIDE: CYCLE NUMBER MIN CYCLE TIME TOLERANCE
---------- ------- ---------------------- ( N )
CAPTURE CYCLE SIZE 12,391 TRANSMIT CYCLE SIZE 59
AVERAGE CYCLE TIME 31 AVERAGE CYCLE SIZE 11,246
TIME SINCE LAST CYCLE SWITCH 22 DURATION OF LAST CYCLE 31
MAX THROTTLE TIME 0 MAX CACHE PERCENTAGE 94
HA WRITES 268,080 RPTD HA WRITES 267
HA DUP. SLOTS 1,032 SECONDARY DELAY 53
LAST CYCLE SIZE 10,478 DROP PRIORITY 9
CLEANUP RUNNING MSC WINDOW IS OPEN ( N )
SRDFA TRANSMIT IDLE SRDF A DSE ACTIVE ( N )
MSC ACTIVE ACTIVE SINCE 07/26/2008 12:01:17
CAPTURE TAG E0000000 00000006 TRANSMIT TAG E0000000 00000005
GLOBAL CONSISTENCY STAR RECOVERY AVAILABLE ( N )
```
8.8 Final testing before permanent reconfiguration

Site C New Production and Site D New DR are now configured as they will be permanently with the exception of a currently disabled link still configured between Site C and Site A. Both sides think they are an R11.

If any additional tests find a problem with Site C, then the production application can be returned to Site A at the point when the application was stopped on Site A. All data produced on Site C would likely be discarded, because the testing revealed some unexpected problem on Site C, possibly making the data suspect. If it was determined that the data was not corrupted but there was still a need to return to Site A Old Production, then it would be possible to restore the changed data from Site C to Site A by changing the direction of synchronization with the `SC RDFGRP` command with the `SYNCH_DIRECTION` action.

After the successful pilot migration, it is very unlikely that any problems are found on Site C or Site D, so the next change is to make the change permanent and allow the retiring or repurposing of equipment at Site A and Site B. How this is done is covered in Chapter 9, “Migration Cleanup.”
Once Site C has been reconfigured to no longer have any relationship with Site A, the Symmetrix arrays at Site A and Site B are free to be repurposed. This chapter describes the process required to repurpose the Symmetrix arrays that are no longer needed. The topics covered include:

- 9.1 Introduction .................................................................................... 136
- 9.2 Permanently disassociate Site A from Site C.............................. 137
- 9.3 Repurposing Site A and Site B ..................................................... 138
9.1 Introduction

Site C New Production and Site D New DR have successfully passed all final testing and the customer is ready to forego the possibility of return to using Site A and Site B. Therefore, Site C will be reconfigured to no longer have any relationship with Site A. The Symmetrix arrays at Site A and Site B will then be free to be repurposed.
9.2 Permanently disassociate Site A from Site C

During the migration cutover, the Site A to Site C SRDF configuration was left in a state such that both sides think they are R11s (refer to Section 8.7, “Reconfigure SRDF replication on Site C,” on page 130). This discrepancy will be cleaned up by using the SC VOL command HDELETE (half delete) action to delete the Site C configuration without changing the configuration on Site A.

```
#SC VOL,LCL(EBD1,2A),HDELETE(FORCE),ALL
#SC VOL,LCL(EBD1,2F),HDELETE(FORCE),ALL
#SC VOL,LCL(EBD1,1A),HDELETE(FORCE),ALL
#SC VOL,LCL(EBD1,1F),HDELETE(FORCE),ALL
```

The SQ VOL command can be used to verify that the formerly concurrent RDF (R11) devices on Site C are now simple RDF R1 devices in R/W-AS status.

```
#SQ VOL,LCL(EBD1,40),ALL
#SQ VOL,LCL(EBD1,50),ALL
```

Sample SQ VOL command output for five devices in rdfgroup# 40 starting at device 200 is:

```
EMCQV00I SRDF-HC DISPLAY FOR (39) EMC SQ VOL, LCL(EBD1,40),5,200
DV_ADDR  _SYM_  | TOTAL|SYS |DCB|CNTLUNIT|  |  R1  |  R2  |SY
SYS  CH|DEV  RDEV GP|VOLSER| CYLS|STAT|OPN|STATUS |MR|INVTRK|INVTRK| 
E900  00 0200 0200 40 PAGPAI  3339 OAPV   0 R/W-AS   L1            75 99
E901  01 0201 0201 40 PAGPBR  3339 OAPV   0 R/W-AS   L1            82 99
E902  02 0202 0202 40 PAGPCP  3339 OAPV   0 R/W-AS   L1            63 98
E903  03 0203 0203 40 RYD903  3339 OAPV   0 R/W-AS   L1            71 99
E904  04 0204 0204 40 RYD904  3339 OAPV   0 R/W-AS   L1            59 99
```

Now that the RDF pairs have been deleted, the dynamic RDF Group can also be deleted. The SC RDFGRP command with the DELETE action will delete the specified RDF Group.

```
#SC RDFGRP,EBD1,2A,DELETE
#SC RDFGRP,EBD1,2F,DELETE
#SC RDFGRP,EBD1,1A,DELETE
#SC RDFGRP,EBD1,1F,DELETE
```

The migration is now complete with production and disaster recovery now at Site C (New) Production and Site D (New) DR.
9.3 Repurposing Site A and Site B

Site A and Site B no longer have any association with Site C and Site D. Depending on company needs and policies, these older Symmetrix arrays may be reconfigured to run different applications or they may no longer be used. Depending on the degree of reconfiguration, commands may be issued to dynamically reconfigure parts of the array or to start entirely from scratch. For example, similar half delete actions can be used to remove the partially configured SRDF connection to Site C and reuse the defined devices as non-SRDF volumes. Alternatively, an entirely new configuration can be laid down with the assistance of an EMC Customer Engineer obviating the need for any unconfiguration. Additionally, if the plan is to stop using the old array entirely, depending on company policies it may be necessary to securely erase disks before releasing them from the site.
This glossary contains terms related to disk storage subsystems. Many of these terms are used in this guide.

A

**administrator** A person responsible for administrative tasks such as access authorization and content management. Administrators can also grant levels of authority to users.

**allocate** To assign a resource for use in performing a specific task.

**allocated storage** The space that is allocated to volumes, but not assigned.

**audit** To review and examine the activities of a data processing system mainly to test the adequacy and effectiveness of procedures for data security and data accuracy.

**authority** The right to access objects, resources, or functions.

B

**backup** A copy of computer data that is used to re-create data that has been lost, mislaid, corrupted, or erased. The act of creating a copy of computer data that can be used to re-create data that has been lost, mislaid, corrupted, or erased.

**bandwidth** A measure of the data transfer rate of a transmission channel.
C

**cache**  A random access electronic storage in selected storage controls used to retain frequently used data for faster access by the channel.

**CJOB**  The #CJOB Enginuity parameter controls the number of I/Os the disk adapters can add to the SRDF workload in adaptive copy disk mode for each SRDF group. This #CJOB parameter is directly related to the number of DA Copy Tasks that are allowed to run to service a given SRDF group.

**CKD**  Count Key Data, a data recording format employing self-defining record formats in which each record is represented by a count area that identifies the record and specifies its format, an optional key area that may be used to identify the data area contents, and a data area that contains the user data for the record. CKD can also refer to a set of channel commands that are accepted by a device that employs the CKD recording format.

**CLI**  See “Command Line Interface (CLI).”

**Command Line Interface (CLI)**  A mechanism for interacting with a computer operating system or software by typing commands to perform a given task, referred to as “entering” a command: the system waits for the user to conclude the submitting of the text command by pressing the **Enter** key. A command line interpreter then receives, analyses, and launches the requested command. Upon completion, the command usually returns output to the user in the form of text lines on the CLI.

**consistent copy**  A copy of data entity (for example, a logical volume) that contains the contents of the entire data entity from a single instant in time.

**console**  A user interface to a server. That part of a computer used for communication between the operator or user and the computer.

D

**data availability**  Access to any and all user data by the application.

**data integrity**  The condition that exists as long as accidental or intentional destruction, alteration, or loss of data does not occur.

**data migration**  The one-time movement of data from source to target, where the data will subsequently only be accessed at the target.
**default**  A value, attribute, or option that is assumed when no alternative is specified by the user.

**dependent write consistency**  A data state where data integrity is guaranteed by dependent write I/Os embedded in application logic. Database management systems are good examples of applications that utilize the dependent write consistency strategy. Database management systems must devise protection against abnormal termination in order to successfully recover from one. The most common technique used is to guarantee that a dependent write cannot be issued until a predecessor write has completed. Typically the dependent write is a data or index write while the predecessor write is a write to the log. Because the write to the log must be completed prior to issuing the dependent write, the application thread is synchronous to the log write (that is, it waits for that write to complete prior to continuing). The result of this kind of strategy is a dependent write consistent database.

**dependent write I/O**  An I/O that cannot be issued until a related predecessor I/O has completed. Most applications, and in particular database management systems (DBMS), have embedded dependent write logic to ensure data integrity in the event of a failure in the host or server processor, software, storage subsystem, or if an environmental power failure occurs. See also “dependent write consistency.”

**device type**  The general name for a kind of device; for example, standard, BCV, VDEV, or Clone.

**director**  The component in the Symmetrix subsystem that allows the Symmetrix to transfer data between the host channels and disk devices.

**disaster recovery**  The process of restoring a previous copy of the data and applying logs or other necessary processes to that copy to bring it to a known point of consistency.

**disk director**  The component in the Symmetrix subsystem that interfaces between cache and the disk devices.

**Enterprise Systems Connection (ESCON)**  A set of products and services that provides a dynamically connected environment using optical cables as a transmission medium.
**ESCON** Enterprise Systems Connection architecture; a set of IBM and vendor products that connect mainframe computers with each other and with attached storage, locally attached workstations, and other devices using optical fiber technology and dynamically modifiable switches called ESCON directors.

**F**

**fabric** Fibre Channel employs a fabric to connect devices. A fabric can be as simple as a single cable connecting two devices. The term is often used to describe a more complex network utilizing hubs, switches, and gateways.

**FBA** Fixed Block Architecture, disk device data storage format using fixed-size data blocks.

**FC** See “Fibre Channel.”

**FCP** See “Fibre Channel protocol.”

**FCS** See “Fibre Channel standard.”

**fiber optic** The medium and the technology associated with the transmission of information along a glass or plastic wire or fiber.

**Fibre Channel** A technology for transmitting data between computer devices at a data rate of up to 8 Gb/s. It is especially suited for connecting computer servers to shared storage devices and for interconnecting storage controllers and drives.

**Fibre Channel protocol** The serial SCSI command protocol used on Fibre Channel networks.

**Fibre Channel standard** An ANSI standard for a computer peripheral interface. The I/O interface defines a protocol for communication over a serial interface that configures attached units to a communication fabric. Refer to ANSI X3.230-199x.

**FICON** An I/O interface based on the Fibre Channel architecture. In this new interface, the ESCON protocols have been mapped to the FC-4 layer, that is, the Upper Level Protocol layer, of the Fibre Channel Protocol. It is used in the S/390 and z/Series environments.
front-end director  The component in the Symmetrix subsystem that interfaces with host bus adapters (HBAs). It transfers data between the host and Symmetrix cache.

G

gatekeeper  A small logical volume on a Symmetrix storage subsystem used to pass commands from a host to the Symmetrix storage subsystem. Gatekeeper devices are configured on standard Symmetrix disks.

Gigabit Ethernet  Technologies for transmitting Ethernet frames at a rate of a gigabit per second, as defined by the IEEE 802.3-2005 standard.

gigabyte (GB)  \(10^9\) bytes.

Graphical User Interface (GUI)  A type of user interface which allows people to interact with a computer and computer-controlled devices. It presents graphical icons, used in conjunction with text, labels or text navigation, to fully represent the information and actions available to a user. But instead of offering only text menus, or requiring typed commands, the actions are usually performed through direct manipulation of the graphical elements.

GUI  See “Graphical User Interface (GUI).”

H

hardware  Physical equipment, as opposed to the computer program or method of use; for example, mechanical, magnetic, electrical, or electronic devices. See also “software.”

highly parallel  Refers to multiple systems operating in parallel, each of which can have multiple processors.

host  Any system that has at least one Internet address associated with it. A host with multiple network interfaces can have multiple Internet addresses associated with it. This is also referred to as a server.

host not ready  In this state, the volume responds not ready to the host for all read and write operations to that volume.
hypervolume  A user-defined storage device allocated within a Symmetrix physical disk.

hyper-volume extension  The ability to define more than one logical volume on a single physical disk device making use of its full formatted capacity. These logical volumes are user-selectable in size. The minimum volume size is one cylinder and the maximum size depends on the disk device capacity and the emulation mode selected.

I/O device  An addressable input/output unit, such as a disk device.

invalid track  An invalid track occurs when data is written to a disk track, and that data is not yet reflected on the partner device. The track on the partner device is said to be invalid. In the normal case, where the source (R1) and target (R2) volumes are in communication and staying in synch, the updated track is passed to the target device, and once it is written there, it is no longer invalid. If the source and target devices are not in communication for some reason, for instance, if the SRDF links are disabled, the invalid tracks build up over time.

JCL  The acronym JCL refers to Job Control Language used on mainframe computers, as the command language used in batch jobs to tell a computer what to do.

KB  Kilobyte, 1024 bytes.

local volumes  Volumes that reside on an Symmetrix system but do not participate in SRDF activity.

logical volume  A user-defined storage device.

MB  Megabyte, $10^6$ bytes.
media  The disk surface on which data is stored.

microprocessor  A processor implemented on one or a small number of chips.

mirrored pair  A logical volume with all data recorded twice, once on each of two different physical devices.

mirroring  The Symmetrix maintains two identical copies of a designated volume on separate disks. Each volume automatically updates during a write operation. If one disk device fails, Symmetrix automatically uses the other disk device.

mirroring (RAID 1)  The highest level of performance and availability for all mission-critical and business-critical applications by maintaining a duplicate copy of a volume on two disk drives.

multipath device  A device made visible to a host on more than one I/O path in order to improve both fault tolerance (failover) and performance (load balancing).

multiprocessing  The simultaneous execution of two or more computer programs or sequences of instructions. See also “parallel processing.”

multiprocessor (MP)  A CPC that can be physically partitioned to form two operating processor complexes.

network topology  A physical arrangement of nodes and interconnecting communication links in networks based on application requirements and geographical distribution of users.

open system  A system whose characteristics comply with standards made available throughout the industry, and therefore can be connected to other systems that comply with the same standards.

operating system (OS)  Software that controls the execution of programs and that may provide services such as resource allocation, scheduling, input/output control, and data management. Although operating systems are predominantly software, partial hardware implementations are possible.
parallel processing  The simultaneous processing of units of work by many servers. The units of work can be either transactions or subdivisions of large units of work (batch). See also “highly parallel.”

password  A unique string of characters known to a computer system and to a user, who must specify the character string to gain access to a system and to the information stored within it.

permanent sparing  Permanent sparing is a process that replaces a failing drive with a spare drive. It is initiated automatically upon detection of certain error conditions, reducing the amount of time that a failed or failing drive remains in the system.

point of consistency  A point in time to which data can be restored and recovered or restarted and maintain integrity for all data and applications.

port  An endpoint for communication between applications, generally referring to a logical connection. A port provides queues for sending and receiving data. Each port has a port number for identification. When the port number is combined with an Internet address, it is called a socket address.

protocol  The set of rules governing the operation of functional units of a communication system if communication is to take place. Protocols can determine low-level details of machine-to-machine interfaces, such as the order in which bits from a byte are sent. They can also determine high-level exchanges between application programs, such as file transfer.

RAID  Redundant array of inexpensive or independent disks. A method of configuring multiple disk drives in a storage subsystem for high availability and high performance.

RAID 0  A protection method where data is striped across several disks to increase performance. Unless combined with RAID 1, does not natively provide protection from data loss due to drive failure. See also “RAID 10.”

RAID 1  A protection method that provides the highest level of performance and availability for all mission-critical and business-critical applications by
maintaining a duplicate copy of a volume on two disk drives. See also “mirroring.”

**RAID 5** A protection method that provides high performance with automatic striping across hypervolumes. Lost hypervolumes are regenerated from remaining members. RAID 5 is configured in (3+1) and (7+1) groups. RAID 5 technology stripes data and distributes parity blocks across all the disk drives in the RAID group.

**RAID 6** A protection method that supports the ability to rebuild data in the event that two drives within the RAID group fail.

**RAID 10** A protection method that combines RAID 1 and RAID 0; used in mainframe environments.

**read access** Permission to read information.

**ready volume** A state indicating the volume is available for read/write operations.

**recovery** The process of rebuilding data after it has been damaged or destroyed, often by using a backup copy of the data or by reapplying transactions recorded in a log.

**remote operations** Operation of remote sites from a host system.

**restore** A process that reinstates a prior copy of the data.

**resynchronization** A track image copy from the primary volume to the secondary volume of only the tracks which have changed since the volume was last in duplex mode.

**S**

**SAN** See “storage area network.”

**server** A program running on a mainframe, workstation, or file server that provides shared services. This is also referred to as a host.

**shared storage** Storage within a storage facility that is configured such that multiple homogeneous or divergent hosts can concurrently access the storage. The storage has a uniform appearance to all hosts. The host programs that access the storage must have a common model for the information on a storage device. Programs must be designed to handle the effects of concurrent access.
**software**  (1) All or part of the programs, procedures, rules, and associated
documentation of a data processing system. (2) A set of programs,
procedures, and, possibly, associated documentation concerned with
the operation of a data processing system. For example, compilers,
library routines, manuals, circuit diagrams. See also “hardware.”

**source device**  The device which is read from in a data migration. See also “target
device.”

**stage**  The process of writing data from a disk device to cache.

**storage administrator**  A person in the data processing center who is responsible for defining,
implementing, and maintaining storage management policies.

**storage area network**  A managed, high-speed network that enables any-to-any
interconnection of heterogeneous servers and storage systems.

**switch**  A component with multiple entry and exit points or ports that provide
dynamic connection between any two of these points.

**switch topology**  A switch allows multiple concurrent connections between nodes. There
can be two types of switches; circuit switches and frame switches.
Circuit switches establish a dedicated connection between two nodes.
Frame switches route frames between nodes and establish the
connection only when needed. A switch can handle all protocols.

**SymmMerge**  SymmMerge is a performance simulation tool that EMC created to
determine the feasibility of consolidating a number of storage systems
to fewer or newer Symmetrix units. At this time, SymmMerge is
designed for EMC internal use only.

**T**

**target device**  The device which is written to in a data migration. See also “source
device.”

**topology**  An interconnection scheme that allows multiple Fibre Channel ports to
communicate. For example, point-to-point, arbitrated loop, and
switched fabric are all Fibre Channel topologies.

**transaction**  A unit of work performed by one or more transaction programs,
involving a specific set of input data and initiating a specific process or
job.
**transactional consistency**  Transactional consistency is a DBMS state where all in-flight transactions are either completed or rolled back.

**virtual storage**  (1) The storage space that can be regarded as addressable main storage by the user of a computer system in which virtual addresses are mapped into real addresses. The size of virtual storage is limited by the addressing scheme of the computer system and by the amount of auxiliary storage available, not by the actual number of main storage locations. (2) An addressing scheme that allows external disk storage to appear as main storage.

**virtualization**  A technique for hiding the physical characteristics of computing resources from the way in which another function interacts with those resources.

**volume**  A general term referring to a storage device. In the Symmetrix subsystem, a volume corresponds to single disk device.

**wait state**  Synonymous with waiting time.

**waiting time**  (1) The condition of a task that depends on one or more events in order to enter the ready condition. (2) The condition of a processing unit when all operations are suspended.

**web browser**  A software application that enables a user to display and interact with text, images, videos, music and other information typically located on a Web page at a website on the World Wide Web or a local area network. Web browsers communicate with Web servers primarily using HTTP (hypertext transfer protocol) to submit information to Web servers as well as fetch Web pages from them.

**zoning**  In Fibre Channel environments, zoning allows for finer segmentation of the switched fabric. Zoning can be used to instigate a barrier between different environments. Ports that are members of a zone can communicate with each other but are isolated from ports in other zones.
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