EMC RECOVERPOINT: ADDING APPLICATION RECOVERY TO VPLEX LOCAL AND METRO

Abstract

This white paper discusses EMC® RecoverPoint local, remote, and Concurrent (local and remote) data protection with EMC VPLEX™ Local and EMC VPLEX Metro based write splitting. RecoverPoint provides local and remote point-in-time recovery capability for applications running on VPLEX Local and Metro solutions.
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Executive summary

The EMC® VPLEX™ family removes physical barriers within, across, and between data centers. VPLEX Local provides simplified management and non-disruptive data mobility across heterogeneous arrays. VPLEX Metro and Geo provide data access and mobility between two VPLEX clusters within synchronous and asynchronous distances respectively. With a unique scale-up architecture, VPLEX’s advanced data caching and distributed cache coherency provide workload resiliency, automatic sharing, and balancing and failover of storage domains, and enable both local and remote data access with predictable service levels.

EMC® RecoverPoint is an enterprise-scale solution designed to protect application data on heterogeneous SAN-attached servers, storage arrays, and virtual storage solutions. RecoverPoint runs on a dedicated appliance and combines industry-leading continuous data protection technology with a bandwidth-efficient, no-data-loss replication technology, allowing it to protect data both locally and remotely.

RecoverPoint uses innovative data change journaling and application integration capabilities to enable customers to address their mission critical business, operations, and regulatory data protection concerns. Customers implementing RecoverPoint will see dramatic improvements in application protection and recovery times as compared to traditional host and array snapshots or disk-to-tape backup products.

This white paper is designed to give technology decision-makers a deeper understanding of the integration of EMC VPLEX and RecoverPoint in terms of solution design, features, and functionality. The key technical considerations for implementing RecoverPoint with VPLEX splitter based technology to achieve local and/or remote point in time operational recovery are examined. The integration of the two products results in a solution that builds on the strengths of RecoverPoint and VPLEX to provide the highest levels of data availability, mobility, and operational recovery for today’s internal and external enterprise storage environments.

Document scope and limitations

This document applies to the EMC VPLEX Local and Metro write-splitter and RecoverPoint CDP, CLR, and CRR. The solution details provided in this white paper are applicable for the following hardware configurations:

- RecoverPoint 3.5
- VPLEX GeoSynchrony 5.1
- VPLEX Local and Metro (VPLEX Geo is currently not supported)
- All VPLEX supported 3rd party storage arrays
- Array based write-splitters provided by CX, VNX, and Symmetrix VMAX Series (Intelligent Fabric based splitters are currently not supported with VPLEX)
The use cases and solution topologies described apply to new and existing VPLEX customers planning to implement RecoverPoint or to existing RecoverPoint customers planning to implement VPLEX.

Please consult with your local EMC Support representative if you are uncertain as to the applicability of these procedures to your VPLEX or RecoverPoint environment.

Introduction

Today’s businesses are faced with an ever-increasing amount of data that threatens to undermine their existing storage management solutions. Data protection is no longer the simple copying of yesterday’s changed files to tape. Critical data changes occur throughout the day, and to protect this data customers are frequently turning to new technology such as continuous remote replication. This white paper provides an overview of EMC RecoverPoint using VPLEX write splitting technology and helps the reader develop a deeper functional understanding of the complementary capabilities that each provide. Information includes:

- Product architectures, components, and data flows
- Advantages of the architecture
- Deployment Options
- VPLEX and RecoverPoint licensing

Audience

This white paper is targeted to corporate management and technical decision-makers, including storage and server administrators, IT managers, and application engineers, as well as storage integrators, consultants, and distributors.
EMC VPLEX Overview

EMC VPLEX represents the next-generation architecture for data mobility and information access. This architecture is based on EMC’s 20-plus years of expertise in designing, implementing, and perfecting enterprise-class intelligent cache and distributed data protection solutions.

VPLEX is a solution for federating EMC and non-EMC storage. VPLEX resides between the servers and heterogeneous storage assets and has unique characteristics in its architecture:

1. **Scale-out clustering hardware** lets you start small and grow big with predictable service levels.
2. **Advanced data caching** utilizes large-scale SDRAM cache to improve performance and reduce I/O latency and array contention.
3. **Distributed cache coherence** provides automatic sharing, balancing, and failover of I/O within and between VPLEX clusters.
4. **A consistent view** of one or more LUNs between VPLEX clusters separated either by a few feet within a data center or across asynchronous RTT distances enables new models of high availability, workload mobility, and collaboration.

![Figure 1. A multi-cluster deployment of VPLEX](image)

**EMC VPLEX family overview**

The EMC VPLEX family today consists of:

- **VPLEX Local** for managing data mobility and access within the data center using a single VPLEX cluster.
- **VPLEX Metro** for mobility and access across two locations separated by inter-site RTT of up to 5 ms. VPLEX Metro uses two VPLEX clusters and includes the unique capability where a remote VPLEX Metro cluster can present LUNs without the need for physical storage for those LUNs at the remote cluster. It also supports synchronous
EMC RecoverPoint: An Integrated Approach to Operational Recovery for VPLEX Local and Metro

distributed volumes that mirror data between the two clusters using write-through caching.

- **VPLEX Geo**, which also uses two VPLEX clusters, for access between two sites over extended asynchronous distances with RTT latencies up to 50 ms. VPLEX Geo distributed volumes support AccessAnywhere distributed mirroring using write-back caching. *Note: VPLEX Geo is not currently supported with RecoverPoint.*

VPLEX addresses three distinct customer requirements:

- **Mobility**: The ability to move applications and data across different storage installations—within the same data center, across a campus, or within a geographical region. And now, with VPLEX Geo, users can move data across even greater distances.

- **Availability**: The ability to create high-availability storage infrastructure across these same varied geographies with unmatched resiliency.

- **Collaboration**: The ability to provide efficient real-time data collaboration over distance for such “big data” applications as video, geographic/oceanographic research, and others.

**VPLEX Architecture**

**VPLEX VS2 hardware platform**

A VPLEX VS2 system with GeoSynchrony 5.1 is composed of one or two VPLEX clusters: one cluster for VPLEX Local systems and two clusters for VPLEX Metro and VPLEX Geo systems. These clusters provide the VPLEX AccessAnywhere capabilities.

Each VPLEX cluster consists of:

- A VPLEX Management Console
- One, two, or four engines
- One standby power supply for each engine

In configurations with more than one engine, the cluster also contains:

- A pair of Fibre Channel switches
- An uninterruptible power supply for each Fibre Channel switch

**VPLEX Witness**

VPLEX Metro and VPLEX Geo systems optionally include a Witness. The Witness is implemented as a virtual machine and is deployed in a separate fault domain from two VPLEX clusters. The Witness is used to improve application availability in the presence of site failures and inter-cluster communication loss.
VPLEX Consistency Groups

VPLEX consistency groups ensure multi-volume write consistency within the VPLEX system in the event of a disaster, providing a point of consistency for disaster restart for all identified applications associated with a business function. For solutions using the VPLEX write-splitter and RecoverPoint, VPLEX consistency groups are used together with RecoverPoint consistency groups to ensure volume protection and failure behavior is aligned across both products.

RecoverPoint and Write-splitting Technology

The EMC RecoverPoint family provides cost-effective, local continuous data protection and continuous remote replication solutions that allow for any-point-in-time data recovery. All RecoverPoint products are appliance-based data protection solutions that ensure the integrity of production data at local and/or remote sites. These products enable customers to centralize and simplify their data protection management and allow for the recovery of data to nearly any point in time.

RecoverPoint is designed to minimize any impact to a production host’s I/O throughput or CPU load. RecoverPoint utilizes write splitting technology located within a storage array or a virtual storage layer which intercepts write I/O’s to the source virtual volumes at “write-speed,” which ensures that there is minimal write performance degradation seen by the production host. Because the VPLEX write-splitter provides support for heterogeneous storage vendors, the write splitting technology can be used across all VPLEX supported 3rd party storage vendors (i.e. those with no native write splitter) with no additional SAN or host infrastructure requirements.

**Note:** It is important to properly size VPLEX and RecoverPoint and to configure the back end storage arrays to ensure minimal impact to applications. EMC has several tools
available through the Powerlink web portal (http://powerlink.emc.com) and through EMC customer and partner support teams. These tools can provide guidance on the amount of bandwidth, the number of VPLEX engines, the number of RecoverPoint appliances, as well as array throughput and journal sizes, to meet required recovery point objectives and protection needs.

**RecoverPoint Consistency Groups and Replication Policies**

Replication within RecoverPoint is based on a logical container called a consistency group. SAN-attached storage volumes at the primary and secondary sites—called replication volumes by RecoverPoint—are assigned to a consistency group to define the set of data to be replicated. An application, such as Microsoft Exchange, typically has its storage resources defined in a single consistency group so there is a mapping between an application and a consistency group. RecoverPoint ensures that data consistency and dependent write-order fidelity are maintained across all the volumes defined in a consistency group, including any volumes accessed by different hosts or reside on different storage systems.

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

Throughout this paper, the two ends of the data replication process in a consistency group are normally designated as follows:

- **Source site** – location from which data is replicated
- **Target site** – location to which data is replicated

In some instances, users may need or want to execute a failover, to facilitate replication in the opposite direction. In these instances, the designations of source and target sites switch.

**Continuous replication**

EMC RecoverPoint automatically optimizes replication performance based on current conditions, including the replication type (local, remote, or both), application load, throughput capacity, and replication policy. RecoverPoint can dynamically respond to workload and link conditions to deliver continuous replication across a wide spectrum of environments. Regardless of the replication optimization, EMC RecoverPoint is unique in its ability to guarantee a consistent copy at the target site under all circumstances, and in its ability to maintain the distributed write-order fidelity in multi-host heterogeneous SAN environments.

**System Architecture**

An example of a two site EMC RecoverPoint deployment is shown in Figure 3 below. Details about the components are then described in the following sections along with the data flow between each piece of hardware.
The RecoverPoint appliance (RPA) runs the RecoverPoint software on top of a custom 64-bit Linux kernel inside a secure environment built from an industry-standard server platform. An RPA manages all aspects of data protection for a storage group, including capturing changes, maintaining the images in the journal volumes, and performing image recovery. Moreover, one appliance can manage multiple storage groups, each with differing policies.

There are at least two active RPAs per site that constitute a RecoverPoint cluster. Physically, the RecoverPoint cluster is located in the same facility as the host and storage subsystems. All RPAs in a cluster have identical functionality. In normal operation, all RPAs are active all of the time. Consequently, if one of the RPAs in a cluster goes down, EMC RecoverPoint supports immediate switchover of the functions of that appliance to one or more of the remaining RPAs.

RecoverPoint Write Splitting

RecoverPoint monitors host writes to block storage using technology called write splitters. Write splitters ensure that a copy of all writes to a RecoverPoint protected volume are tracked and sent to the local RecoverPoint appliance. With the Sofia (VPLEX 5.1) software release and the introduction of VPLEX write splitter, RecoverPoint now supports four types of write splitters:

- Array-based write splitter – EMC CLARiiON, VNX Series, and Symmetrix VMAX Series
- Intelligent fabric-based write splitter -- Brocade and Cisco
- Host-based write splitter
- VPLEX-based write-splitter – VPLEX Local and Metro
RecoverPoint/CL supports all four types of write splitters; RecoverPoint/EX supports the array-based write splitter for Symmetrix VMAX Series, VNX Series, and CLARiiON arrays; and RecoverPoint/SE supports the array-based write splitter for the VNX series and CLARiiON series arrays, and the Windows host-based write splitter. A RecoverPoint configuration requires at least one type of splitter at each site. The combination of array based splitting and VPLEX based splitting is supported. It’s worth noting, however, there are some mixed VPLEX and other splitter combinations that will not be supported with the VPLEX splitter. For example, Intelligent Fabric based splitting is not currently supported with VPLEX write splitting. Consult the RecoverPoint 3.5 release notes and RecoverPoint product documentation for the most up to date support statements on other combinations of splitters.

**VPLEX Write Splitter**

The VPLEX GeoSynchrony 5.1 software release adds an integrated RecoverPoint write splitter to the VPLEX cache layer. The VPLEX write splitter is designed to interoperate with RecoverPoint 3.5 and higher. All heterogeneous (3rd party vendor) storage arrays supported by VPLEX can now take advantage of the data protection capabilities provided by RecoverPoint. This means that splitting can be done by VPLEX for fibre channel storage arrays from 3rd party vendors which do not possess native write splitting capability. For VPLEX, the write splitter function is carried out by the VPLEX directors – no host splitting software is required. Unlike the host and fabric splitters, the VPLEX write splitter supports LUNs up to 32 TB in size; other splitters are limited to LUNs up to 2 TB in size.

Additionally, multiple RecoverPoint clusters can share the VPLEX write splitter, enabling up to four RecoverPoint clusters to protect a single VPLEX Cluster. Please note, a protected LUN cannot span RecoverPoint clusters, which means that more than one RecoverPoint cluster cannot protect the same LUN.

**Repository volume**

The repository volume is a SAN-attached volume approximately 3GB in size which is provisioned only to RecoverPoint. The repository volume is used to maintain the configuration and communication between RPAs in a cluster. Similar to a cluster server’s quorum volume, the repository volume contains the status of the overall RecoverPoint system and acts as a resource arbitrator during RPA failover and recovery operations. There is no user-accessible information stored on the repository volume.

**Journal volume**

Journal volumes hold data waiting to be distributed to target replica volumes and also retain copies of the data previously distributed to the target volumes to facilitate operational recovery or disaster recovery to any point in time that is retained in the journal history. Each consistency group has its own journal volumes, which allows for differing retention periods across consistency groups. Each consistency group has two or three journal volumes, one assigned to the local copy volumes (if present), one assigned to the remote copy volumes (if present), and one assigned to the production or source volumes. Journal volumes are used for the source and both copies in order to support production failover from the current active source volume to either the local or remote copy volume. A given copy journal can consist of one or more storage devices. RecoverPoint will stripe the data across the number of devices provisioned for a given journal.
Storage efficiency is realized in the history journal by retaining only the changes between journal entries when snapshot consolidation is enabled. Additionally, the journal volume can also be compressed, resulting in even more storage savings. These options can be turned on or off on a per-consistency group basis. Source and target images on the Replica volumes are always consistent upon completing the distribution of each write change.

**RecoverPoint Consistency Groups**

Figure 4 below shows the architecture of RecoverPoint consistency groups. Volumes are grouped into consistency groups, and replicated to target volumes in the local and/or remote site. Writes to source volumes will be replicated in the same order on the local and/or remote volumes, which ensures that transactional consistency is maintained.

![Figure 4. RecoverPoint Consistency Groups](image)

If one of the source volumes in a consistency group goes offline, such as what may occur in a *rolling* disaster where a partial loss affects only a few of the source volumes, then the replication for all volumes in the consistency group will be paused until the source volume comes back online. In this way, consistency groups prevent dependent writes from getting out of sync, thus ensuring the integrity and consistency of the data at the remote site. With the VPLEX splitter, RecoverPoint consistency groups are also used to check alignment with VPLEX consistency groups to ensure both products are protecting the same set of volume and providing the same failure behavior. With VPLEX Geosynchrony 5.1 the VPLEX write splitter supports up to 2048 virtual volumes. This value *does not* increase as multiple independent RecoverPoint clusters are attached to the same VPLEX write splitter.

**Data Path with VPLEX Splitting**

**Continuous Data Protection (CDP)**

RecoverPoint can be used to provide image replication and protection within a single site by using continuous data protection (CDP) technology. For CDP, the data is continuously written to the RecoverPoint journal volume and to the RecoverPoint replica image. The operation of the system is the same as the other splitter solutions, including the ability to use the journal...
to recover back to a point in time, and the ability, if necessary, to fail over to the target volume(s).

Every write is kept in the journal volume, allowing recovery to any point in time. In Figure 5, there is no WAN, the target volume(s) are part of the storage at the same site, and the same RPA appears in each of the segments. The data flow is described in detail next.

![Figure 5 - Data flow for CDP](image)

**Write**

The flow of data for a write transaction follows:

1. The host writes data to the virtual volume through the VPLEX Splitter. The splitter sends it to the RPA and to the source replication volume.
2. If synchronous replication is selected then the RPA must immediately write the data to the journal before returning the ACK.
3. The VPLEX splitter sends an ACK to the host that the write has been completed successfully.

**Transfer**

The flow of data for transfer for asynchronous replication is as follows:

1. RPA writes the image to the journal.
2. Upon successful writing of the complete image to the journal, an ACK is returned to the RPA.

**Note:** Upon receiving this ACK, the RPA removes the associated marking information for the completed image from the repository volume.
Distribution

RecoverPoint proceeds at first opportunity to “distribute” the image to the appropriate location on the target-site storage. The logical flow of data for distribution is as follows:

1. The target RPA reads the image from the journal.
2. The RPA then reads existing information from the relevant target replication volume.
3. The RPA writes “undo” information (that is, information that can support a rollback, if necessary) to the journal.
4. The RPA then writes the image to the appropriate target replication volume.

For continuous data protection every write is captured and resides either in the RPA memory or on the journal. In the event of a failure the latest changes are always available.
Continuous Remote Replication (CRR)

Figure 6 shows data flow in the basic system configuration for data written by the host, and where the system replicates data to a remote site.

Figure 6 - Data flow for CRR

For remote replication, data originates as a *write* from a host at the source site. The data is then *transferred* to the target site, and then distributed to the appropriate volume(s). The data flow for asynchronous remote replication is described in detail next.

**Write**

The flow of data for a write transaction is as follows:

1. The host writes data to the volume through the VPLEX splitter. VPLEX Splitter (KDriver) sends it to the RPA and to the source replication volume.
2. The RPA returns an ACK to the VPLEX Splitter (KDriver). The storage system holding the source replication volume returns an ACK to the VPLEX Splitter (KDriver) upon successfully writing the data to storage.
3. VPLEX Splitter (KDriver) sends an ACK to the host that the write has been completed successfully.

**Note:** This sequence of events 1-3 can be repeated multiple times before the data is transferred between RecoverPoint clusters.
Transfer

The flow of data for transfer is as follows:

1. After processing the image data (for example, applying the various deduplication and compression techniques), the RPA sends the image over the WAN or Fibre Channel to its peer RPA at the target site.

2. The RPA at the target site inflates and decompresses the image and then writes the image to the journal.

3. Upon successful writing of the complete image to the journal, an ACK is returned to the target RPA.

4. The target RPA returns an ACK to its peer at the source site.

**Note:** Upon receiving this ACK, the source RPA removes the associated marking information for the completed transfer from the repository volume.

Distribution

RecoverPoint proceeds at the first opportunity to distribute the image to the appropriate location on the target-site storage. The logical flow of data for distribution follows:

1. The target RPA reads the image from the journal.

2. The RPA then reads existing information from the relevant target replication volume.

3. The RPA writes “undo” information (that is, information that can support a rollback, if necessary) to the journal.

The RPA then writes the image to the appropriate target replication volume. The remote journal and replica volume must handle five I/Os, two writes, and one read for the journal and a read and a write to the replica volume. The process is similar for Synchronous remote replication except the transfer to must be completed to the remote RPA (and optionally written to the journal) prior to returning an ACK back to the host.

Concurrent Local and Remote Data Protection

RecoverPoint can be used to perform both local and remote replication for the same set of production volumes. This type of replication is called concurrent local and remote data protection. A single copy of the write is sent to the RPA by the splitter; at that point, it is divided into two streams, with one stream being handled as a CRR stream and the other stream being handled as a CDP stream. The flow for these two streams is identical to the CRR and CDP flow mentioned previously, with each stream independent of the other. If local replication is paused, this does not affect the remote replication stream, which will continue. Similarly, if remote replication is paused, the local replication will continue.

RecoverPoint supports a simultaneous mix of groups for CRR, CDP, or CLR. Certain policy parameters do not apply for CDP and will not be visible in the management interface. Consistency groups that are managed and controlled by VMware vCenter™ Site Recovery Manager (SRM) can be either CRR or CLR consistency groups; however, only the remote replicas will be utilized by VMware® vCenter SRM for failover. Consistency groups that are managed and controlled by Cluster Enabler can only be CRR consistency groups.
VPLEX and RecoverPoint Supported Features and Topologies

The VPLEX GeoSynchrony 5.1 and RecoverPoint 3.5 software releases bring RecoverPoint’s best-in-class operational and disaster recovery capabilities to the VPLEX Local and VPLEX Metro products. With the VPLEX write splitter, customers are able to take full advantage of all RecoverPoint CDP, CRR, or CLR features on VPLEX virtual storage. The support requirements for RecoverPoint with VPLEX write splitting technology may be found in the GeoSynchrony 5.1 and RecoverPoint 3.5 release notes.

VPLEX virtual volumes residing on the following device types may be replicated by RecoverPoint:

- Local Devices
- Metro Distributed Raid-1 (synchronous cache mode)

**Note:** RecoverPoint may be connected to a VPLEX write splitter at only one cluster (site) of a VPLEX Metro installation. No communication is allowed between RecoverPoint and the second cluster (site) of a Metro installation. The RecoverPoint repository and journals must be local to the VPLEX site protected by RecoverPoint, and not distributed.

VPLEX virtual volumes residing on the following device types **may not** be replicated by RecoverPoint:

- Remote Export
- Geo Distributed Raid-1 (asynchronous cache mode)

Additional limitations for VPLEX GeoSynchrony 5.1 and RecoverPoint 3.5 include:

- No RecoverPoint virtual access image access mode
- No RecoverPoint virtual-with-physical-roll image access
- Co-existence with host or intelligent switch splitter
- Virtual Volume expansion is non-disruptive for hosts, but requires disruption to the RecoverPoint Consistency group that contains the virtual volume to be expanded.
RecoverPoint and VPLEX Solution Topologies

There are a wide variety of potential use cases with RecoverPoint and VPLEX write splitting. In this section, these solutions have been divided into five categories based VPLEX Local or Metro and on the number of data centers (sites):

- Single site solutions with VPLEX Local
- Two site solutions with VPLEX Local
- Two site solutions with VPLEX Metro
- Three site solutions with VPLEX Metro (includes Metro to Local)
- Four site solutions

Starting with the simplest site topologies and operational recovery requirements, we move through the various multi-site topologies and corresponding recovery capabilities.

Single Site Solutions with VPLEX Local

Within a single datacenter, VPLEX Local customers will be able to save unlimited point in time copies on a virtual volume using RecoverPoint CDP. This solution topology provides the ability to recover applications from operational disasters such as data corruption, viruses, or human error. Using RecoverPoint CDP the customer can quickly return to any point-in-time. In addition, application event aware based rollback is supported on VPLEX Local virtual volumes. Applications supported include Microsoft SQL, Microsoft Exchange and Oracle database applications. Further details on each of these application integrations with RecoverPoint can be found at [http://powerlink.emc.com](http://powerlink.emc.com).

Figure 7: Operational recovery with VPLEX Local

The local replica of data provided by RecoverPoint CDP may reside on VPLEX virtual storage or on physical storage arrays which have built-in write splitters. RecoverPoint CRR and CLR are also supported within a single data center or campus type of deployment. Because they
would still be administratively treated as multiple sites, they are discussed as multi-site solutions in the following sections.

**Single Site - Multiple splitters**

Within a single site, customers are also able use a single RecoverPoint cluster to replicate data from both virtual (VPLEX) and physical array-based splitter storage environments. As shown below, these topologies allows customer to perform operational recovery on VPLEX virtual volumes from independent VPLEX clusters within the production site and on physical volumes from an array based splitter within a single production site. Application data can be protected and replicated between multiple independent VPLEX clusters, from arrays with built-in write splitting to VPLEX virtual storage, or from VPLEX virtual storage to arrays with built-in write splitting.

![Site](image)

**Figure 8a: Multiple splitters with the same site RecoverPoint appliances**

![Site](image)

**Figure 8b: Multiple VPLEX systems with same site RecoverPoint appliances**
Two Site Solutions with VPLEX Local

Two site topologies consisting of EMC RecoverPoint and VPLEX Local allow customers to recover from operational disasters such as site loss, application data corruption, viruses, or human error. Storage administrators can quickly return to any point-in-time at the local site (where write splitting is occurring) or the remote site. In case of primary site disaster, customer can recover to any point of time at the remote site.

In case of site disasters, recovery at remote site to any point in time for virtual volume can be automated through integration with MSCE and VMware SRM. Simulation of disasters at the primary site and testing all of the RecoverPoint disaster recovery features at the remote site is possible with this topology. Application event aware based rollback will be supported on VPLEX Local virtual volume. Applications supported include Microsoft SQL, Microsoft Exchange and Oracle database applications.

As shown in Figure 9 and Figures 10a and b (below) RecoverPoint appliances will be deployed at both the primary site (Site A) where VPLEX Local is deployed and the remote site (Site B). The remote site may be another independent VPLEX Local cluster, an array-based splitter supported by RecoverPoint, or a combination of the two.

**VPLEX to VPLEX:**

![Diagram](image-url)

Figure 9: VPLEX to VPLEX
VPLEX to Array:

Figure 10a: VPLEX to VNX

Figure 10b: VPLEX to Symmetrix VMAX Series
Two Site Solutions with VPLEX Metro

Two site topologies consisting of EMC RecoverPoint and VPLEX Metro allow customers to achieve the ability to avoid the downtime associated with primary site loss and/or storage array failures, while at the being able to rapidly recover from application data corruption, viruses, or human error. VPLEX Metro customers will be able to save unlimited point in time copies on a VPLEX distributed or local virtual volume using RecoverPoint CDP. With CDP technology, storage administrators can quickly return to any point-in-time at the primary site (where VPLEX write splitting is occurring) or the remote site. In case of primary site disaster, customers can continue running at the 2nd site while the first site is repaired. RecoverPoint, will not be able to track write activity at the remote site (non-splitting site) until the primary site is restored. Once the primary site is restored, RecoverPoint will automatically re-synchronize by replicating only the unique new data across from the remote site. VPLEX will also incrementally and non-disruptively rebuild the copy of data located at the primary site. This makes failing back to the primary site a non-disruptive activity provide the application and host OS support online mobility. See the VPLEX 5.1 Administrator’s guide for further details on configuring and managing VPLEX distributed devices.

Application event aware based rollback will be supported on VPLEX Metro distributed or local virtual volume. Applications supported include Microsoft SQL, Microsoft Exchange and Oracle database applications.

For this solution topology, RecoverPoint appliances are deployed at one (and only one) VPLEX Metro site. Deploying RecoverPoint appliances at both VPLEX Metro sites is not currently supported in the VPLEX 5.1 release.
Three site topologies consisting of EMC RecoverPoint and VPLEX Local and Metro allow customers avoid the downtime associated with primary site loss and/or storage array failures, while at the being able to rapidly recover from application data corruption, viruses, or human error. VPLEX Metro customers are able to save unlimited points in time on a VPLEX Metro distributed/local virtual volume using RecoverPoint CRR/CLR. Recovery from operational disasters such as application data corruption, viruses, human error, can be achieved at one VPLEX Metro site (where RecoverPoint appliances are deployed) or at a third (remote) site.

In case of a primary site (VPLEX site with RecoverPoint appliances) failure, VPLEX Metro customers can choose to continue operations at the 2nd VPLEX site while the first site is repaired. RecoverPoint, will not be able to track write activity at the remote site (non-splitting site) until the primary site is restored. Once the primary site is restored, RecoverPoint will automatically re-synchronize by replicating only the unique new data across from the remote site. VPLEX will also incrementally and non-disruptively rebuild the copy of data located at the primary site. This makes failing back to the primary site a non-disruptive activity provided the application stack and host OS support online mobility. See the VPLEX 5.1 Administrator’s guide for further details on configuring and managing failover and failback with VPLEX distributed devices.

In case of the loss of multiple VPLEX sites or logical corruption of a virtual volume, recovery at remote site (3rd site) to a consistent point in time for virtual volume can be automated through 3rd part software integration. For example, with VMware SRM, VPLEX customers will also be able to simulate disaster at the primary site and test all RecoverPoint disaster recovery features at the remote site (3rd site).

Application event aware based rollback will be supported on VPLEX Metro distributed/local virtual volume. Applications supported include Microsoft SQL, Microsoft Exchange and Oracle database applications.

For this use case, RecoverPoint appliances are deployed at one VPLEX Metro cluster (Site A or Site B below) and at a 3rd site (Site C below). The 3rd site may be another independent VPLEX cluster, an array-based splitter supported by RecoverPoint 3.5, or a combination of the two.
VPLEX Metro to VPLEX Local

Site A

Site B

Site C

Figure 13: VPLEX Metro to VPLEX Local

VPLEX Metro to Array-based Splitter

Site A

Site B

Site C

Figure 14a: Operational and Disaster recovery on VPLEX Metro distributed/local virtual volume
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Figure 14b: Operational and Disaster recovery on VPLEX Metro distributed/local virtual volume

Shared VPLEX Write splitter with Multiple RecoverPoint Clusters

With a shared VPLEX splitter, customers replicate data on a production VPLEX cluster to multiple RecoverPoint clusters. This requires VPLEX splitter sharing with multiple RecoverPoint clusters as shown in Figure 15, below.

Figure 15: VPLEX cluster at Site A with multiple RecoverPoint clusters

The shared splitter solution topology can provide replication from a primary site to up to 4 other remote sites using up to 4 (maximum) different RecoverPoint clusters. Each RecoverPoint instance provides a local and a remote copy of a VPLEX virtual volume as each volume may only be replicated by a single RecoverPoint cluster at a time.

Four Site Solutions with VPLEX Metro

Four site solution topologies (four copies of the same virtual volume) can be achieved with the combination of RecoverPoint and VPLEX Metro. Four site topologies allow customers to
achieve operational recovery between two synchronously replicated VPLEX Metro sites. Customers are able to avoid the downtime associated with primary or secondary site failures while retaining an equivalent level of protection at failover sites (site 3 and Site 4). VPLEX Metro customers are able to save unlimited points in time on a VPLEX Metro distributed/local virtual volume using RecoverPoint CRR/CLR. Recovery from operational disasters such as application data corruption, viruses, human error, can be achieved at one VPLEX Metro site (where RecoverPoint appliances are deployed) or at third and fourth (remote sites C and D) sites. It’s worth noting that when you have a VPLEX Metro and you perform recover back to site B (shown below), VPLEX will ensure that the recovered data is also simultaneously restored at site A.

![Diagram of VPLEX cluster at Site A with multiple RecoverPoint clusters](image)

**Figure 16: VPLEX cluster at Site A with multiple RecoverPoint clusters**

**Testing RecoverPoint Operational Recovery Capabilities**

This section provides a high level process discussion and summary of the various RecoverPoint replication testing, failover, and recovery scenarios. **It is not intended to replace the RecoverPoint Administrators guide.** For the most comprehensive procedural steps, important considerations, and the up to date product details always use the latest RecoverPoint Administrators guide or consult your local EMC support team.

**Recovery Using Local Replica**

From time to time, it is a good practice to make sure that replicas can be used to restore data, recover from disaster, or seamlessly take over production. In most cases, while testing a replica, applications can continue to run on the production servers, and replication can continue as usual. The writes will be stored in the replica journal until testing is completed. When testing is completed and write access at the replica disabled, any writes made during testing will be rolled back; and the writes from production will be distributed from the journal.
EMC RecoverPoint: An Integrated Approach to Operational Recovery for VPLEX Local and Metro

Recovery using Local Replica Recovery Steps

1. On the local RecoverPoint Site, from the Image Access menu, select Enable Image Access.

   ![Diagram of Local at New York]

   **Note:** To test images for an extended period of time or need maximum performance while testing, select Logged Access (physical). Currently this is the only available option with VPLEX write splitter based configurations.

2. Enable host access to replica virtual volume(s) by adding them to a VPLEX storage-view. For array based luns, add appropriate lun masking to hosts for replica volumes.

3. At the host, mount the local replica virtual volume you wish to access. If the volume is in a volume group managed by a logical volume manager, import the volume group.

   **Note:** Please adhere to best practice when mounting replicas (i.e. use a different host from production or source for hosts OS and LVM that could be confused by identical disk labels, formats, and signatures).

4. Access the virtual volumes and test as desired. If you need to test longer than is possible with Logged Access (because the journal is full or will be full) or you require even better performance than Logged Access, Direct Image Access may be preferable. Refer to “Direct Image Access” on page 269 in the RecoverPoint Administrators Guide for details. Note the drawbacks of using Direct Image Access.

5. When testing is completed, unmount the replica virtual volumes from the host. If using logical disk management, deport the volume groups. Then Disable Image Access at the local replica. The writes to the local replica will automatically be undone.

6. Remove access to replica virtual volume by removing it from any VPLEX storage-views it is in.

   **Note:** The same procedure as for testing (“Testing a replica”) can be used to offload a task to a replica. For instance, if you need to run a large query on a database, and you do not want to tie up your source, you can run the query on a replica. Of course, this assumes that you do not need the very latest information (your data will be out of date by your lag time, possibly a few seconds, plus the length of time it takes to run the query.
Recovery Using Remote Replica

1. On the Remote RecoverPoint Site, select **Image Access** menu, select **Enable Image Access**.

   ![CRR at London Diagram]

   **Note:** For VPLEX, you may only select **Logged Access** (physical) mode.

2. At the host, mount the replica virtual volume you wish to access. If the volume is in a volume group managed by a logical volume manager, import the volume group.

3. If desired, run fsck (chkdsk on Windows) on the replica volumes.

4. Access the remote virtual volumes and test as desired. When testing is completed, unmount the remote replica volumes from the host. If using logical disk management, deport the volume groups. Then **Disable Image Access** at the remote replica. The writes to the remote replica will automatically be undone.

Creating and Accessing Bookmarks (Snapshots)

The concept of snapshotting and bookmarking is explained in “Bookmarks” in the *RecoverPoint 3.5 Administrators Guide*. When replicating normally, writes to the production source are also written to the journal of the replicas. The storage at the replica sites is not accessible (state of storage = No access), because the snapshots in the journal are being distributed to the storage at that site.

To do any of the following, you must access the replica:

- Test a replica virtual volume
- Roll back the production source to a previous point in time
- Fail over to a replica
- Migrate permanently to a different production site

To enable a host to access a replica virtual volume, enable image access to that replica; then mount the virtual volume. If the access is logged, distribution of writes from the journal to the replica will stop.

Writes will be collected in the journal until image access is disabled. If the journal is completely filled with writes, replication will be disabled. See the *RecoverPoint 3.5 Administrators Guide* for further details and testing options.

**Bookmarking Tips**

- You can only bookmark a snapshot for a consistency group that is enabled and actively transferring.
• *Latest* is a reserved term and therefore cannot be used as a bookmark name.
• Some applications support a quiesced state. For best reliability, you should use the quiesced state when bookmarking a snapshot.

**Creating a Bookmark (Snapshot)**

1. In the RecoverPoint navigation pane, select the RecoverPoint consistency group you want to bookmark.
2. Click the **Bookmark** button

3. Enter the following information on the Bookmark a snapshot of <group> dialog:
   a. Enter a descriptive name for the bookmark
   b. Set the consolidation policy for the bookmark

   The default consolidation policy for a snapshot is Always Consolidate, which means that the snapshot is consolidated the next time that the consolidation process runs.
   a. Check Set snapshot consolidation policy
   b. Set the snapshot consolidation policy:

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never consolidate snapshot</td>
<td>Snapshot is never consolidated.</td>
</tr>
</tbody>
</table>
   | Snapshot must survive Daily/Weekly/Monthly consolidations | • Daily: Snapshot remains after daily consolidations, but is consolidated in weekly, monthly and manual consolidations.  
   |                      | • Weekly: Snapshot remains after daily and weekly consolidations, but is consolidated in monthly and manual consolidations.  
   |                      | • Monthly: Snapshot remains after daily, weekly and monthly consolidations, but is consolidated in manual consolidation |

4. Click OK.

**Accessing the RecoverPoint bookmarks you’ve created**

1. Click the Image Access pull-down of the desired replica virtual volume.

   ![](image)

   The Enable Image Access drop-down menu is displayed.
2. Select Enable Image Access. The Enable Image Access dialog box is displayed.

3. Select by which method you wish to specify which snapshot to access:
   - Select an image from the list
   - Specify desired point in time
   - Directly select the latest image

   Then select the specific image you wish to access. The snapshot you select to access depends on what you want to achieve:
   - To test an image, you may wish to start with the last image known to be valid.
   - To analyze data, you generally want the latest snapshot.
   - To fail over to a replica
     
     **Note:** You generally want the most recent snapshot that you know to be valid. For instance, if you are using Microsoft Volume Shadow Copy Service, you probably want to select the most recent shadow copy. The shadow copies will be bookmarked with the name that you assigned to shadow copies in the Microsoft Volume Shadow Copy Service configuration.
   - To restore the production virtual volume, select **Restore Production**
   - Migration should be well planned in advance, and the snapshot to select for migration should be part of an overall migration strategy.

4. After specifying the snapshot, the Image access mode dialog box is displayed. Select one of the options listed. See the *RecoverPoint 3.5 Administrators Guide* for details on each image mode.

   **Note:** When restoring or failing over you must ensure the original source volume is not in use (not mounted) by the host as the data image will change.

5. After selecting the Image access mode and clicking **Next**, the Image access mode Summary box is displayed. Check your choices. If necessary, go back and change any choices to meet your requirements. When satisfied, click **Finish**

6. From the host, mount the volumes you want to access and choose an appropriate course of action from the following:
   - Access another image
   - Disable image access
   - Undo writes
- Enable direct access
- Move to previous point in time
- Move to next point in time
- Fail over to local (or remote) replica
- Recover production

These courses of action are described in the *RecoverPoint 3.5 Administrators Guide*. To set this replica as the production site, you must first fail over to the replica.

Undo information for any changes made to the replica by the host will be written to the image access log, and automatically undone when you disable image access.

The quantity of data that can be written by the host application to the replica journal is limited by the capacity of the journal. About 5% of the journal is reserved for instant recovery (indexing) information; and approximately 1 GB is reserved for handling peaks during distribution. The remaining disk space is available for the journal and the image access log. The size of the image access log is, by default, 20% of the available disk space; however, this proportion can be modified (refer to Proportion of journal allocated for image access log (%) in the RecoverPoint 3.5 Administration Guide). The remaining available space is reserved for the journal.

**RecoverPoint Failover and Failback**

As discussed in the previous sections, there are a number of options available once bookmarking and image access is available. This section reviews the Failover and Failback capabilities provided by RecoverPoint. Complete details regarding Failover and Failback are provided in *RecoverPoint 3.5 Administrator's Guide*. This section assumes VPLEX virtual volumes are used, but the procedure is the same for mixed VPLEX and array based write splitting environments.

1. Enable image access to the replica virtual volume that you want to continue working from.
2. In the Status Tab, select Enable Image Access from the image access menu above the replica virtual volume that you wish to fail over to. When prompted, select the snapshot to which you wish to fail over. The latest image is a logical choice. When prompted, select Logged Access.
   
   **Note:** It can take a few minutes for the system to roll to the desired snapshot.
3. If necessary, modify your existing VPLEX storage-views to allow host access to replica virtual volumes. If the replica resides on physical storage provided an array then ensure lun masking is provided for host access.
4. From the host you plan to access the replica virtual volume, mount the replica virtual volumes. If the virtual volume is in a volume group managed by a logical volume manager, import the volume group.
5. If desired, run fsck (chkdsk on Windows).
6. At the Failover Actions menu, select Failover to <local replica name> or Failover to <remote replica name>.
A popup message is displayed prompting you to verify that you indeed wish to perform the failover. Keep the Start transfer from <copy name> checkbox selected. Click the Yes button to start the failover.

**Note:** The replica’s journal will be erased. In a CLR (three-copy) configuration, transfer to the third copy will pause until production is resumed at the production source (in Step 7)

7. Repair the production site as required. In the meantime, your applications and business operations can continue at the replica. The production journal and the production virtual volumes (assuming they are online) will be kept up-to-date from the replica.

8. When repairs at the production site have been completed, from the Image Access menu above the production hosts icon in the Status Tab, select Enable Image Access.
   
   a. Select to Failover to the latest image, in Logged access mode.
   
   b. Fail back to production virtual volumes. To do so, from the Failover Actions menu above the production hosts icon in the Status Tab:

   - If RecoverPoint is configured for CLR (i.e. you are replicating to both a CDP and a CRR copy), select Resume Production.
- If RecoverPoint is configured for CDP or CRR (i.e. you are replicating to one copy), select **Fail over to** `<production copy name>`. A popup message is displayed prompting you to verify that you indeed wish to perform the requested action. Keep the **Start transfer from** `<production copy name>` checkbox selected. Click the **Yes** button to initiate the failback.

**Note:** The production journal is erased. If you have three copies (production, local, and remote), transfer to the third copy is automatically resumed.

9. Unmount the replica virtual volumes from the replica hosts. If the volume is in a volume group managed by a logical volume manager, deport the volume group.

10. Remove replica virtual volumes from storage-views to ensure no host access during normal replication operation.
Conclusion and Solution Highlights

To protect vital data customers are frequently turning to industry leading technologies like EMC RecoverPoint and VPLEX. The combination of VPLEX and RecoverPoint delivers previously unattainable levels of data protection. In this white paper we examined the deployment topologies and use cases for RecoverPoint and VPLEX Local and Metro. As was shown, RecoverPoint with VPLEX write splitting delivered local and remote operational recovery capabilities along with VPLEX disaster avoidance and data mobility characteristics. VPLEX customers are now able to leverage integrated operational recovery technology at local or remote sites without the associated degradation of application performance possible with host-based solutions. For RecoverPoint customers, VPLEX adds all of the benefits of virtual storage along with the ability to provide write splitting functionality for all VPLEX supported 3rd party storage vendors. Additionally, RecoverPoint’s policy-based replication management, data deduplication, and data compression algorithms dramatically reduce the storage and WAN bandwidth required as compared to host- or array-based local and remote replication solutions.

For VPLEX Local customers

- Fine grained operational recovery capability on VPLEX Local virtual storage.
  - RecoverPoint CDP/CRR/CLR Point-in-time protection for operational and disaster recovery on VPLEX Local virtual storage
  - RecoverPoint enabled Application aware bookmark creation on VPLEX Local virtual storage
- Disaster recovery on VPLEX Local virtual storage
  - In case of primary site disaster, customer can recover to a consistent point of time at the remote site.
  - RecoverPoint CRR/CLR enabled automated disaster recovery on VPLEX Local virtual storage or physical (array-based splitter) storage.

For VPLEX Metro customers

- Fine grained operational recovery capability on VPLEX Metro virtual storage.
  - RecoverPoint CDP/CRR/CLR Point-in-time protection for operational recovery on VPLEX Metro virtual storage
  - RecoverPoint enabled Application aware bookmark creation on VPLEX Metro virtual storage
- Disaster recovery on VPLEX Metro virtual storage
  - Support of VPLEX Metro enabled load balanced and HA data centers which are separated by synchronous distance and RecoverPoint CRR/CLR enabled protection to an independent site for disaster recovery.
  - RecoverPoint CRR/CLR enabled Automated disaster recovery on VPLEX Metro virtual storage.
References available on Powerlink.EMC.com

- White Paper: Workload Resiliency with EMC VPLEX
- Techbook: EMC VPLEX Architecture and Deployment: Enabling the Journey to the Private Cloud
- RecoverPoint Administrator’s Guide 3.5
- VPLEX 5.1 Administrators Guide
- VPLEX 5.1 Configurations Guide
- VPLEX Procedure Generator
- EMC Navisphere Online Help Documentation