Disaster-tolerant solutions with HPE 3PAR Remote Copy
Contents

Overview .........................................................................................................................3
Data replication and disaster tolerant solution challenges ................................................................. 3
Disaster-tolerant solution metrics ........................................................................................................ 3
HPE 3PAR Remote Copy software ........................................................................................................ 4
  What’s new for HPE 3PAR Remote Copy with HPE 3PAR OS 3.2.2? ......................................................  4
  HPE 3PAR Remote Copy replication modes .......................................................................................... 5
Remote Copy Link Layer support ......................................................................................................... 7
  Remote Copy over IP................................................................................................................................ 7
  Remote Copy over Fibre Channel .......................................................................................................... 9
  Remote Copy over Fibre Channel bridged over an IP network ............................................................................................... 9
Remote Copy connections ..................................................................................................................... 10
  Latency support with Remote Copy ..................................................................................................... 10
Remote Copy functionality ..................................................................................................................... 11
  Remote Copy coordinated snapshots .................................................................................................... 11
  Auto recovery policy .......................................................................................................................... 11
  New creatorcopygroup and setrcopygroup options for asynchronous streaming mode ................... 11
  Remote Copy volume group VLUN limitations .................................................................................. 12
System sizing considerations when using Remote Copy ........................................................................ 13
  Data replication link sizing ................................................................................................................ 13
  Remote Copy topologies .................................................................................................................... 15
    Remote Copy performance design .................................................................................................. 18
Solution benefits ................................................................................................................................. 19
  Simplified implementation ................................................................................................................. 19
  Simplified management .................................................................................................................... 19
  Failover management ........................................................................................................................ 20
    Transparent failover with HPE 3PAR Peer Persistence ................................................................. 20
    Cross-product interoperability ....................................................................................................... 21
    Simple verification of replicated data ............................................................................................... 22
    Access to production data without impacting replication ........................................................... 22
Recovery managers ............................................................................................................................ 22
  Integration with cluster products ...................................................................................................... 22
Summary ............................................................................................................................................. 23
Overview

Today’s IT organizations are faced with the difficult task of satisfying the diverse disaster-tolerant needs of the entire enterprise. Business-, government-, and industry-driven requirements compel the need to store more data and make it continuously available.

With the increased need for data availability comes an increased demand for fast disaster recovery, and an even stricter demand for very small recovery point objective (RPO) in the face of a data center disaster. Most types of replication do expose the user to some data loss in the event of a disaster.

An enterprise that is unable to recover its data assets quickly with minimal data loss following a disaster may be at risk for regulatory action, or worse, an inability to continue business. How do IT organizations protect more applications and data than ever while at the same time limiting the potential for data loss without adverse effects on server performance that can result from synchronous replication?

HPE 3PAR StoreServ Storage addresses all of these challenges by offering Remote Copy, a powerful yet simple solution for remote data replication that is the foundation of a properly designed and deployed disaster tolerant solution. New to the HPE 3PAR Remote Copy family with the release of HPE 3PAR OS 3.2.2 is Asynchronous Streaming Remote Copy software, which provides the capability to deploy replication solutions that can provide an RPO measured in seconds.

Data replication and disaster tolerant solution challenges

Even after natural or human-induced disasters that drastically affect day-to-day operations, businesses must continue to function. Compliance with business standards, industry trends, or federal regulations may place additional requirements on an enterprise looking to create or expand disaster recovery. Maximum RPO is one such important requirement.

For some organizations, adequate funding for disaster recovery is difficult to obtain because it may be perceived as an added expense for a very limited subset of corporate data. Clearly articulating how and why disaster recovery is necessary to meet the requirements, put in place by management or the Federal Government, is paramount. This helps to deploy a workable solution that meets expectations for defined RPO and recovery time objective (RTO).

Many storage administrators believe that by simply replicating data from the primary data center to a backup data center, they have fulfilled the enterprise’s requirement for disaster tolerance. This couldn’t be farther from the truth. A proper disaster-tolerant solution is a combination of technologies, software, and processes. These that are combined into a solution designed to meet a defined goal for RPO and RTO, and not just a technology that replicates data from one location to another.

Most probably, you’ll agree that planning and implementing a disaster recovery solution is one of the most complex, time-consuming, and expensive projects that any enterprise will undertake. Designing one that meets a very small RPO can make the objective even more daunting.

Disaster-tolerant solution metrics

The primary metrics on which a disaster-tolerant solution is designed and measured are RPO and RTO. Even though for many enterprises RTO is not a very important metric (for some it is but generally not), the maximum amount of data that can be lost in the event of a disaster, RPO is very important. At the very core of any disaster-tolerant solution is the ability to ensure that data loss will not exceed the defined RPO for the solution following recovery from a disaster.

RPO is a definition of the maximum amount of data that can be lost in the event a disaster occurs. RPO is generally defined as an amount of time and not a given quantity of data. For example, an RPO of two hours would guarantee that following a disaster that occurs at 2 pm, once recovery completes at the disaster recovery site, all transactions that were committed up to and including 12 pm would be present in the replicated copy of the database. The RPO could, in fact, contain transactions committed after 12 pm but the defined two-hour RPO guarantees transaction committed up to 12 pm will always be present. With HPE 3PAR Asynchronous Streaming Remote Copy, solutions can be designed to meet requirements with RPO definitions measured in seconds without imposing negative performance implications on the servers whose data is being replicated.
RTO is a definition of the amount of downtime that may elapse following a disaster before the database needs to be up and running, and consuming new transactions. In the vast majority of disaster-tolerant designs, this is secondary to the amount of data loss that can be tolerated. A good disaster-tolerant solution will have some type of automatic recovery mechanism, such as clustering, which is integrated with the data replication software to both automate and limit the amount of downtime suffered following a disaster. In most cases, RTO is driven by the amount of time it takes to initiate a failover of the database to the disaster recovery data center, restart the database and have it complete crash recovery.

**HPE 3PAR Remote Copy software**

Traditionally, enterprise and midrange array-based replication solutions have not been interoperable, which leads to complex high-cost replication solutions. It also increases the knowledge base that must be available to the local staff or the hired consultants responsible for maintaining the replication solution. Not providing interoperability between enterprise and midrange storage often leads administrators to implement storage arrays at both sites for every array protected at the primary site in a 1:1 ratio of array type. The problem with this approach is that the cost of the storage is tied closely to the number of storage arrays being protected instead of the amount of data being protected.

HPE 3PAR Remote Copy supports replication of data between all array models with one exception. Support for Asynchronous Streaming mode on HPE 3PAR OS version 3.2.2 is provided between all HPE 3PAR StoreServ models except for the 7200 and 7200c models. Support of Asynchronous Streaming mode on 7200 and 7200c models will be supported on a following release. Contact your HPE representative for details on the support of Asynchronous Streaming Remote Copy with HPE 3PAR StoreServ array models 7200 and 7200c.

---

**Note**

Contact your HPE representative for details on support of Remote Copy Asynchronous Streaming mode on 7200 and 7200c models of the HPE 3PAR StoreServ arrays.

---

Implemented using either the native IP network interface on the HPE 3PAR arrays or native Fibre Channel SAN fabric (or via Fibre Channel extended over IP via FC-IP routers), users may flexibly choose from three different data replication modes to design a solution that meets their requirements for RPO, RTO, and cost.

HPE 3PAR Remote Copy allows you to replicate data between any two models HPE 3PAR StoreServ Storage systems. Eliminating the incompatibilities and complexities associated with trying to replicate between other vendors’ midrange and enterprise array technologies. Source and target volumes may also be flexibly and uniquely configured to meet user’s needs (for example, different RAID levels; thick, thin, or deduped volumes; or different drive types).

**What’s new for HPE 3PAR Remote Copy with HPE 3PAR OS 3.2.2?**

There is a lot of new and enhanced functionality as well as configuration support with HPE 3PAR Remote Copy in the HPE 3PAR OS 3.2.2 release. The new functionality and enhanced configuration support include:

- Support for asynchronous streaming replication—a new replication mode that can be used to design solutions that deliver an RPO measured in seconds compared to periodic asynchronous mode’s minutes (see the section titled “Asynchronous Streaming mode” for details)
- Support for greater network latency for solutions using Remote Copy synchronous replication mode
- Support for synchronous replication mode for solutions that bridge Fibre Channel to IP to extend a SAN fabric (FCIP)
- “Certified” support for Remote Copy over Fibre Channel solutions (RCFC) that leverage dark fiber solutions. These certified solutions provide for increased latencies via HPE or Alcatel-Lucent-tested optical networks over dense wavelength division multiplexing (DWDM). These certified optical network solutions are supported for all Remote Copy replication modes
HPE 3PAR Remote Copy replication modes
HPE 3PAR Remote Copy software now offers a full set of features that can be used to design disaster-tolerant solutions requiring an RPO as small as zero to an RPO measured in seconds to an RPO measured in hours or days or even longer. Users can choose between the three different data replication modes offered, synchronous, Asynchronous Streaming, or Periodic Asynchronous replication to design the most cost-effective solution that meets their solution requirement for RPO and RTO.

Synchronous mode
In synchronous mode, host-initiated write data is mirrored to write cache on both the primary and the secondary StoreServ arrays before the write completion is acknowledged to the host. On the primary StoreServ array, data is mirrored across the cache of two nodes. The write request is then sent to the backup StoreServ array via a communication link.

The backup StoreServ array also mirrors the data in its cache (again, on two nodes) and then sends an acknowledgement to the primary system. The host write is acknowledged to the host server after the remote array’s acknowledgement is received by the primary array (figure 1). As with all synchronous replication solutions, Synchronous Remote Copy provides an RPO of zero or no data loss.

When used with an RCFC transport (or Fibre Channel extended with IP via FC-IP routers) HPE 3PAR Synchronous replication utilizes a patented protocol that only requires a single round trip across the FC network to replicate data vs. the standard double round trip SCSI protocol found in most implementations. Synchronous Remote Copy does this by having the secondary array post a group of SCSI read requests to the primary array. As host I/Os are received by the primary array it simply responds to the previously posted read requests from the secondary array, hence saving one of the round trips found in a normal SCSI write request.

Synchronous Remote Copy is now supported on all network transports provided by Remote Copy, RCIP, RCFC, and FCIP. The maximum latency supported by Remote Copy when configured for synchronous replication mode is 5 ms of round-trip latency. When paired with the HPE and Alcatel-Lucent optical network replicating over DWDM replication distances of up to 500 km are now possible.
**Periodic asynchronous mode**

Periodic asynchronous mode is asynchronous replication that is ideal for environments that need to replicate data where the write I/O service times would be too large if the data were being replicated synchronously, and where an RPO of 10 minutes or greater can be tolerated. Periodic asynchronous mode insulates the host write I/Os from any replication latency (and target array write latency) resulting from the link latency or speed.

The network throughput requirements when using periodic asynchronous mode are not as stringent as they would be with synchronous or asynchronous streaming mode. This is because with periodic asynchronous mode the replication link speed can be sized close to the average data generation rate that occurs during the largest delta resync—providing cost saving on replication.

<table>
<thead>
<tr>
<th>Time</th>
<th>Primary site</th>
<th>Secondary site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base volume</td>
<td>Snapshot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>Initial copy</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>Resynchronization starts with snapshots</td>
<td>B^</td>
</tr>
<tr>
<td></td>
<td>Resynchronization delta copy</td>
<td>B^</td>
</tr>
<tr>
<td>3</td>
<td>Upon completion, deletes old snapshot</td>
<td></td>
</tr>
</tbody>
</table>

In periodic asynchronous mode, host writes are completed on the primary array and the host write is acknowledged as soon as the data is mirrored across two nodes. The volumes on the primary array and volumes on the secondary array are then resynchronized “periodically”—when scheduled or when resynchronization is manually initiated via the `syncrcopy` command.

In this example (figure 2), what the user gets on the secondary array would be an I/O consistent copy of the source data as it looked at 12:10 initially and then again at 12:20. The process would then repeat itself 10 minutes later (in this example, the resync interval has been set to 10 minutes) and the user will get an I/O consistent copy of the source data as it looks at 12:30, 12:40, and so on.

When using Periodic Asynchronous Remote Copy choose the largest delta-resync interval practical, which will allow the solution to meet your RPO. The larger the delta resync interval, the closer the replication network can be in Megabits to the “average” data generation rate of the replicated data. This saves overall network cost.

**Asynchronous streaming mode**

For synchronous replication solutions as link latencies increase so does the latency between a host write and array acknowledgement. In most cases, this puts a practical limitation on the link latency that can be used for synchronous replication. With the release of HPE 3PAR OS v3.2.2, support for the new HPE 3PAR Asynchronous Streaming Remote Copy is available. It is an excellent option when an RPO of zero is desired but where the write I/O latency associated with a synchronous replication solution cannot be tolerated.

Asynchronous Streaming Remote copy is, as the name implies, asynchronous replication of data between two HPE 3PAR arrays but it differs from Periodic Asynchronous Remote Copy. The difference is instead of replicating data periodically at a defined resynchronization interval (for example, every 10 minutes) Asynchronous Streaming Remote Copy constantly places I/O data from the primary array onto the replication link for delivery at the secondary array. Asynchronous Streaming Remote Copy does this by holding data in cache on the primary array while it is being replicated to the secondary array. Once receipt of the data at the secondary array has been confirmed to the primary, the cache space holding the data is freed up.
This continuous “streaming” of the data between arrays will allow solutions based on Asynchronous Streaming Remote Copy to provide RPOs measured in seconds or even less. Meanwhile, journal-based asynchronous replication solutions meet RPO requirements defined in multiple minutes or hours.

Asynchronous Streaming Remote Copy is perfect for environments, where very small RPOs are required. Or for environments, where synchronous replication is desired but replicating the link latencies are so large it will result in unacceptable write I/O response times for the data to be replicated synchronously. Deploying an Asynchronous Streaming Remote Copy solution in such an environment solves the write I/O response time problem while providing the smallest RPO possible short of zero.

Asynchronous Streaming Remote Copy solutions generally requires replication link speed to be sized within 95–99 percent of the maximum data generation rate. This ensures cache on the primary array is not saturated and very small RPO is delivered.

**Figure 3. Asynchronous streaming mode**

**Remote Copy Link Layer support**

In order to satisfy the varying business or technical needs of users, Remote Copy offers two native methods of connectivity: native Gigabit and 10GbE (RCIP) and native Fibre Channel over optical fiber (RCFC). With suitable FC-IP routers, FCIP is also supported (with FCIP Remote Copy over Fibre Channel can utilize a SAN fabric that is extended over an IP network to provide long-distance Remote Copy support over IP).

**Remote Copy over IP**

Remote Copy over IP (RCIP) is a native IP implementation of Remote Copy over Ethernet. Every HPE 3PAR StoreServ array comes with a standard Gigabit or 10GbE port on every node that is dedicated for RCIP. RCIP is only supported for synchronous and periodic asynchronous replication solutions. It is ideal for short, medium, and long-haul replication. It is most often used by organizations that require disaster recovery for small to medium environments with only moderate data generation rates and a limited number of volumes to be replicated.

Synchronous mode is supported on IP networks with up to 5 ms of round-trip latency. Periodic asynchronous mode is supported on IP networks with up to 150 ms round-trip latency. Check with your HPE representative for Asynchronous Streaming Remote Copy support via RCIP.

**Note**

Check with your HPE representative in regards to Asynchronous Streaming Remote Copy support via RCIP.
RCIP uses multiple links between arrays (minimum of two and up to eight) to maximize bandwidth and ensure availability. By offering native IP connectivity, along with the site's existing IP infrastructure, RCIP is quicker to implement than solutions that don’t offer native IP replication.

When using RCIP, it is recommended that the network allocated to Remote Copy is a dedicated network (or dedicated VLAN carved out of a site network) and that it not share network bandwidth with other applications. If the Remote Copy solution is deployed on a shared network, there is no way to ensure the solution can meet the defined RPO when using asynchronous replication. Poor performance on a shared network is a possibility even in synchronous replication.

For synchronous solutions, it is possible that non-Remote Copy traffic using bandwidth on the network will result in higher than expected write I/O latencies for the host I/Os being replicated synchronously across the shared network. For solutions based on Periodic Asynchronous Remote Copy, sharing the network with other applications may prevent data replication within the chosen resync interval. This results in missing the RPO target of the solution. The system log reporting will also send out messages that the delta resync interval has exceeded.

The use of VLANs to dedicate a given bitrate to RCIP is supported and is, in fact, recommended over having Remote Copy share bandwidth on the network with other applications.

While RCIP is compatible with partner solutions that optimize bandwidth by compressing data on the network (making a 100 Mbps network look like a 400 Mbps network, for example, by compressing 400 MB of data so it fits on a 100 Mbps link) the nature of the data being replicated can affect the effectiveness of these tools. For example, if the data being replicated is poorly compressible or not compressible at all, then the WAN optimizer will not provide the network bandwidth the solution was sized for resulting in the solution not achieving its designed for RPO.

Remote Copy does not cause this. It is a result of the data being generated and whether the WAN optimizer can do a good job of compressing that data or not. It can also result in situations that prevent Remote Copy from replicating data within the chosen resync interval, eventually missing the RPO target of the solution. The system log reporting will send out messages that the delta resync interval has exceeded.

It is also possible where dropped Remote Copy heartbeat messages and/or TCP retry messages show up in the system log. This happens because the WAN accelerator drops IP packets when its buffers overflow and it has to ask Remote Copy to resend the IP packets.

In situations where the anticipated amount of data to be replicated is high, FCIP (RCFC extended over a long distance WAN using FC-to-IP routers) can be a better choice than RCIP. HPE recommends the use of FCIP.

---

**Note**

For environments with high data replication rates, where replication over an IP network is necessary, HPE recommends the use of FCIP over RCIP.

In summary, RCIP supports:

- Round-robin load balancing across all available RCIP links between a pair of HPE 3PAR StoreServ arrays
- GiGe and/or 10-GiGe connection between HPE 3PAR StoreServ systems through LAN/MAN/WAN switches
- Synchronous and periodic asynchronous modes
- Solutions requiring the replication of a moderate amount of data
- One RCIP connection per node (up to eight RCIP connections on an 8-node array)
- Can be used in conjunction with RCFC and FCIP
- All Remote Copy topologies
- Maximum network latencies of 5 ms round trip for synchronous replication and 150 ms round trip for periodic asynchronous modes
Remote Copy over Fibre Channel
For customers that choose Fibre Channel connectivity between arrays HPE 3PAR StoreServ Storage offers Remote Copy over Fibre Channel connectivity (RCFC). RCFC is most often used for shorter distance solutions such as a campus or a metropolitan. It is a solution that can support distances of up to 500 km if desired (5 ms maximum of round-trip network latency over the SAN fabric).

RCFC uses Fibre Channel connections (at least two) between arrays for availability as well as for increasing total available bandwidth for replication. Customers have the flexibility to use connections across any approved Fibre Channel fabric to create multiple hops between arrays. These hops can include any HPE fabric vendor-approved connectivity such as FC ISLs between buildings, fabric extension via long-haul ISLs, and more. The ISLs can be provided through long-wavelength GBICs between switches and wave division multiplexing solutions such as DWDM that provide extended ISLs.

Note
Refer to the HPE SAN Design Guide for details on supported SAN fabric switches, GBICs, and distances. The HPE SAN Design Guide can be accessed via SPOCK: h20272.www2.hp.com/spock/

In summary, RCFC supports:
- Load balancing across available links between a source target Remote Copy pair for links configured for the same replication mode (synchronous, asynchronous streaming, or periodic asynchronous)
- All HPE 3PAR supported SAN infrastructure as defined in the HPE SAN design guide
- Synchronous, asynchronous streaming, and periodic asynchronous replication modes
- Solutions requiring the replication of large amounts of data
- Up to four RCFC links per node (maximum of 32 per array)
- All Remote Copy topologies
- HPE and Alcatel-Lucent—certified DWDM extended optical networks
- Maximum network latencies of 5 ms round-trip latency for synchronous, asynchronous streaming, and periodic asynchronous modes

Remote Copy over Fibre Channel bridged over an IP network
In addition to support over native optical Fibre Channel networks, Remote Copy is also supported over Fibre Channel fabrics bridged via IP for extended distance (i.e., latency) support for high throughput solutions where RCIP is not recommended. In situations where latency and bandwidth are concerns, or where the anticipated amount of data to be replicated is high, FCIP (RCFC extended over a long distance WAN using FC-to-IP routers) can be a better choice than RCIP.

In summary, FCIP supports:
- Fibre Channel SAN networks that are extended over IP using HPE approved FC-IP routers
- Load balancing across available links between a source target pair and Remote Copy pair for links configured for the same replication mode (synchronous, asynchronous streaming, or periodic asynchronous)
- Solutions requiring high replication throughput
- Up to four RCFC links per node (maximum of 32 per array)
- All Remote Copy topologies
- Maximum round-trip network latencies of 5 ms for synchronous, 10 ms for asynchronous streaming, and 120 ms for periodic asynchronous modes
Remote Copy connections

3.2.2 Remote Copy supports:

- Four RCFC connections per node (for nodes configured with enough FC ports)
- One RCIP connection per node

With these increases it is possible for a single eight-node HPE 3PAR StoreServ array to have up to 40 Remote Copy links:

- 32 combined RCFC and FCIP connections (four per node) + 8 RCIP connections (one per node) = 40 total Remote Copy connections

The Remote Copy connections on an array can all be used between a single pair of HPE 3PAR StoreServ arrays in a one-to-one topology or they can be used to connect the array to multiple HPE 3PAR StoreServ arrays together in an "M-to-N" or a synchronous long distance (SLD) topology (more on these topologies in the section titled "Remote Copy topologies"). For a single pair of eight-node HPE 3PAR array, if both arrays have enough ports to support 40 connections then all 40 connections may be used. See table 1 for details on the number of RCIP and RCFC links supported on HPE 3PAR OS 3.13.

Table 1. RCIP and RCFC link count support for HPE 3PAR OS 3.1.3 and later

<table>
<thead>
<tr>
<th></th>
<th>PRE 3.1.3</th>
<th>3.1.3 AND LATER (7000, 8000, 10000, AND 20000 ONLY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum RCFC and FCIP ports/node</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Maximum RCFC and FCIP ports/storage system</td>
<td>4</td>
<td>32</td>
</tr>
<tr>
<td>Maximum RCIP ports/node</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Maximum RCIP ports/storage system</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

Latency support with Remote Copy

The maximum latency supported on the network used by Remote Copy has increased significantly with the release of HPE 3PAR OS 3.2.2. Table 2 shows the maximum supported latency values starting with HPE 3PAR OS 3.2.2.

Table 2. Remote Copy latency support starting with HPE 3PAR OS 3.2.2

<table>
<thead>
<tr>
<th>REPLICATION MODE</th>
<th>TRANSPORT LAYER</th>
<th>LATENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronous</td>
<td>RCIP</td>
<td>5 ms</td>
</tr>
<tr>
<td></td>
<td>RCFC</td>
<td>5 ms</td>
</tr>
<tr>
<td></td>
<td>FCIP</td>
<td>5 ms</td>
</tr>
<tr>
<td>Periodic asynchronous</td>
<td>RCIP</td>
<td>150 ms</td>
</tr>
<tr>
<td></td>
<td>RCFC</td>
<td>5 ms</td>
</tr>
<tr>
<td></td>
<td>FCIP</td>
<td>120 ms</td>
</tr>
<tr>
<td>Asynchronous streaming</td>
<td>RCIP</td>
<td>Not supported</td>
</tr>
<tr>
<td></td>
<td>RCFC</td>
<td>5 ms</td>
</tr>
<tr>
<td></td>
<td>FCIP</td>
<td>10 ms</td>
</tr>
</tbody>
</table>
Remote Copy functionality

Remote Copy coordinated snapshots
Starting with HPE 3PAR OS 3.2.2, Remote Copy now supports coordinated snapshots for VLUNs being replicated synchronously, with asynchronous streaming mode and with periodic asynchronous mode. Prior versions of the HPE 3PAR OS only supported coordinated snapshots for Remote Copy groups that were being replicated in synchronous mode.

Coordinated snapshots allow the storage administrator to, with a single “createsv –rcopy” command, create a snapshot of the VVs in a Remote Copy group on the source array and at the exact point in time a duplicate of those snapshots will also be created on the target array. By quiescing, a database before creating coordinated snapshots the storage admin can create transactionally consistent snapshots on the primary and secondary arrays that are suitable for use for database backup or other work.

Auto recovery policy
For Remote Copy groups, HPE 3PAR Remote Copy software provides for an “auto recovery” policy to be set on each Remote Copy volume group. This policy does not define whether replication groups should be reversed and replication resume automatically following an RC Group failover. Rather, it defines whether or not replication should automatically resume when the replication links return following a complete link failure. The default behavior is no_auto_recover, which prevents automatic restart in case of recovery from a complete link failure. The default behavior allows the administrator to ensure that the network issue is adequately resolved before resuming replication. In the case of a “flapping” WAN link, this allows Remote Copy to remain quiescent rather than attempt multiple restarts across an unreliable network.

The administrator can override the default setting for “auto recovery” by choosing auto_recover via the setrcopygroup CLI command or via the IMC or SSMC, which allows setting the automatic restart of a Remote Copy group once the link between the local and remote site is recovered. This mode is useful when the administrator does not wish to manually restart the copy operations after a link failure.

New creatercopygroup and setrcopygroup options for asynchronous streaming mode

New “async” replication mode
With the addition of Asynchronous Streaming Remote Copy with HPE 3PAR OS 3.2.2, there is a new replication mode associated with the creatercopygroup” command, the “async” option has been added to specify asynchronous streaming mode is desired. The setrcopygroup command also supports the new “async” replication mode for Remote Copy groups, where the storage administrator wants to set asynchronous streaming mode. Switching replication modes for a group does require that the group first be stopped from the “stoprecopygroup” command. The group is first stopped, the mode is then changed with the “setrcopygroup” command, and the group is then restarted with the “startrcopygroup” command.

New “snap_freq” subcommand for Asynchronous Streaming Remote Copy groups
When using the “setrcopygroup” command for a Remote Copy group running in asynchronous streaming mode there is a new “snap_freq” subcommand that specifies how frequently Remote Copy should automatically take coordinated snapshots of the VLUN members of the group. For groups in asynchronous streaming mode, Remote Copy will, on a regular basis (default is once an hour), create its own coordinated snapshots. These snapshots are used as resync points should all of the replication links fail and a delta resync become necessary.

Remote Copy will utilize these coordinated snapshots to get the primary and secondary arrays back into synchronization. The default interval for creating these automatic coordinated snapshots is once an hour but this interval can be increased or decreased with the “snap_freq” subcommand to the “setrcopygroup” command. It is recommended that care be taken if the “snap_freq” frequency is reduced down from the default one-hour interval to a smaller more frequent value as creating snapshots too frequently (especially for Remote Copy groups containing a lot of VLUNs) can add a substantial load to the array.

New “period” subcommand behavior for Asynchronous Streaming Remote Copy groups
For Remote Copy groups set for asynchronous streaming mode, the “period” subcommand operates differently than it does for groups in periodic asynchronous mode. With Periodic Asynchronous Remote Copy, the “period” subcommand specifies how frequently the VLUNs on the primary array should be delta-resynched with the VLUNs on the secondary array. A value of zero specifies they will never be delta-resynched (a manually initiated delta-resynch is required).
When a Remote Copy Group is started in asynchronous streaming mode ("async" mode), the "period" subcommand serves two purposes. First, if Remote Copy determines that it needs to suspend Asynchronous Streaming Remote Copy group(s), in reaction to an issue such as replication link throughout degradation for example, the "period" subcommand specifies the order in which Remote Copy will choose groups to suspend. Groups with larger "period" value definitions will be suspended first and will to be restarted last vs. groups with smaller "period" values. This provides the storage administrator with some QoS control on how Remote Copy behaves if the replication environment degrades for some reason.

The second purpose of the "period" subcommand is to specify how long, in minutes, Remote Copy should wait before trying to automatically restart an asynchronous streaming group. If, after waiting, the defined "period" Remote Copy determines that resources are still insufficient to restart the group it will wait another full period before trying to restart the group again. If a group is defined to have a period value of zero, it will be the first group to be suspended if necessary and Remote Copy will not attempt to restart this group automatically, a manual restart of the group will be required.

**Note**

An Asynchronous Streaming Remote Copy group with a "period" value of zero (0) will be suspended first and will not automatically restart. A manual restart of the groups will be required if it becomes suspended.

### Remote Copy volume group VLUN limitations

Remote Copy volume groups define collections of volumes that are required to have write order consistency across them to ensure data I/O integrity. Use cases include multiple volumes written to by a database application or multiple LUNs used by a file system. Unless write order consistency is maintained across all the volumes associated with a database instance, recovery from a disaster by the application cannot be guaranteed at the target array. Remote Copy volume groups ensure this write order consistency. There are limits to the number of VVs that can be replicated via Remote Copy and limits on the number of VVs supported per Remote Copy volume group. The specific limits depend on the HPE 3PAR OS release and the replication mode chosen. Check table 3 for details on the total number of volumes and total volumes that can be included per Remote Copy volume group for HPE 3PAR OS release 3.2.2.

**Table 3. HPE 3PAR OS 3.2.2 limits on number of replicated volumes per Remote Copy volume group based on replication mode and system node count**

<table>
<thead>
<tr>
<th>REPLICATION MODE(S)</th>
<th>2-NODE SYSTEM</th>
<th>4- TO 8-NODE SYSTEMS</th>
<th>MAXIMUM RC VOLUME GROUPS</th>
<th>MAX VVS PER RC VOLUME GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronous mode</td>
<td>2400</td>
<td>2400</td>
<td>2400</td>
<td>300</td>
</tr>
<tr>
<td>Asynchronous streaming mode</td>
<td>2400</td>
<td>2400</td>
<td>512</td>
<td>300</td>
</tr>
<tr>
<td>Combined synchronous and asynchronous streaming modes</td>
<td></td>
<td></td>
<td>2400 (512 may be for asynchronous streaming)</td>
<td>300</td>
</tr>
<tr>
<td>Periodic asynchronous mode</td>
<td>6000</td>
<td>6000</td>
<td>6000</td>
<td>300</td>
</tr>
<tr>
<td>Combined synchronous, asynchronous streaming, and periodic asynchronous modes</td>
<td>2400</td>
<td>2400</td>
<td>2400 (512 may be asynchronous streaming)</td>
<td>300</td>
</tr>
</tbody>
</table>

When mixing replication modes between a pair of HPE 3PAR arrays, the maximum number of volumes supported is defined by the replication mode with the lowest limit. For example, if you are mixing synchronous, asynchronous streaming, and periodic asynchronous modes between two arrays you do not get 2400 synchronous or asynchronous streaming volumes and 6000 periodic asynchronous volumes. You get a maximum (total) of 2400 volumes replicated between those two arrays because both synchronous and asynchronous streaming are limited to 2400 volumes.

If the array is in an MxN configuration, the maximum replicate volumes still has the same limits, a total of either 2400 or 6000. This means in an MxN topology, if an array has a Remote Copy relationship with four other arrays the maximum number of VVs it can replicate (total) is limited by the replication mode(s) it is using. If that array is replicating via synchronous mode with two arrays, asynchronous streaming with one array, and periodic asynchronous with two arrays, it can replicate a maximum (total) of 2400 VLUNs and that includes bidirectional replication.
System sizing considerations when using Remote Copy

When sizing HPE 3PAR arrays that will be used to replicate data using Remote Copy, care must be taken to account for the additional IOPS and workload that Remote Copy will impose on the arrays. This means that in addition to being sized to service the native workload generated by servers connected to it, the secondary array in a Remote Copy relationship must be sized to also service the additional write I/Os for the replicated data coming from the primary array. This is true for all replication modes—synchronous, asynchronous streaming, and periodic asynchronous.

Additionally, both arrays must be sized to account for the IOPS resulting from snapshots created by Remote Copy. In periodic asynchronous mode, snapshots are created on both the primary and the secondary arrays during every “period” interval. This means if a 10-minute “period” is specified for a Periodic Asynchronous Remote Copy group, the primary and secondary arrays will both create snapshots for all the VVs in that Remote Copy group every 10 minutes. This takes place before sending delta changes from the primary array to the secondary array.

The snapshots on the primary array will result in copy on write I/Os (COW I/Os) for all new host writes to the VVs in the Remote Copy group on the primary array. This array must be sized to account for the additional back-end write I/Os generated by these snapshots. On the secondary array, a snapshot of all the base VVs in the Remote Copy group is taken prior to the delta changes being sent from the primary array. As the delta changes coming from the primary array are applied to the base VVs on the secondary array, COW I/Os will occur on the snapshots for these volumes. The secondary array must be sized to account for the additional back-end write I/Os generated by the snapshots.

If you are using asynchronous streaming mode, Remote Copy will create coordinated snapshots at every “snap_freq” interval (default is once an hour). These coordinated snapshots will result in additional back-end I/Os on both the primary and secondary array. These additional I/Os must be accounted for when sizing the arrays. In synchronous mode, Remote Copy only creates snapshots if the replication links fail or if a Remote Copy group is suspended. So the impact of snapshots is not as pronounced although the user-initiated coordinated snapshots need to be considered.

If the CPG specified on either array for the Remote Copy snapshots is a CPG using nearline drives, performance will suffer as the COW I/Os to the nearline drives may not be serviced fast enough due to their limited performance. For this reason HPE recommends the administrator does not use nearline drives for snapshots that Remote Copy creates.

Note
HPE recommends that nearline drives should not be used for the snapshots that Remote Copy creates.

Data replication link sizing

In any live data replication based disaster-tolerant solution, the network used to replicate data between the primary and the disaster recovery sites is a key part of the solution. It may be the case that the solution is active-active where both sites run production and are expected to back one another up, so there is no “primary” and “secondary” site—both sites are primary for some RC groups and secondary for other RC groups. The replication network’s speed has a direct effect on the RPO and RTO of the solution, as well as an effect on the total recurring cost of the solution. It must be sized properly to ensure smooth operation of the entire solution, at all times, at the best cost to the enterprise.

Most solutions replicating data synchronously require a replication link where the speed is very close to the maximum data generation rate of the data generation (sometimes a solution sized for the 95th or 98th percentile will work but not always). For example, if there is a peak data generation rate of 400 MB that lasts a few minutes during the day, yet the average data generation rate for the rest of the day is closer to 250 MB, a replication link of 400 MB will be required to prevent server I/O latency spikes when the 400 MB I/O spike occurs.

The link must be sized to the maximum I/O rate spike, if not, queued data waiting to get onto the link will manifest itself as additional I/O latency. Think of it like a freeway with only two lanes versus a freeway with six lanes. For a given spike in traffic, you will wait in line much longer to get onto the two-lane freeway than to get onto the six-lane freeway, simply because the six-lane freeway can move more traffic.
Figure 4. Effect of replication link speed on synchronous replication when the data generation rate exceeds the replication link speed

For solutions using periodic asynchronous replication, the replication link can be sized to the average data generation rate for the period in which the most data is generated. For example, if the solution is set to a period of 10 minutes, if the 24-hour day is broken down into 10 minute periods and in the worst case 400 MB on average is generated during one of these periods the replication link needs to be sized to 400 MB to ensure the data from the worst case period can be replicated within 10 minutes before the next period starts. If the data cannot be replicated within the period length an error will be logged in the system log indicating that the remote copy group did not meet its resync interval.

With Asynchronous Streaming Remote Copy properly sizing the replication link becomes especially important as the solution is expected to provide for an RPO measured in seconds rather than minutes or hours. Delivering an RPO measured in a handful of seconds requires a replication link whose speed is very close to the write rate of the data that is being generated so that RC can ship data at close to the rate it is being generated.

This means that like a synchronous replication solution, a solution based on Asynchronous Streaming Remote Copy will require replication links that are sized very close to the maximum write data generation rate expected. At its first delivery, Asynchronous Streaming Remote Copy holds data that is being replicated in cache, on both the primary and secondary arrays. It is important to ensure that this data does not consume too much cache on either array.

If it does, Asynchronous Streaming Remote Copy will suspend Remote Copy groups in reaction to the overconsumption of array cache. Having properly sized data replication links will ensure constant and smooth streaming of data between the arrays, which in turn ensures the target RPO is met.

Figure 5 (a). Effect of replication link speed on Periodic Asynchronous Remote Copy cache consumption
Remote Copy topologies

HPE 3PAR Remote Copy software can be deployed in different topologies depending on customer needs. Remote Copy supports M-to-N topologies. It also supports Synchronous Long Distance (SLD) that combines synchronous and periodic asynchronous replication to replicate a Remote Copy group to two separate target arrays. The M-to-N topology is very flexible and allows for some very complex Remote Copy solutions to be deployed.

One-to-one topology

Remote Copy's simplest topology is a one-to-one configuration (it's an M-to-N where M = N = 1), where a pair of HPE 3PAR StoreServ arrays replicate volumes between one another (figure 6). This topology supports disaster-tolerant and cluster-based scenarios between two geographically distinct data centers if desired. HPE 3PAR StoreServ Storage supports bidirectional replication in a one-to-one topology. Synchronous, Asynchronous Streaming, and Periodic Asynchronous replication modes may be used simultaneously in a one-to-one configuration, albeit for different RC groups and on different Remote Copy physical links.

The three modes can only be run simultaneously between two HPE 3PAR StoreServ arrays if they are both running HPE 3PAR OS 3.2.2 and later. When mixing different replication modes between two StoreServ arrays different physical transports must be used for each mode. For example, RCIP for the Periodic Asynchronous Remote Copy groups, RCFC for Synchronous Remote Copy groups, and FCIP for Asynchronous Streaming Remote Copy groups.

![Figure 6. One-to-one bidirectional remote copy](image-url)
M-to-N topology

In an M-to-N topology any HPE 3PAR StoreServ array in the topology can have a bidirectional Remote Copy relationship with up to four other HPE 3PAR StoreServ arrays. The relationship between any pair of arrays can be simultaneously synchronous and periodic asynchronous, it can be bidirectional and use RCIP, RCFC, or FCIP link layer connections. RCFC and FCIP both leverage FC ports on the StoreServ for replicating data, but with FCIP, an FC-IP router is used to extend the SAN fabric over an IP network. Asynchronous streaming is supported between any pair of arrays in an M-to-N topology. However, any given array can replicate in asynchronous streaming mode with at most one other array and the Remote Copy link layer must be RCFC or FCIP. In an M-to-N topology, the Remote Copy groups are only replicated between a single pair of arrays, there is no support for a Remote Copy group to be replicated from one primary array to two separate secondary arrays. Figure 7 and 8 show example M x N topologies.

Figure 7. Three StoreServ arrays in an M-to-N configuration (only one of these Remote Copy relationships can be in asynchronous streaming mode)
**Synchronous long distance topology**

The Remote Copy SLD topology allows volumes in a Remote Copy volume group to be replicated from one primary StoreServ array to two different secondary StoreServ arrays. It does this by replicating data synchronously between two StoreServ arrays, the “source” and “sync target” arrays. SLD simultaneously replicates the same data via periodic asynchronous mode between the source and a third StoreServ array, the disaster recovery, or “async target” array. Right now, Asynchronous Streaming Remote Copy is not supported in SLD topologies but will be supported in the future.

---

**Note**

Check with your HPE representative for information on the support of asynchronous streaming mode in a SLD topology.

---

The user has the option of treating the two sync arrays in an active-active manner, failing over between them if and when a data center failure dictates a failover is necessary and resuming operations on the “sync target array”. This provides a failover solution that delivers an RPO equal to zero due to the synchronous nature of the replication that occurs between the sync arrays. On failover to a sync target array, the passive periodic asynchronous link between that array and the async target array is made active. Any data that was replicated on the sync target but that has not yet made it to the async target array is sent following the failover. This brings the async target array up to date with the last write that occurred on the sync target. Operations then continue in the sync target data center and it continues to replicate data to the async target array.

The user also has the option, when a data center failure dictates that a failover is necessary, of failing over to and resuming operations on the async target array. This can be done once data that was replicated on the sync target but that has not yet made it to the async target is replicated to the async target array. Once the async target array is consistent with the state of the sync target array, operations continue on the async target array with no data loss (RPO = 0).

This failover results in the periodic asynchronous link between the sync target and async target array being reversed so updates to the async target array are replicated back to the sync target array, albeit in periodic asynchronous mode. Used in this manner, an asynchronous long distance topology can deliver an RPO of zero at the async target site except in cases where a regional disaster has rendered both the source and synch target arrays down simultaneously.
Starting with the release of HPE 3PAR OS 3.1.2 bidirectional replication between the two “sync arrays” is supported. This means that Remote Copy can support multiple SLD configurations across the three arrays that are set up in an SLD topology (figure 9). Also, we can have other separate Remote Copy groups that are not part of an SLD configuration replicating synchronously between the two sync arrays in the topology.

![Bidirectional synchronous replication via RCFC or RCIP](image)

**Figure 9.** SLD mode: Long-distance replication with zero data loss

### Remote Copy performance design

HPE 3PAR StoreServ Storage is built around a massively parallel architecture where all workloads are distributed across all available system resources. Maximum performance levels are delivered by striping volumes widely across many disk spindles and dividing the workload for any given volume across all available controller nodes. This frees the administrator from the requirement to plan, design, or fine-tune volume layouts since all provisioning tasks automatically take advantage of this massively parallel architecture.

HPE 3PAR Remote Copy software is implemented over multiple replication links (at least two) for availability and performance (load balancing). All Remote Copy operations, even if for a single volume, are balanced over all available links of the same type (RCIP, RCFC, or FCIP) configured for the same replication mode (synchronous, asynchronous streaming, or periodic asynchronous) between two arrays (same RC target). By utilizing all available links, Remote Copy enhances the efficiency, performance, and scalability of the solution. Should one link fail, all operations continue seamlessly on the remaining links and alerts are generated to enable the administrator to address the link failure.

In order to further maximize the performance of Remote Copy operations, multiple connections are opened on the Remote Copy link. While ensuring write order consistency, Remote Copy will use multiple connections (sockets) to ensure that independent writes (for example, from different volume groups or while synchronizing a periodic asynchronous mode volume group) will not block each other. Furthermore, performance over high-latency TCP links is enhanced by using multiple connections over the same link.
HPE is sensitive to the needs of IT administrators and has architected Remote Copy to efficiently use the resources allotted to the solution. The “setrcopytarget tunelinks” command can be used to specify the link speed and steady state latency to RCIP allowing Remote Copy to automatically choose the correct number of connections to properly tune link throughput. RCIP Copy IP will adjust the number of sockets it uses on the network to maximize throughput based on the inputs to this command. The “setrcopytarget tput” command is used to specify the maximum amount of bandwidth RCIP is allowed to use in its IP connection for RCIP-based solutions. This gives the storage administrator some level of QoS to prevent Remote Copy from consuming the entire throughput of the available IP link.

**Solution benefits**

**Simplified implementation**

In order to simplify implementation HPE 3PAR Remote Copy software was designed to be end-user configurable and maintainable.

- Supports synchronous, asynchronous streaming, and periodic asynchronous modes so that array administrators don’t have to implement different vendor solutions depending on distance requirements, data loss tolerance levels, and RTO and RPO.
- Supports replication over Fibre Channel (RCFC), IP-extended SAN fabrics (FCIP), as well as native IP (RCIP) connectivity. This again ensures that the array administrator has flexibility and choice within a single product and isn’t required to introduce additional third-party hardware for distance extension or protocol conversion.
- Supported on all HPE 3PAR StoreServ models, so organizations can save drastically on hardware costs by using a mixture of midrange and high-end arrays depending on specific needs. HPE 3PAR StoreServ Storage is the only platform that currently supports multi-site and multi-mode disaster recovery using midrange arrays.\(^1\)
- End-user configurable, allowing the administrator to easily configure and manage the remote replication solution directly. This simplicity allows the administrator to respond to changing business needs quickly, without requiring additional third-party consulting or lengthy planning cycles.

**Simplified management**

When a storage administrator manages a remote replication solution, simplicity is essential to ensuring the safe recovery of data. HPE 3PAR Remote Copy software delivers simplicity throughout the product. For example, Remote Copy is managed with a hierarchical layering of manageable objects and relationships to help organize the replication process logically. This allows simple management of entire arrays or individual groups of volumes where appropriate. In addition, Remote Copy provides the ability to start and stop all Remote Copy groups with a single operation, which greatly enhances the ease of use. These objects and relationships are as follows:

- **Remote Copy links**: This is the vehicle by which data is sent and received between Remote Copy targets. A link is specifically defined from one physical interface (FC or IP) on one HPE 3PAR StoreServ to the equivalent physical interface another system.

- **Remote Copy pairs (or targets)**: This is the relationship between two HPE 3PAR StoreServ systems. For any given system, the remote or secondary system is referred to as the remote copy target. It is the relationship between the local system or primary array and the target system or secondary array that constitutes a Remote Copy pair. Remote Copy commands generally refer to the target, which is a named object that is created when you first configure Remote Copy.

- **Remote Copy volume groups (or consistency groups)**: These are logically related groups of volumes for which there is a cross-volume ordering of writes. Actions taken on a volume group are taken on all volumes in the group simultaneously, ensuring write order consistency. Multiple volume groups can be associated with each Remote Copy target.

---

\(^1\) Please check with your HPE representative for details on support for Remote Copy between the versions of the HPE 3PAR StoreServ OS in your environment.
Figure 10 represents a schematic view of the layering of volume groups, targets, and links. The following statements apply to the relationships illustrated in this diagram:

- Remote Copy links are defined between systems over a physical link connection (either FC or IP). These links can be viewed and managed easily, giving the HPE 3PAR administrator a simple view of the “health” of the remote replication link.
- A Remote Copy target is the relationship between the primary system and the secondary system, and is layered over the pair of links. In this fashion, the links form a highly available transport for the Remote Copy target relationship.
- One or more volume groups are added to a Remote Copy target.

![Remote Copy target diagram](image)
The Remote Copy target describes a collection of volume groups and physical links shared between the primary storage system and the secondary storage system. This allows simplified management via the Remote Copy target object for common tasks rather than managing multiple links and volume groups independently.

**Failover management**

When a disaster occurs that requires failover to the remote site, it is important that the failover be easy to manage. A failover scenario could be at the level of the entire physical site or it might be limited to a single server or even a single application. Remote Copy allows for failure of entire Remote Copy targets, which results in failover of all volumes that are being replicated between the HPE 3PAR StoreServ arrays. Similarly, failover of individual Remote Copy volume groups for cases where a single server or application needs to be failed over is also supported.

Remote Copy makes failover management simple through the ability to failover one or all of the groups with a single command.

**Transparent failover with HPE 3PAR Peer Persistence**

Peer Persistence is a high-availability configuration between two data centers in which the ESXi hosts or Windows® hosts are setup in a metro cluster configuration with access to storage arrays in both sites. Storage volumes created on one storage array are replicated to the other array using Synchronous Remote Copy to ensure that the volumes are in sync at all times.

Peer Persistence software takes advantage of the asymmetric logical unit access (ALUA) capability that allows paths to a SCSI device to be marked as having different characteristics. With ALUA the same LUN can be exported from both arrays simultaneously, but only the paths to the side accepting write I/Os to the volume will be marked as active. The paths to the secondary side volume will be marked as standby preventing any host from performing I/O using those paths. In the event of a non-disruptive array volume migration scenario, the standby paths are marked as active and host traffic to the primary storage array is redirected to the secondary storage array without impact to the hosts. Figure 11 shows a recommended Peer Persistence configuration.
With Peer Persistence VMware® vMotion or Hyper-V Live Migration can also be used for load balancing across data centers. With Peer Persistence, movement of VMs across data centers is completely transparent to the application, thereby enabling a truly load-balanced VMware environment.

Refer to the Peer Persistence white paper that can be located at hp.com/go/3PAR for more information.

**Cross-product interoperability**

HPE 3PAR Remote Copy software is common to and fully interoperable across the entire HPE 3PAR StoreServ product family, which consists of four different classes of HPE 3PAR StoreServ systems. Since all classes of systems are built on the same platform and run the same software, one can choose, for example, to replicate from up to four HPE 3PAR StoreServ 7200 systems at various data centers to a single HPE 3PAR StoreServ 10000, HPE 3PAR StoreServ 7400, or HPE StoreServ 20000 array at a failover site.

Alternatively, a customer with an HPE 3PAR StoreServ 10000 and modest remote replication needs might choose to use HPE 3PAR StoreServ 8000 at the remote site to back up a smaller subset of applications hosted on the primary array. HPE 3PAR StoreServ Storage allows the customer the flexibility to properly size the remote site storage based on the needs of the solution.
**Simple verification of replicated data**

Remote Copy on the target StoreServ array can be used to create read or write snapshots of the VVs in the Remote Copy volume group for verification purposes. This simple and efficient operation allows periodic validation of the data without the remote site downtime that is associated with other replication solutions. Furthermore, the same approach can be used to facilitate offsite and serverless backup. A snapshot of the Remote Copy volume group is presented to a backup server where tape backup or archives are maintained. This achieves the goal of offsite tape storage without the tapes ever being created at the original primary site.

Additionally, coordinated snapshots can be leveraged to provide a transactionally consistent copy of a database for a Remote Copy group being replicated via asynchronous streaming or periodic asynchronous by quiescing the database and then creating the coordinated snapshot. The snapshot can then be used for backup or other activities with the knowledge that it was created at a particular point in time, complete up to the last committed transaction.

**Access to production data without impacting replication**

Remote Copy users have the flexibility to replicate a read or write virtual copy (snapshot) of a replicated storage volume to the same or another destination of HPE 3PAR StoreServ system. Customers with separate development or data mining data centers can leverage the enhanced capability to provide these data centers with access to production data without interrupting the replication process on the base storage volume.

**Recovery managers**

HPE 3PAR StoreServ Storage also extends the value of periodic asynchronous mode by integrating Remote Copy with HPE 3PAR StoreServ Recovery Manager Software for Oracle, Exchange, SQL, and VMware. This integration allows users the capability of further protecting their Oracle, Exchange, SQL, or VMware environments with remote replication using HPE 3PAR Remote Copy software, all via an easy-to-manage interface.

**Integration with cluster products**

HPE 3PAR StoreServ Remote Copy replication is also tightly integrated with the HPE Cluster Extension (CLX), Metrocluster, and Continentalcluster products.

Integration with Cluster Extension provides true integrated disaster-tolerant solutions that extend Microsoft® Cluster Server clusters for Windows 2003, 2008, and Windows 2012 (November 2012) beyond a single data center to metro distances using Remote Copy to provide the data replication.

Integration with HPE Metrocluster and Continentalcluster products provides integrated disaster-tolerant solutions cluster for both HPE-UX and Linux® at both metro and continental distances.

All of these integrated cluster solutions provide true, complete disaster-tolerant solutions based on HPE 3PAR StoreServ Remote Copy.

Contact your HPE sales representative for more details.
Summary

HPE 3PAR Remote Copy software provides the data sharing and data protection solution that today’s IT departments require with ground-breaking simplicity and efficiency. By simplifying the deployment of remote replication, Remote Copy empowers the storage administrator to deploy new disaster recovery solutions quickly and to adapt to changing business needs.

Remote Copy integration with, Cluster Extension, Metrocluster, and Continental cluster, provide disaster tolerant solutions that offer administrators solutions that effectively protect their data and quickly recover from outages with limited administrative interaction.

In addition, HPE 3PAR StoreServ Storage is the first storage platform to support multi-site capability on midrange arrays, enabling cloud service providers and enterprise customers alike to reduce their equipment costs.

Learn more at
hp.com/go/3PAR