Universal Replicator overview

With Hitachi Universal Replicator (UR) you can perform asynchronous replication of data to one or more remote sites.

About Universal Replicator

Hitachi Universal Replicator (UR) presents a solution to avoid cases when a data center is affected by a disaster that stops operations for a long period of time. In the Universal Replicator system, a secondary storage system is located at a remote site from the primary storage system at the main data center, and the data on the primary volumes (P-VOLs) at the primary site is copied to the secondary volumes (S-VOLs) at the remote site asynchronously from the host write operations to the P-VOLs. Journal data is created synchronously with the updates to the P-VOL to provide a copy of the data written to the P-VOL. The journal data is managed at the primary and secondary sites to ensure the consistency of the primary and secondary volumes.

The redundancy provided by the RAID configuration (for example, RAID1 or RAID5) enables recovery from a P-VOL read failure. The primary storage system never reads the Universal Replicator S-VOL for data recovery.

Replication operations

Remote replication for a UR pair is accomplished using the master journal volume on the primary storage system and the restore journal volume on the secondary storage system. As shown in the following figure, the P-VOL data and subsequent updates are transferred to the S-VOL by obtain journal, read journal, and restore journal operations involving the master and restore journal volumes.

Note

• Universal Replicator does not have a feature to copy the data from one P-VOL to multiple S-VOLs or to copy the data from multiple P-VOLs to one S-VOL.
• If the primary system fails reading a P-VOL, the redundancy of RAID-1, RAID-5, or RAID-6 enables the recovery from the failure. The primary system never reads the S-VOL for data recovery.
• VSP G130 is available only in select markets. Contact your local sales representative for availability.

Obtain journal

Obtain journal operations are performed when the primary storage system writes journal data to the master journal volume. The journal data consists of the P-VOL data to be copied to the S-VOL as well as update sequence information and other metadata. When a pair is created and the P-VOL data is copied for the first time, the journal data copied to the master journal volume is called the base journal data. When the host writes updated data to the P-VOL, normal journal
data is copied to the master journal volume. If a P-VOL write operation fails, the primary storage system does not create the journal data.

- The primary storage system assigns write-sequence numbers to the P-VOL data copied to the master journal volume.
- The write-sequence numbers and other metadata attached to the journal data ensure the consistency of the data in the P-VOL and S-VOL.

**Journal copy**

Journal copy operations are performed when journal data is copied from the master journal volume to the restore journal volume on the secondary storage system.

- When the secondary storage system issues the read-journal command to the primary storage system, the primary storage system transfers the journal data stored in the master journal volume to the restore journal volume in the secondary storage system.
- Journal copy operations occur on a continual basis unless there is no journal data in the master journal volume. The request for data from the secondary storage system is repeated as soon as the previous read operation is completed.

The UR journal copy operations "pull" data from the primary storage system to the secondary storage system. Journal data is copied to the secondary site only when the secondary storage system issues a read-journal command, with the primary storage system operating as a resource controlled by the secondary storage system's transaction processor.

**Restore journal**

Restore journal operations are performed when the secondary storage system writes journal data in the restore journal volume to the S-VOL.

- Journal data in the restore journal volume is copied to the S-VOL according to the write-sequence numbers to ensure data consistency.
- When a restore journal operation to the S-VOL is completed, the journal data in the restore journal volume is discarded, and the journal data in the master journal volume is also discarded.

The primary storage system discards journal data in the master journal volume when it receives the sequence number from the restore journal, which is attached to the read journal command from the secondary storage system.

**Copy operations**

The copy operations for Universal Replicator include initial copy, update copy, and the underlying operations that are executed, such as journal processing and differential data management.

**Initial copy operation**

When the initial copy operation is executed, all data in the P-VOL is copied in sequence directly to the S-VOL without use of the primary journal volumes. The copied data in the initial copy operation is referred to as base journal data, even though the primary journal volumes are not used.
When you create or resynchronize two or more pairs within the same journal, the base journal data is copied to the respective S-VOLs, one at a time. This extends the time required for all the operations to be completed.

As an option, you can create a pair and specify that no data is copied during the initial copy operation. This option should be specified only when the data in the P-VOL and S-VOL is already identical, or when the P-VOL and S-VOL do not yet contain any data. Use of this option establishes the pair quickly without the delay of the initial copy operation. Once the pair is established (pair status is PAIR), update copy operations are performed to copy all P-VOL updates to the S-VOL.

A Universal Replicator pair can also be created using a TrueCopy initial copy operation. This reduces the time to complete the initial copy operation. For details, see .

**Update copy operation**

When a host performs a write I/O operation to a P-VOL of a volume pair, an update copy operation is performed. The updated data is copied to the master journal on the primary storage system along with metadata that includes sequence and other consistency information. The updated data and its metadata are called the journal data. When the secondary storage system issues the read-journal command, which occurs independently of host I/O activity, all journal data in the master journal is sent to the restore journal on the secondary storage system. When the P-VOL updates are successfully duplicated on the S-VOL, the journal data on the primary and secondary storage systems is discarded.

Journal data is transferred using special I/O operations called RIO (remote I/O) that are initiated by the secondary storage system. RIO provides the most efficient type of data transfer. The channel extenders must be capable of supporting RIO.

If an update copy operation fails, the secondary storage system suspends the affected pair or all pairs in the journal, depending on the type of failure. The suspended pair or journal returns to Paired status when the primary and secondary storage systems are resynchronized.

Notif the primary storage system receives a request for writing to the P-VOL (update I/O) from a host during initial copy, the primary storage system suppresses initial copy to prioritize the update I/O. However, when a copy pace for mirror option is Faster in HDvM - SN, or when 4 or a larger value is specified by the -copy_size option of the raidcom modify journal command in CCI, the primary storage system does not suppress initial copy. When specifying Faster for a copy pace, be sure not to cause an update I/O during initial copy. If an update I/O occurs, data volume pairs might be split (suspended).

**Pair status**

The pair status of a volume indicates the synchronization status of the pair to which it belongs. When a pair operation is performed, the pair status of the volumes changes. The pair status of a volume determines the operations that can be performed on the pair. For example, you can only split a pair when the pair status of the volumes is COPY or PAIR.

During normal operations you need to monitor the pair status to ensure that you can perform the desired operations and to verify that operations completed successfully.

**Pair status definitions**
Device Manager - Storage Navigator displays both the Device Manager - Storage Navigator pair status name and the CCI pair status name, except when the names are the same. When they are the same, the CCI status is not displayed.

The following table lists and describes the pair status names.

<table>
<thead>
<tr>
<th>HDvM - SN status</th>
<th>CCI status</th>
<th>Description</th>
<th>P-VOL access</th>
<th>S-VOL access</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Unpaired-no HDvM - SN status)</td>
<td>SMPL</td>
<td>The volume is not assigned to a pair and is not in a journal.</td>
<td>Read/Write</td>
<td>Read/Write</td>
</tr>
<tr>
<td>COPY</td>
<td>COPY</td>
<td>The initial copy operation is in progress.</td>
<td>Read/Write</td>
<td>Read Only</td>
</tr>
<tr>
<td>PAIR</td>
<td>PAIR</td>
<td>The pair is synchronized. Updates to the P-VOL are duplicated on the S-VOL.</td>
<td>Read/Write</td>
<td>Read Only</td>
</tr>
<tr>
<td>HDvM - SN displays this status as PAIR</td>
<td>PFUL</td>
<td>If data in the journal volume exceeds the threshold (80%), pair status changes to PFUL. The pair is not suspended; the copy operation continues. If the journal option, Inflow Control, is set to Enable in HDvM - SN, or the modify journal command is executed in CCI when status changes to PFUL, host I/O is delayed because update I/O to the journal volume is delayed.</td>
<td>Read/Write</td>
<td>Read Only</td>
</tr>
<tr>
<td>PSUS</td>
<td>PSUS</td>
<td>The pair has been split by the user and the P-VOL and S-VOL are no longer synchronized. • The primary and secondary storage systems keep track of journal data discarded during the split operation. • When the operation is performed on the primary storage system, the status of both the P-VOL and S-VOL changes to PSUS. • When the operation is performed on the secondary storage system, the status of the S-VOL changes to PSUS, and the</td>
<td>Read Only, but if you enable the Secondary Volume Write option then split the pair from the primary site, it is Read/</td>
<td></td>
</tr>
<tr>
<td>HDvM - SN status</td>
<td>CCI status</td>
<td>Description</td>
<td>P-VOL access</td>
<td>S-VOL access</td>
</tr>
<tr>
<td>------------------</td>
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<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>PSUE</td>
<td>PSUE</td>
<td>The pair is suspended by the system due to an error; it is not synchronized.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The primary and secondary storage systems keep track of journal data discarded during the suspension operation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The primary storage system keeps track of P-VOL tracks that are updated while the pair is suspended.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• When a UR suspension condition is detected, the primary storage system changes the P-VOL and S-VOL status to PSUE. If the secondary storage system detects the condition, it changes the S-VOL status to PSUE, and the primary storage system detects this and changes the P-VOL status to PSUE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>See also <a href="https://knowledge.hitachivantara.com/Documents/Management_Software/SVOS/8.2/Remote_Replication/Universal_Replicator/01_Universal_Replicator_overview">UR PSUS types and behaviors</a>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspending</td>
<td>(No equivalent CCI status)</td>
<td>The pair is not synchronized and in transition from the PAIR or COPY status to PSUS or PSUE status.</td>
<td>Read/Write</td>
<td>Read Only</td>
</tr>
<tr>
<td>Deleting</td>
<td>(No equivalent CCI status)</td>
<td>The pair relationship is being deleted. When the operation is complete, the status changes to unpaired.</td>
<td>Read/Write</td>
<td>Read Only</td>
</tr>
<tr>
<td>HOLD</td>
<td>(No equivalent CCI status)</td>
<td>• When used with TC, this status indicates that the creation of a delta resync pair is completed. Delta resync might not be executed depending on the internal process status even if the creation of the</td>
<td>Read/Write¹</td>
<td>Read/Write²</td>
</tr>
<tr>
<td>HDvM - SN status</td>
<td>CCI status</td>
<td>Description</td>
<td>P-VOL access</td>
<td>S-VOL access</td>
</tr>
<tr>
<td>------------------</td>
<td>------------</td>
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</tr>
</tbody>
</table>
| delta resync pair is completed. When used with GAD, this status indicates that delta resync can be executed. If the P-VOL status is HOLD, the updated data of the TC or GAD S-VOL is stored in the master journal volume.  
  - Operations allowed:  
    - Delta resync  
    - Pair-delete  
    - Change pair options | HOLDING ³ (No equivalent CCI status) | Read/Write¹ | - |
| When used with TC, this status indicates that the pair status is changing to HOLD so that the delta resync pair can be created.  
  Operations allowed on pairs in HOLDING status:  
  - Delta resync operation  
  - Pair release  
  - Change pair options | (No equivalent CCI status) | Read/Write¹ | - |
<p>| An error occurred on a pair in HOLD status. | HLDE (No equivalent CCI status) | Read/Write¹ | - |</p>
<table>
<thead>
<tr>
<th>HDvM - SN status</th>
<th>CCI status</th>
<th>Description</th>
<th>P-VOL access</th>
<th>S-VOL access</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• When P-VOL status is HLDE, incoming write data for the TC or GAD S-VOL is not stored in the master journal volume.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Operations allowed on pairs in HLDE status:</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>- Recover pair status to standby (HOLD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pair delete</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Change pair options</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>This status results when the journal volume becomes full and suspends. Pair status changes from COPY, PAIR or PFUL to PFUS. The UR pair is suspended and the copy operation stops. Make sure to review configuration of the remote path and journal volume.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If a Dynamic Provisioning virtual volume (DP-VOL) is used as the UR S-VOL, and the capacity of a pool-VOL is nearly full, UR status becomes PFUS and the pair is suspended.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>• If the journal option Inflow Control is set to Yes when status changes to PFUS, the pair is not suspended for the time set in the Data Overflow Watch field in HDvM - SN, or for the time specified by the raidcom modify journal command with the -data_overflow_watch option in CCI, even when the journal volume becomes full. During the time it takes for the journal data area to clear, the response to host I/O is delayed.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|                  |            | See [Changing options used by journals](https://knowledge.hitachivantara.com/Documents/Management_Software/SVOS/8.2/Remote_Replication/Universal_Replicator/01_Universal_Replicator_overview) for details about Data Overflow Watch. | Read /Write | Read Only, unless the write option is enabled.
<table>
<thead>
<tr>
<th>HDvM - SN status</th>
<th>CCI status</th>
<th>Description</th>
<th>P-VOL access</th>
<th>S-VOL access</th>
</tr>
</thead>
<tbody>
<tr>
<td>(No equivalent HDvM - SN status)</td>
<td>SSWS</td>
<td>After Takeover, SSWS is the status of the S-VOL. With this status, data can be written to the S-VOL. The copy flow between P-VOL and S-VOL is reversed by running the CCI horctakeover command or pairsplit -RS. Therefore, the S-VOL is ready for host write operations. During disaster recovery, the host can write data to the S-VOL in SSWS status at the intermediate site or secondary site. However, in a 3DC configuration in which three UR sites are combined, the host cannot write data to the S-VOL if the volume is shared by the mirror that includes the UR delta resync pair.</td>
<td>Read Only</td>
<td>Read/Write</td>
</tr>
</tbody>
</table>

**Notes:**

1. Access to the P-VOL depends on the status of the TC or GAD pair that shares the volume.
2. The UR S-VOL in HOLD status uses two mirrors. In a 3DC configuration combined with TrueCopy, accessing the S-VOL depends on the status of the mirror that is not HOLD. In a 3DC configuration in which three UR sites are combined, the host cannot write data to the S-VOL regardless of the mirror status.
3. HOLDING indicates either that differential data used for a delta resync operation does not exist or that the system cannot judge whether the delta resync can be performed without the differential data.

When differential data does not exist in the secondary TC or GAD site, even after the S-VOL is updated, the differential data might be discarded due to one of the following reasons:

- The cache or shared memory was added to or removed from the system during maintenance work.
- The system was powered off during maintenance work.
- The UR or TCUR, TC, or GAD pair was suspended and then resynchronized.

After the system is back to normal, differential data is stored again in the TC S-VOL if you update the data in the primary site.

The delta resync operation can be executed without differential data if the primary site has not received a data update or if data in the TC or GAD S-VOL and the UR S-VOL is the same.

Even if the delta resync operation without differential data is executable, the pair status changes to HOLD even when the differential data exists if the conditions for discarding the differential data are satisfied. To change the
status of the pair to HOLD, update the data in the primary storage system after the recovery from the condition of the differential data discarding.

If you cannot connect to the secondary site of TC or GAD due to failures or disasters, the transition from HOLDING to HOLD is not performed correctly. When used with GAD, keep updating I/O from the server to GAD P-VOL or S-VOL for about two minutes.

### Additional information on pair status

You should know what happens when you split or suspend a pair.

- When a pair is split by the user or suspended by the system, the primary storage system notifies the hosts by issuing a service information message (SIM). If SNMP is installed and operational, this SIM results in an SNMP trap indicating the reason for suspension.
- When you suspend a pair, the status changes to Suspending first, and then to PSUS. When you delete a pair, the status changes to Deleting first, and then to SMPL. However, Suspending and Deleting are not displayed as the pair status in CCI.
- If you split a pair in Flush mode, it takes some time for the pair status to change to PSUS. To shorten the time, select Purge for Split Mode in HDvM - SN, or execute the pairsplit -P command in CCI before splitting a pair. If a pair is split in Flush mode, the status changes to Suspending first, and then it changes to PSUS when all journals in the master journal are restored to the restore journal. The time for a pair to change to PSUS can be calculated as follows (the actual time might vary depending on the internal processing status of storage systems):

\[
\text{time-for-Suspending (sec.)} = \frac{C \times U}{V}
\]

where:

- C is the total capacity (GB) of the master journal volume.
- U is the usage rate of data (%) in the master journal volume.
- V is the line speed (GB/sec) between the primary and the secondary storage systems.

The total capacity (GB) can be checked in the Journals tab of the Journals window or using the raidcom get ldev command.

The data usage rate can be checked in the Performance Monitor window in Performance Monitor or using the raidcom get journal command. For details about Performance Monitor, see the Performance Guide.

When using CCI to monitor the time until the status changes to PSUS in Flush mode, specify a value equal to or greater than the calculated time (in seconds) for the -t option of the pairsplit command.

### UR PSUS types and behaviors
The PSUS status, which indicates that a pair is split or suspended, can be set by the user or by the system from the primary or secondary storage system.

You can check the types of PSUS in Status of the View Pair Properties window. The following table lists and describes the PSUS status types.

<table>
<thead>
<tr>
<th>PSUS type</th>
<th>Applies to</th>
<th>Description</th>
</tr>
</thead>
</table>
| S-VOL by Operator          | P-VOL, S-VOL        | • The user split the pair from the primary or secondary storage system using the S-VOL-write option.  
                             |                     | • CCI displays this PSUS type as SSWS.                                            |
| By MCU                     | S-VOL               | • The secondary storage system received a request from the primary storage system to split the pair.  
                             |                     | • The P-VOL PSUS type is S-VOL by Operator.                                       
                             |                     | • CCI displays this PSUS type as SSWS.                                            |
| By RCU                     | P-VOL, S-VOL        | • The primary storage system suspended the pair after detecting an error condition on the secondary storage system.  
                             |                     | • The S-VOL suspend type is S-VOL Failure.                                         
                             |                     | • CCI displays this suspend type as PSUE.                                          |
| Pairsplit-S to RCU         | P-VOL               | • The primary storage system detected that the S-VOL is unpaired after the user released the pair from the secondary storage system.  
                             |                     | • The pair cannot be resynchronized.                                               |
| JNL Cache Overflow         | P-VOL, S-VOL        | • The pair was suspended because the journal volume was near capacity.           
                             |                     | • CCI displays this PSUS type as SSWS.                                            |

- A pair can be split after the initial copy is complete.
- A pair must be split to perform maintenance on the P-VOL, or to enable write-access to the S-VOL.
- After the status changes to PSUS, the primary storage system performs the following tasks:
  - Stops journal-obtain operations
  - Continues to accept write I/Os from hosts to the P-VOL
  - Keeps track of the updated P-VOL tracks
- When the UR pair is split by the user, the primary storage system and secondary storage system will either execute suspended update copy, synchronize the pair then split or delete suspended update copy then split the pair based on the user specified Split Mode option (Flush or Purge). The journal data that is deleted during UR pair split is stored in the primary and secondary storage systems. When the pair status becomes PSUS, the primary storage
system will stop obtaining the journal for the pair and accept write I/O for split UR P-VOL and record the updated P-VOL track during pair split.

- If you enable the S-VOL write option (Secondary Volume Write) when splitting the pair, the secondary storage system keeps track of updated S-VOL tracks. When the pair is resynchronized, the secondary storage system sends the S-VOL track bitmap to the primary storage system, which then merges P-VOL and S-VOL bitmaps to synchronize the tracks.

- A split or suspended S-VOL has a separate consistency status, which indicates the S-VOL’s update sequence consistency with respect to the other S-VOLs in the associated journal. The consistency status is displayed only on the secondary storage system. The following table lists and describes the S-VOL consistency statuses.

<table>
<thead>
<tr>
<th>Consistency status</th>
<th>Description</th>
</tr>
</thead>
</table>
| Volume             | - Only the current pair was split or suspended.  
|                    | - Update sequence consistency between this S-VOL and other S-VOLs in the associated journal is not ensured.  
|                    | - This S-VOL cannot be used for disaster recovery at the secondary site.  
|                    | - This status is indicated when:  
|                    |   ◦ The pair is split by the user using the Split Pairs window (Suspend Range-Volume (LU) pairsplit option).  
|                    |   ◦ The pair is suspended due to a failure that did not affect the entire journal.  
| Mirror             | - The pair was split or suspended along with the other pairs in the associated mirror.  
|                    | - Update sequence consistency between this S-VOL and other S-VOLs in this mirror is ensured.  
|                    | - This S-VOL can be used for disaster recovery on the secondary storage system.  
|                    | - This status is indicated when:  
|                    |   ◦ The mirror is split using the Split Mirrors window (or by specifying mirror of the CCI pairsplit -r option).  
|                    |   ◦ All pairs in the associated mirror are suspended due to a failure that affected the entire group, for example, path failure.  
|                    |   ◦ One pair in the mirror was suspended due to a failure that did not affect the entire group.  

**UR PSUE types and behaviors**

The PSUE status, which indicates that a pair is suspended, can be set only by the primary or secondary storage system. The primary storage system suspends a pair and changes its status to PSUE when it detects any of the following conditions:

- The user has released the pair on the secondary storage system.  
- An error condition related to the S-VOL or an update copy operation.  
- The primary storage system is not able to communicate with the secondary storage system.
A Universal Replicator suspension condition is detected by the system.

The following table lists and describes the PSUE status types.

<table>
<thead>
<tr>
<th>PSUE Type</th>
<th>Applies to</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-VOL Failure</td>
<td>P-VOL, S-VOL</td>
<td>The primary storage system detected an error during communication with the secondary storage system or during update copying. S-VOL PSUE type is usually PSUE-S-VOL Failure. CCI might display this status as SSWS.</td>
</tr>
<tr>
<td>MCU IMPL</td>
<td>P-VOL, S-VOL</td>
<td>The primary storage system could not find valid control information in its nonvolatile memory during IMPL (initial microprogram load). This condition occurs if the primary storage system is without power for more than 48 hours (power failure and fully discharged backup batteries).</td>
</tr>
<tr>
<td>Initial Copy Failed</td>
<td>P-VOL, S-VOL</td>
<td>The pair was suspended before the initial copy operation was complete. The data on the S-VOL is not identical to the data on the P-VOL. CCI might display this status as SSWS.</td>
</tr>
<tr>
<td>MCU P/S OFF</td>
<td>S-VOL</td>
<td>The primary storage system is powered off. CCI displays this as SSUS.</td>
</tr>
</tbody>
</table>

When a pair is suspended, the primary storage system stops performing journal-obtain operations for the pair. However, the primary storage system continues the following operations:

- Continues accepting write I/Os for the suspended P-VOL
- Keeps track of the P-VOL cylinders/tracks that are updated
- Keeps track of journal data discarded during the pair suspension. (Both primary and secondary storage systems do this.)

A split or suspended S-VOL has a separate consistency status that indicates its update sequence consistency with respect to the other S-VOLs in the associated journal. Consistency status displays on the secondary storage system only.

When the pair is resynchronized, the primary and secondary storage systems perform the following operations:

- The secondary storage system sends the S-VOL bitmap to the primary storage system
- The primary storage system merges the P-VOL and S-VOL bitmaps to synchronize the tracks
These actions ensure that all cylinders/tracks containing journal data discarded on the secondary storage system are resynchronized.

### 3DC configurations with three UR sites

You create a 3DC multi-target or 3DC cascade configuration by combining three Universal Replicator sites. A 3DC multi-target configuration involves one primary site and two secondary sites. A 3DC cascade configuration involves a primary site, an intermediate site, and a secondary site.

Note 3DC configuration with three Universal Replicator sites can be used only for configurations with VSP G900 and VSP F900 combined, or with VSP G1000, VSP G1500, VSP F1500, VSP G800, and VSP F800 combined.

### 3DC multi-target configuration with three UR sites

With Universal Replicator, you can set up two secondary sites for one primary site.

The following illustration shows the 3DC multi-target configuration with three UR sites:

- **UR primary site**
- **UR secondary site (copies data with a mirror whose ID is an arbitrary number (M in the illustration) from the primary site).**
- **UR secondary site (copies data with a mirror whose ID is an arbitrary number (N in the illustration) from the primary site).**

**Note** In a 3DC multi-target configuration using delta resync with three UR sites, both the P-VOL and S-VOL of a delta-resync pair are displayed as secondary volumes in the Remote Replication window (Pair Position column).
3DC multi-target configuration with three UR sites using delta resync

You should create a UR pair that connects the two secondary sites so that the remote copy system created with the host operation site and backup site can be created immediately in the event of a failure or disaster at the primary site. A UR pair that is created to make a triangle-shaped remote copy connection among the three sites is called a UR delta resync pair. By creating a UR delta resync pair in advance, you can transfer the copying operations from between the secondary sites back to from the primary to the secondary site in a short time when the failure is corrected and the primary site is brought back online.

The following illustration shows the 3DC multi-target configuration with three UR sites using delta resync:

3DC cascade configuration with three UR sites

With Universal Replicator, you can set up one intermediate site and one secondary site for one primary site. It is advisable that you create a UR pair that connects the primary and secondary sites so that the remote copying system that is created with the host operation site and backup site is configured immediately in the event of a failure or disaster at the intermediate site. A UR pair that is created to make a triangle-shaped remote copy connection among the three sites is called UR delta resync pair. By creating a UR delta resync pair in advance, you can transfer the copying operations from between the primary and secondary sites back to between the intermediate and secondary sites in a short time when the intermediate site failure is corrected and the intermediate site is brought back online.

The following illustration shows the 3DC cascade configuration with three UR sites:

• UR primary site (copies data with a mirror whose ID is an arbitrary number (M in the illustration) to the intermediate site). Data can be copied with a mirror whose ID is an arbitrary number (P in the illustration) to the secondary site.
• UR intermediate site (copies data with a mirror whose ID is an arbitrary number (M in the illustration) from the primary site and copies data with a mirror whose ID is an arbitrary number (N in the illustration) to the secondary site). Data can be copied with a mirror whose ID is an arbitrary number (P in the illustration) from the primary site.

• UR secondary site (copies data with a mirror whose ID is an arbitrary number (N in the illustration) from the intermediate site). Data can be copied with a mirror whose ID is an arbitrary number (P in the illustration) from the primary site.