Using Dell PS Series Asynchronous Replication

Best practices for replication, planning, and recovery with PS Series arrays

Dell Storage Engineering
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A Dell Best Practices Guide

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Acknowledgements

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Introduction

Replication provides a method for protecting volume data without setting the volumes offline and without causing disruption to applications and users. It also provides a disaster-recovery option in case the original group or volume is destroyed or unavailable.

Dell™ PS Series Asynchronous Replication is used to copy volume data from one PS Series group to another PS Series group. The two groups must be connected through a TCP/IP network, and can be an unlimited distance apart.

Audience

The information in this guide is intended for technology professionals interested in using Dell PS Series storage with Asynchronous Replication to protect and recover data.

Objective

This guide details the Asynchronous Replication feature in Dell PS Series firmware.

While Dell PS Series storage also provides real-time data protection with Synchronous Replication, this topic is not covered in this guide. For additional information on Synchronous Replication, refer to the document, *Dell EqualLogic PS Series Array: Understanding Synchronous Replication (SyncRep)*.

For off-network PS Series volume replication, Dell also provides a standalone program called the Manual Transfer Utility. For additional information on this program, refer to the *Manual Transfer Utility Version 1.2.3 Installation and User's Guide* on eqlsupport.dell.com.

1 About Asynchronous Replication

A replica represents the contents of a volume at the time the replica was created. Each replicated volume has a replica set, which is the set of replicas created over time.

A volume and its replicas are always stored on different groups connected by a robust network link. Separating the groups geographically protects volume data in the event of a complete site disaster.

To replicate volume data, configure the group that contains the volume and the group that will store the replicas as replication partners. A group can have multiple partners, but a volume can replicate to only one partner.

- **Primary group**. This is the group storing the volume. The primary group administrator configures the secondary group as a replication partner and initiates the replication operation. Replication from the primary group is considered outbound.
- **Secondary group**. This is the group storing the replicas. The secondary group administrator configures the primary group as a replication partner and provides space for the replicas. Replication to the secondary group is considered inbound. Refer to the section, Primary and secondary group administration, for more information.

Mutual authentication using passwords provides security between partners.

Each partner plays a role in the replication of a volume, and you can monitor replication activity from either partner**.** A PS Series group can have up to 16 replication partners[1]. This gives you significant flexibility to choose a replication configuration that meets your needs, such as:

- One group replicates to another group.
- One group replicates different volumes to different groups.
- Two groups replicate to each other.
- Several groups replicate to the same secondary group.

Note: For additional information on replication, refer to the Dell PS Series *Group Manager Administrator's Manual* on eqlsupport.dell.com (login required).

[1] The limits mentioned in this document apply to PS Series groups that contain at least one member that is not a PS4000. In a group of only PS4000 arrays, the limits are two members per group, two replication partners, and 32 volumes configured for replication. See the latest PS Series release notes on eqlsupport.dell.com for the complete supported configuration limits.

2 Replication planning

Below are some guidelines for getting started with replication planning.

1. Plan the replication configuration for your groups and volumes. For each volume, determine the replication space requirements (section 2.2) for the primary and secondary groups. This will help in determining the local space required for replication and choosing the best replication partner for each volume.
2. Configure one or more replication partners (section 3). For each partner configured, an administrator must log into the partner and configure the primary group as a replication partner, making sure to delegate sufficient space (section 2.2) to the primary group.
3. Configure each volume for replication (section 3.1). Specify the replication partner, local replication reserve, replica reserve on the partner, and whether to maintain the failback snapshot.
4. Create a replica on demand (section 4), or set up a schedule (section 2.6) to create replicas automatically at a specified time and frequency. Using a schedule, you can specify how many replicas to keep.
5. Regularly monitor (section 5.1.1) to ensure the replicas have completed and that the correct number of replicas is stored on the partner.
6. Adjust values over time as needed. For example:

   - Adjust the schedule (section 3.1.1) to create more replicas, retain fewer, or to create them at a different interval or time.
   - Increase or decrease the amount of delegated space (section 2.2) on the partner, depending on your actual space usage and needs.
   - Increase or decrease replicated volume's replica reserve (section 2.2).

Answering the following questions will help determine which groups to configure as replication partners, how often to replicate the volumes, how many replicas to keep, how to coordinate the replication plan, and whether or not to enable failback on the volumes:

- How large are the volumes?
- How much and how often does volume data change?
- How many copies of the volume (replicas) should be kept?
- How much space is available on each group to store a partner's replicas?
- What are the business recovery needs for the applications using the volumes?

  - Recovery Time Objective (RTO): The amount of time within which a business process must be restored after a disaster or disruption. The RTO determines whether or not to keep a failback snapshot. See the section, Failover and failback considerations.
  - Recovery Point Objective (RPO): The acceptable amount of data loss for a specific amount of time. The RPO determines the necessary frequency of replication.

- Who manages the replication and data recovery process?

2.1 Primary and secondary group administration

Because replication involves two groups, group administrators must coordinate their efforts.

To configure groups as replication partners, each administrator needs the following information:

- Group name and IP address of the partner
- Amount of space each group will delegate to the other, if any
- Mutual authentication passwords that enable the two groups to communicate with each other

2.2 Space requirements

Volume replication between partners requires space on both the primary group (the volume location) and the secondary group (the replica location). These space requirements are classified as follows:

Delegated space (section 5.1.3) on the secondary group, is the amount of space dedicated to storing replicas from the primary group. All replica reserves are confined to exist within this configured limit.

In PS Series firmware v8 and later, you can assign delegated space for a single partner in multiple pools (section 5.1.3) and the entire storage space can be used within the group. Delegated space can be assigned in one, some, or all pools. Prior to PS Series firmware v8, delegated space was restricted to one storage pool for a particular replication partner. Also, in PS Series firmware v8 and later, you can configure a mapping between primary pools and secondary pools for initial replica set placement. See Figure 1.

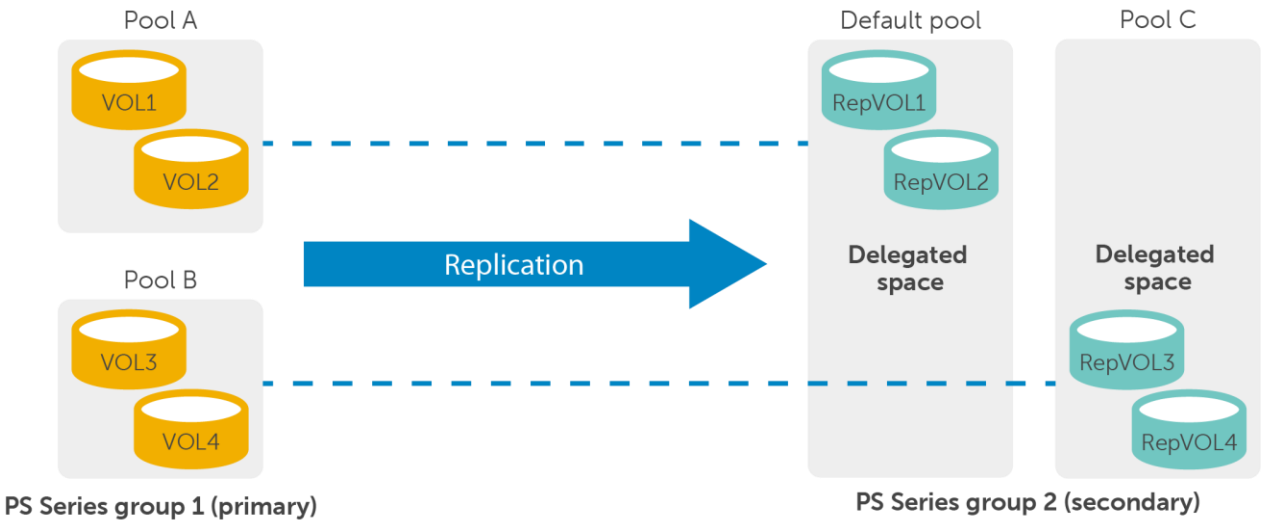


Figure 1 Mapping between primary and secondary pools for initial replica set placement

Local replication reserve on the primary group, is the amount of space reserved in the pool for replication operations. Local replication reserve keeps track of changes that occur to the volume while it is being replicated. It also stores a failback snapshot, if you choose to keep one.

Because replicas and failback snapshots are a representation of the volume data at a precise point in time, the group must maintain that state until the replication completes. To allow the volume to remain online and in use during this time, the group uses the local replication reserve to temporarily track changes to the volume while the operation is underway. When the replication is complete, the local replication reserve space is freed, unless the volume was configured to keep a failback snapshot (see section 2.7).

Current replica volume reserve (in MB/GB/TB) on the secondary group, is the reserved space for replication on the volume.

Total replica reserve is the amount of space reserved for the replica set within the configured delegated space on the secondary group. Total replica reserve is a percentage of the current replica volume reserve that provides additional space for replicas. If the current replica reserve is 1 GB, and you specify 200% for total replica reserve, the total replica reserve size is 2 GB. If the current replica volume reserve increases to 4 GB, then the total replica reserve size also increases to 8 GB. The total replica reserve for a volume can potentially limit the number of replicas that are kept. To prevent older replicas from being deleted, space can automatically be borrowed (section 5.1.3.1) from other sources when the total replica reserve is consumed.

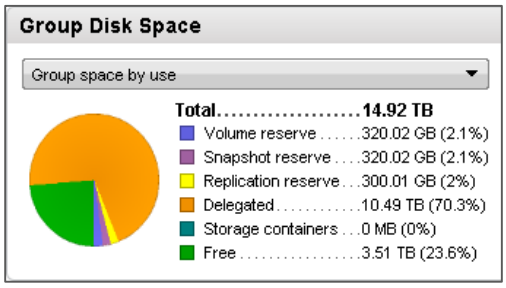


Figure 2 Examples of group space usage (1)

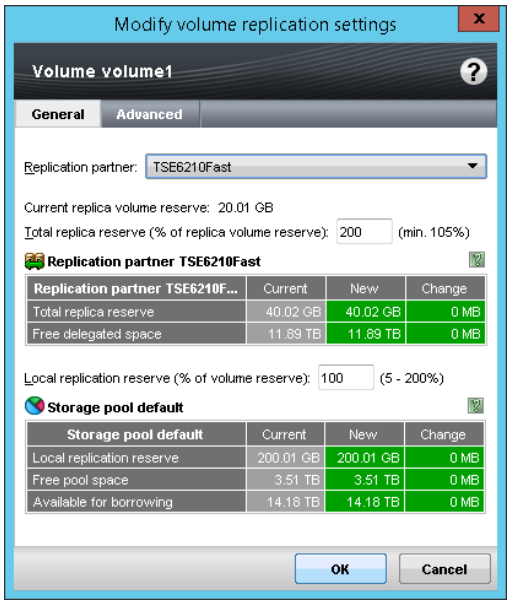


Figure 3 Examples of group space usage (2)

2.3 Volumes

Up to 128 volumes per group can be configured for replication (and active replication) at any time. A volume can have only one replication partner. However, different volumes on the same PS Series group can replicate to different partners.

For example, on GroupA, the replication partners are GroupB and GroupC. On GroupA, the volumes and their replication partners can be set up in the following example:

- Vol1 → GroupB
- Vol2 and Vol3 → GroupC

2.4 Volume collections

A volume collection is a group of up to eight volumes that can be managed together. For example, a volume collection can consist of: a volume for a database and another volume for its log file, volumes that store email, volumes for a particular group of users or a department, or any other volumes that you want to replicate at the same time. All volumes in a collection must be configured to replicate to the same partner.

2.5 Replica frequency and keep count

Each volume can have up to 512 replicas stored on its partner.

Based on your RTO and RPO, you can specify how often to replicate a volume and how many replicas you want to keep on the partner group.

For example, if your volume data does not often change, you might decide to replicate the volume once per week. Depending on how much data is replicated each time and the amount of replica reserve, you could keep, for example, many weeks' or months' worth of replicas on the partner.

On the other hand, if the data of a volume changes frequently and you want to minimize the amount of potential transaction loss in the event of a disaster, you might decide to replicate the volume daily or even hourly. For example, you could keep a full day's worth of hourly replicas on the partner.

The replication frequency and the number of replicas to keep depend on your business needs, and are limited only by the configuration limits and the amount of space available on the volume's replication partner.

Use the following formula to determine the number of replicas to keep:

Frequency of replications x *time period to retain* = *Number of replicas to keep*

For example: 2 replications per day x 14 days = 28 replicas

Note: A group can have up to 10,000 snapshots and replicas (total) from all of its replication partners.

2.6 Schedules

Using schedules can help ensure your volumes and volume collections are replicated at the best intervals and times to meet your business needs.

For example, consider a volume that rarely changes. You can configure a schedule that replicates its data once a week on Sunday mornings at 2:00 a.m. If you decide to increase or decrease the replication frequency, you can modify the schedule at any time.

2.7 Failover and failback considerations

If a failure or maintenance in the primary group makes a volume unavailable, you can failover to the secondary group by promoting a replica (section 5.1.4) to a recovery volume to allow hosts to access it. If the primary group becomes available, you can failback to the primary group (section 5.1.7).

There are two ways you can access the data in replicas on a partner group: cloning and promoting. Because this document focuses on failover and failback, it covers only promoting. Cloning creates a new, separate volume from the replica set, which cannot be failed back to the primary group. For detailed information on cloning, please refer to Dell PS Series *Group Manager Administrator's Manual* on eqlsupport.dell.com.

You can do several things with a replica set that you have promoted to a volume, for example:

- Back up the volume data, keeping the original volume on the primary group online and in-use. This also offloads the backup performance impact to the group storing the replicas. You can also use the promoted volume for another function, such as attaching it to a server to run a data-analysis process, reporting engine, test failover, and so on.
- Use the latest replica to continue business operations if the original volume becomes damaged or destroyed. This is called failover. In the failover situation, you have two further options:
  - Permanently connect initiators (and therefore applications and users) to the replacement volume on the partner and accept the loss of the original volume. Users can continue to use the replacement volume indefinitely.
  - Connect initiators to the replacement volume temporarily while you work to recover the original volume, and then failback the data that changed in the meantime (replicate the deltas to the original volume). Then, move the connections (and users) back to the original volume, returning to your starting configuration. This is called failback.

Configuring a volume to keep a failback snapshot can minimize the amount of data that must be replicated back to the primary group when you are ready to restore the original configuration.

Without a failback snapshot, you can still return to hosting the volume on its original group, but you must replicate the entire volume's contents, which could take hours or even days depending on the size of the communications link and the amount of data to transmit.

If you decide to enable failback support, you can specify it at the time you initially configure replication on the volume, or at any time thereafter.

Note: You must create a replica to establish the failback snapshot before you attempt to failback. Because the failback snapshot uses space from the volume's local replication reserve, you may want to increase that value to ensure replication continues to succeed.

The general overview of the failback process is as follows.

1. On the primary group, the original volume becomes unavailable, or the primary group becomes unavailable.
2. On the secondary group, promote the replica set (section 5.1.4). The promoted volume is called a recovery volume.
3. Connect host initiators to the recovery volume (section 5.1.5). Hosts can continue to access the data via the recovery volume.
4. The primary group becomes available again.
5. Replicate the recovery volume back to the original group (section 5.1.6). Two things occur automatically:

   a. On the primary group, the original volume is demoted to a failback replica set.
   b. On the secondary group, the recovery volume is replicated to the primary group.

   If the original volume has a failback snapshot, only the differences will be replicated. If not, the entire contents of the recovery volume are replicated.

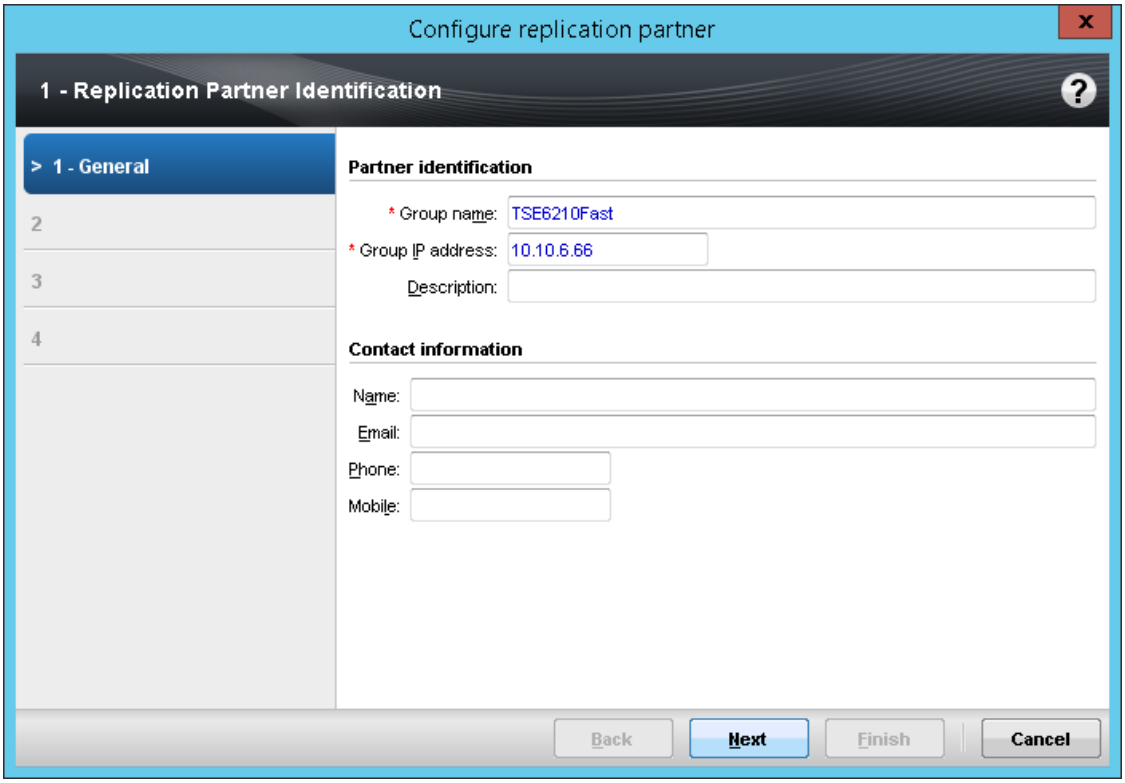
6. If the failback operation will not happen immediately, set up a replication schedule (section 2.6) on the recovery volume to keep the two groups synchronized.
7. As soon as the replication operation completes, failback to primary (section 5.1.7).

3 Configuring group replication

To enable replication between groups, you must perform a configuration task on both the primary and secondary groups.

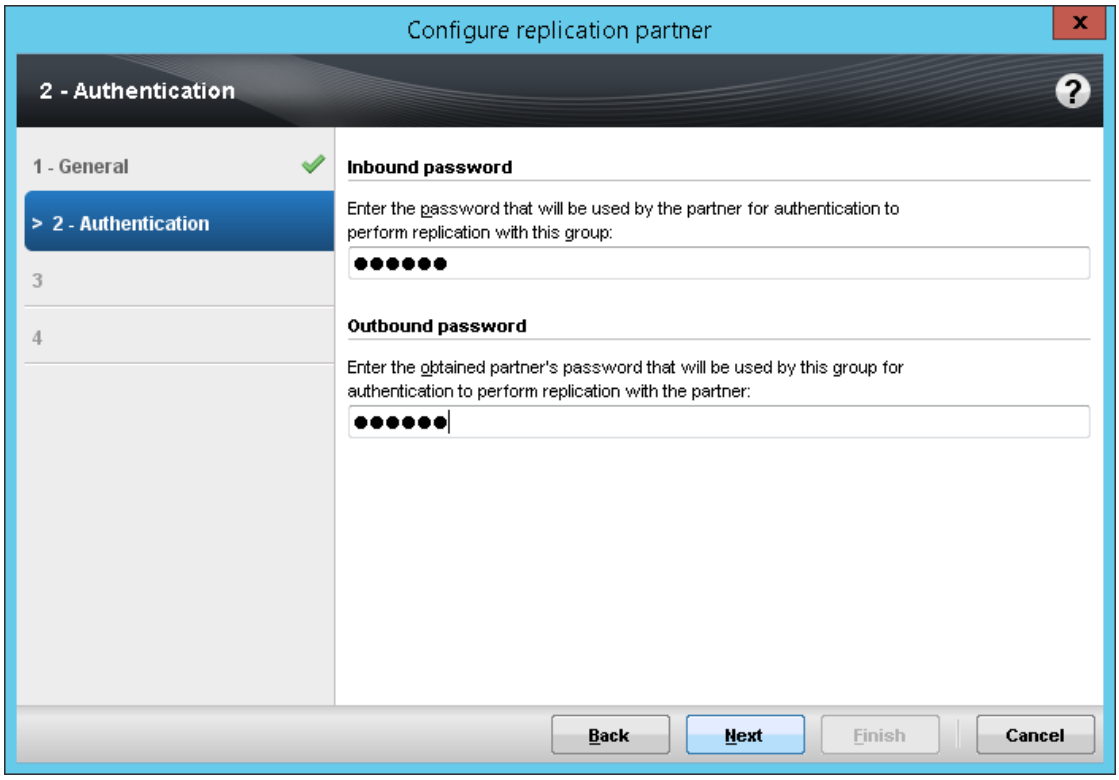
1. Identify the names and IP addresses for the primary and secondary groups.
2. Log in to Group Manager on the primary group.
3. Select the **Replication** View.
4. Click **Replication Partners** in the tree view.
5. In the Activities Pane, click **Configure partner**.
6. Identify the replication partner:

    a. Enter the group name of secondary group.
    b. Enter the group IP address of secondary group.
    c. Optionally, enter the partner contact information.
    d. Click **Next**.



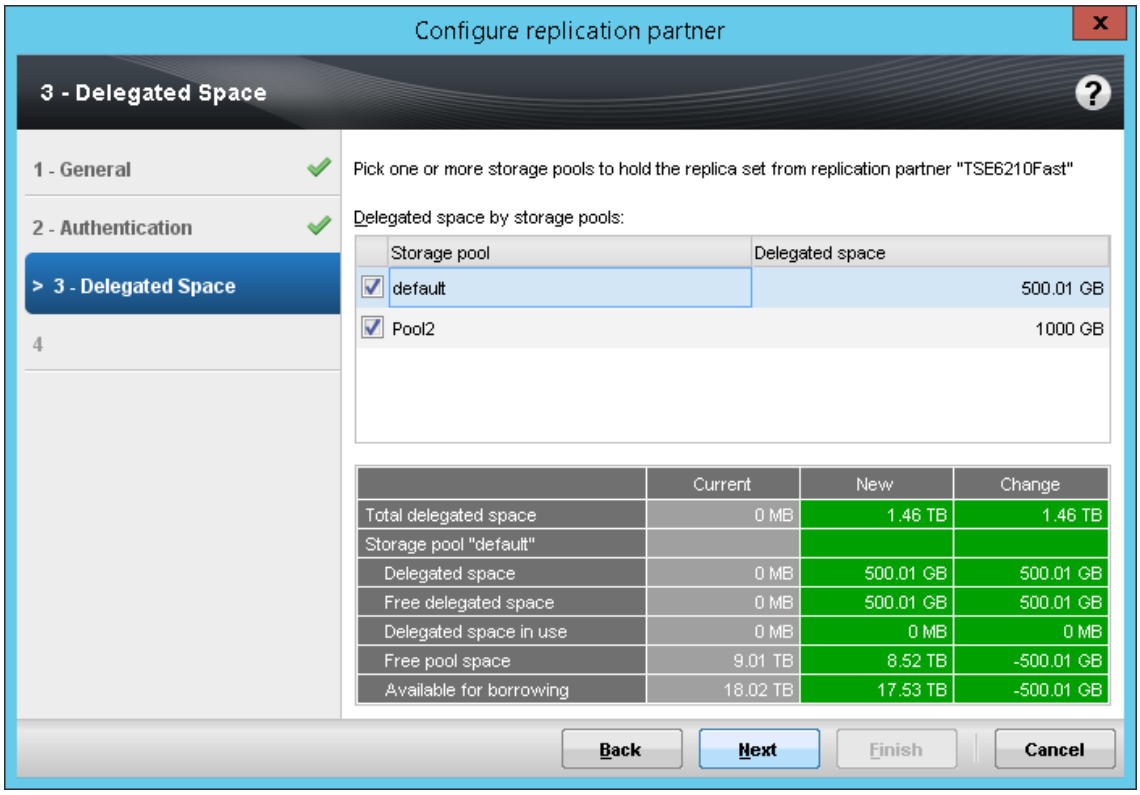
7. Specify the inbound and outbound passwords:

   a. Enter the **Inbound password** used by the partner for authentication to perform replication with this group:
   b. Enter the obtained partner's **Outbound password** that will be used by this group for authentication to perform replication with the partner.
   c. Click **Next**.



8. Select the storage pools and configure the delegated space:

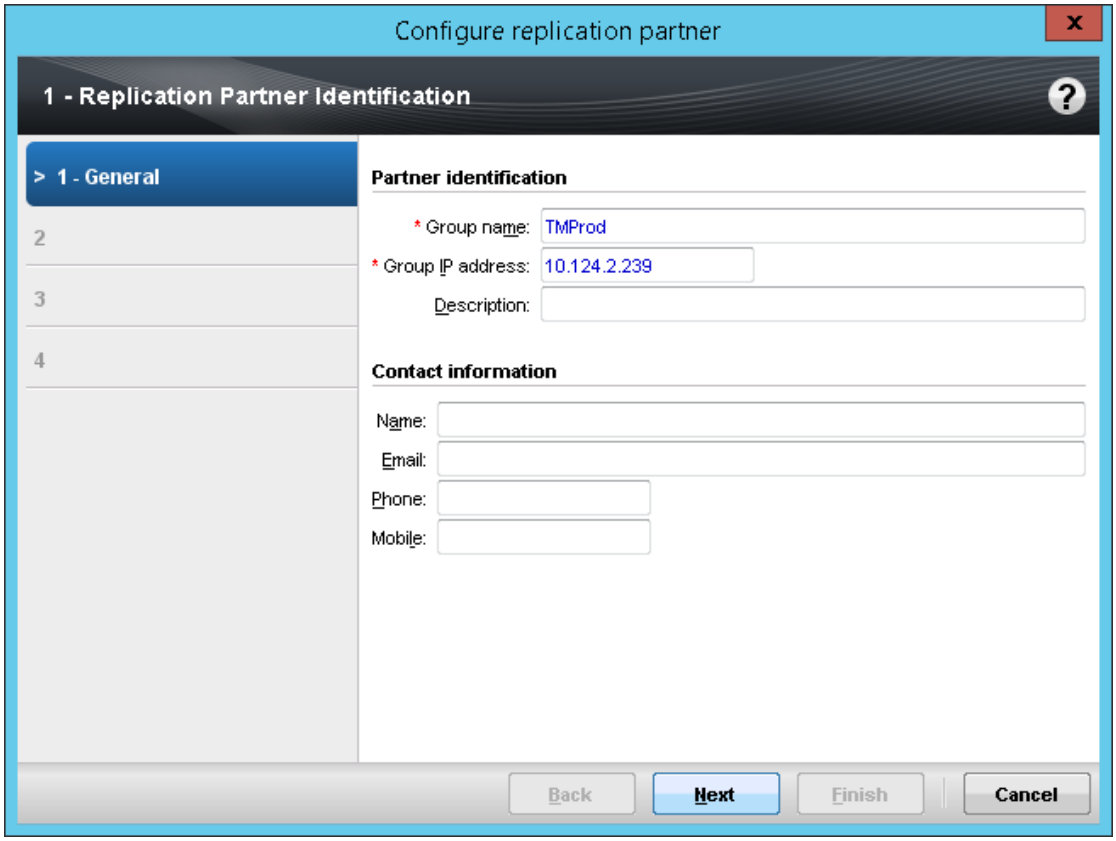
   a. Pick one, or more (PS Series firmware v8 or later), storage pools to hold the replica set from the replication partner.
   b. Specify the delegated space for one, or more (PS Series firmware v8 or later) selected storage pools.
   c. Click **Next**.



9. Review the summary and click **Finish**.

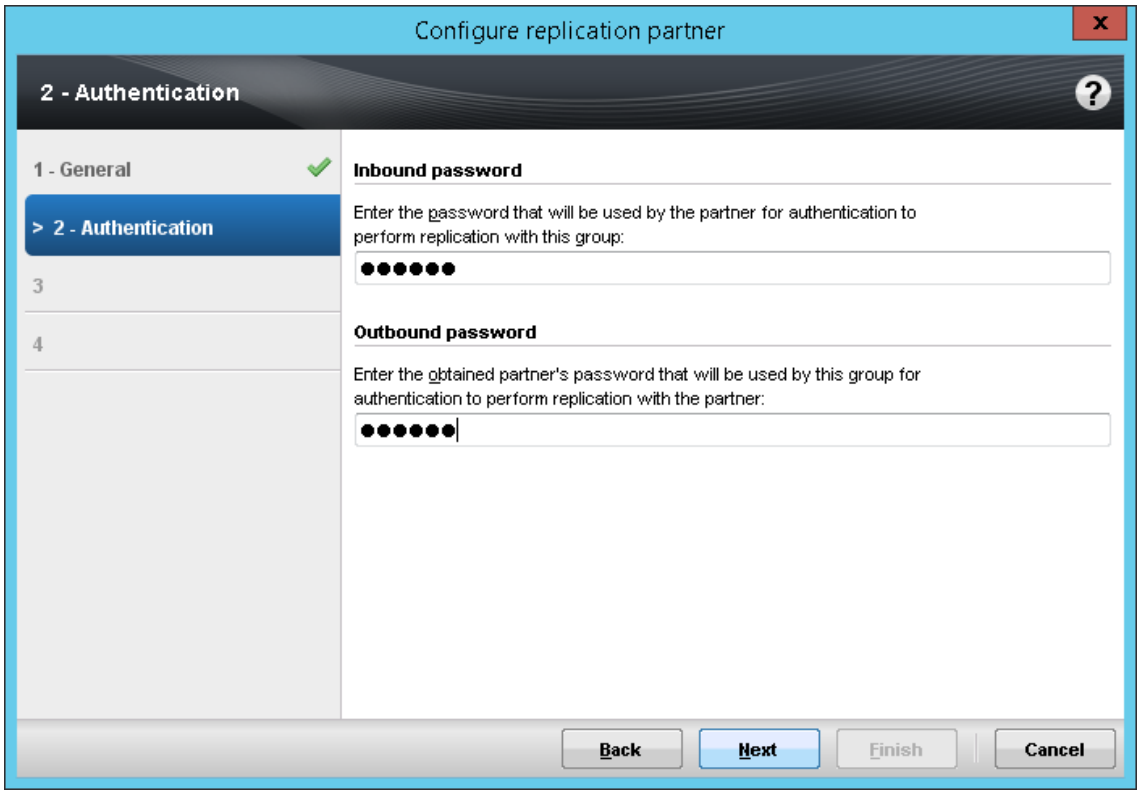
10. Log in to Group Manager on the secondary group.
11. Click to select the **Replication** View.
12. Click **Replication Partners** in the tree view.
13. Identify the replication partner:

    a. In the Activities Pane, click **Configure partner**.
    b. Enter the group name of primary group.
    c. Enter the group IP address of primary group.
    d. Optionally, enter the partner contact information.
    e. Click **Next**.



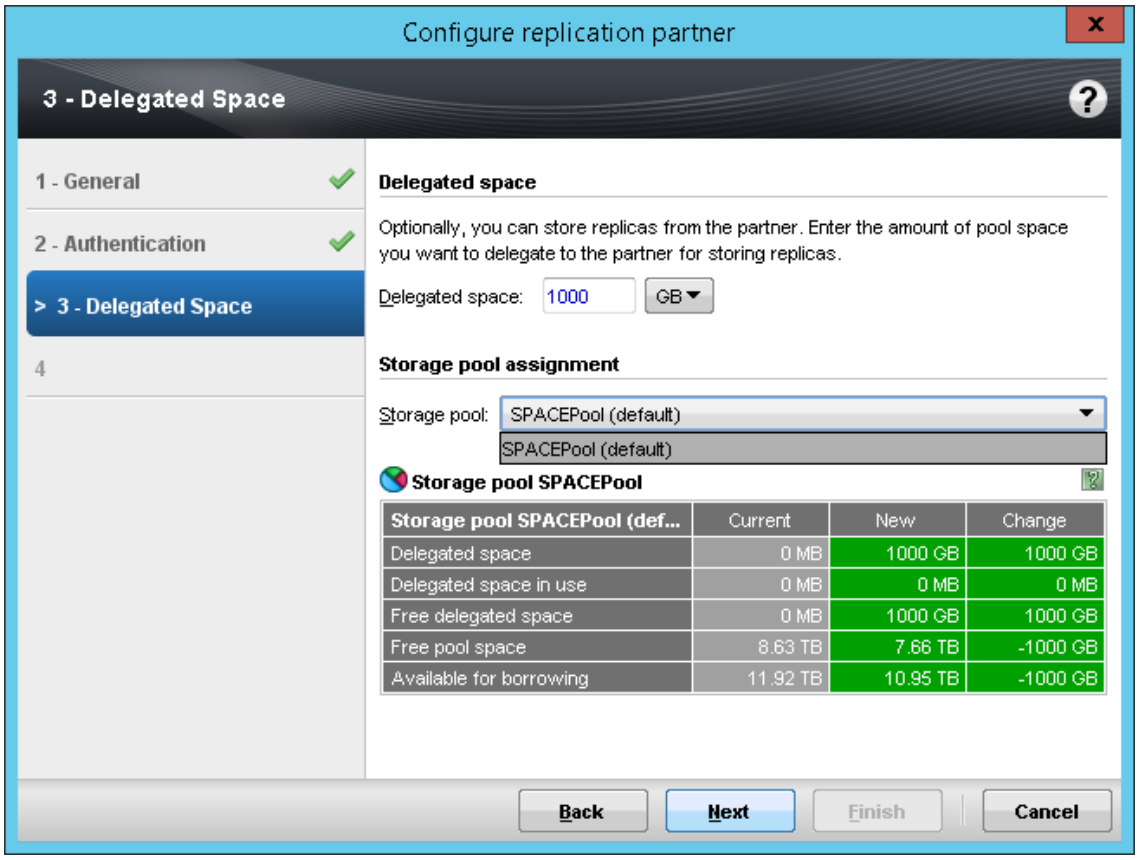
14. Specify the inbound and outbound passwords:

    a. Enter the **Inbound password** that will be used by the partner for authentication to perform replication with this group.
    b. Enter the obtained partner's **Outbound password** that will be used by this group for authentication to perform replication with the partner.
    c. Click **Next**.



15. Select the storage pools and configure the delegated space:

    a. Pick one, or more (PS Series firmware v8 or later), storage pools to hold the replica set from the replication partner.
    b. Specify the delegated space for one, or more (PS Series firmware v8 or later) selected storage pools.
    c. Click **Next**.



16. Review the summary and click **Finish**.

3.1 Configuring volume replication

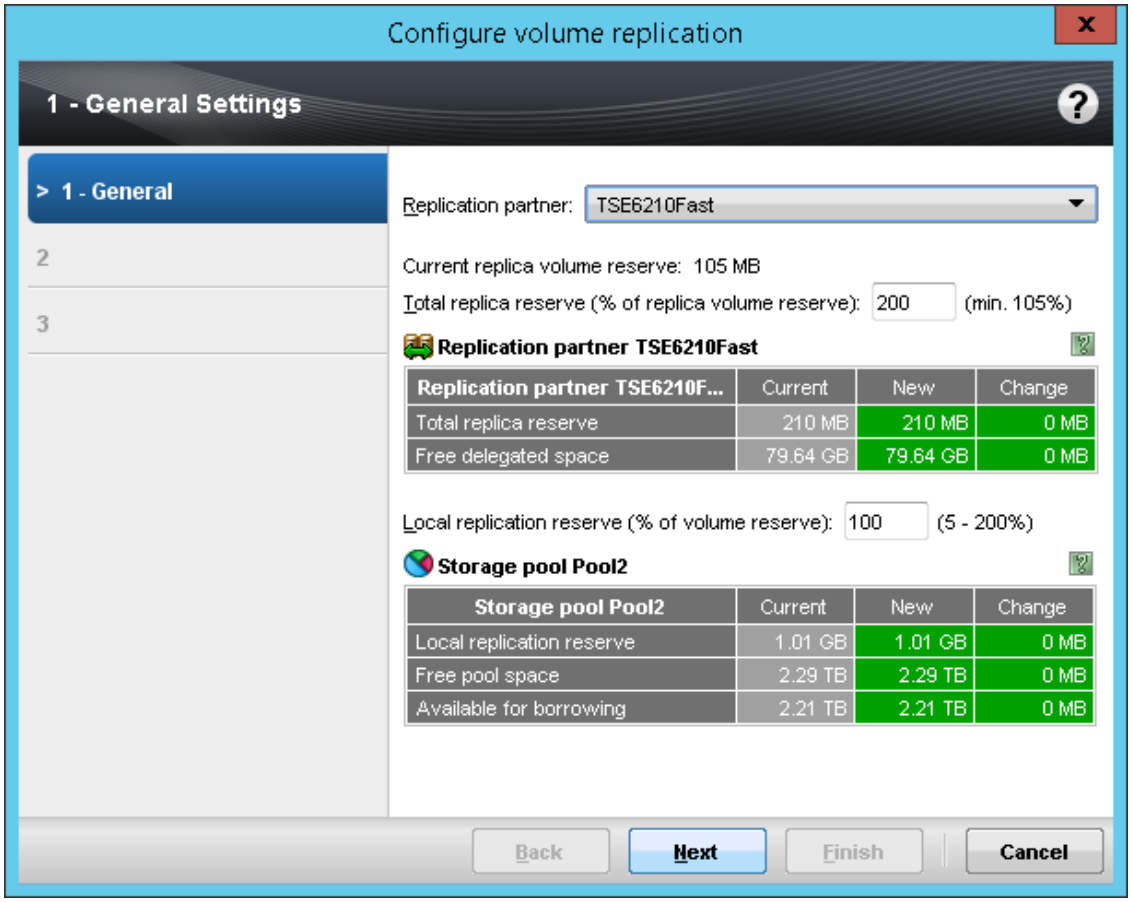
Once replication has been configured in the group (section 3), you can enable replication on volumes.

1. In Group Manager, select the **Volumes** View.
2. Right-click a volume and select **Configure replication**.

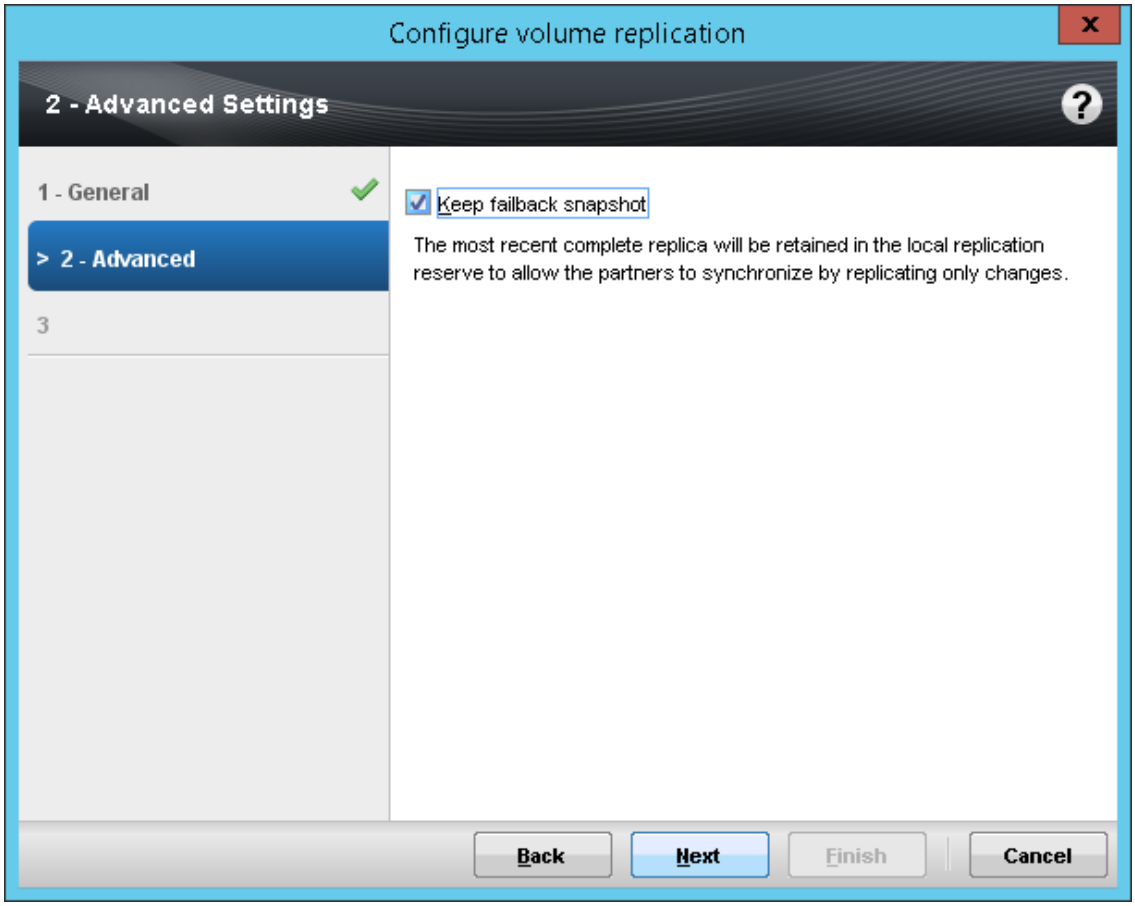
    a. Select the replication partner.
    b. Specify the **Total replica reserve.**
    c. Specify the **Local replication reserve.**

Note: Consider that the default values of 200% for total replica reserve and 100% for local replication reserve ensure you can keep a failback snapshot on the local group and can replicate 100% of the volume changes between replications.

    d. Click **Next**.



e. Optionally, select **Keep failback snapshot**. If selected, the most recent complete replica will be retained in the local replication reserve to allow the partners to synchronize by replicating only changes.
f. Click **Next**.

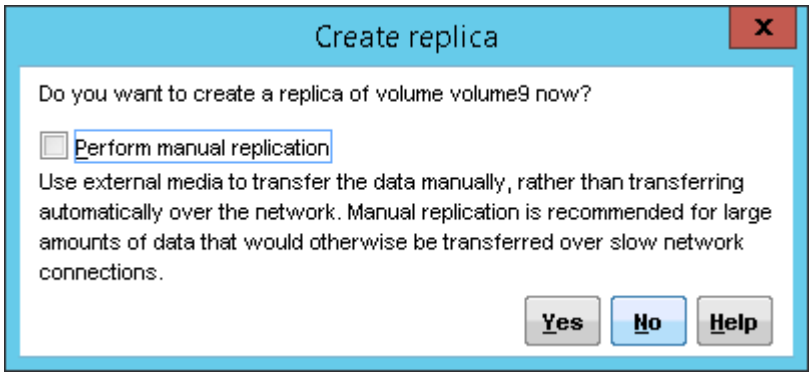


g. Review the summary and click **Finish**.

3. Optionally, select **Perform manual replication** to use external media to transfer the data manually with the Manual Transfer Utility, rather than transferring automatically over the network.

   Manual replication is recommended for large amounts of data that would otherwise be transferred over slow network connections. For additional information on the Manual Transfer Utility, refer to the *Manual Transfer Utility Version 1.2.3 Installation and User's Guide* on eqlsupport.dell.com.

4. Click **Yes** to create a replica immediately, or click **No** to skip this step.



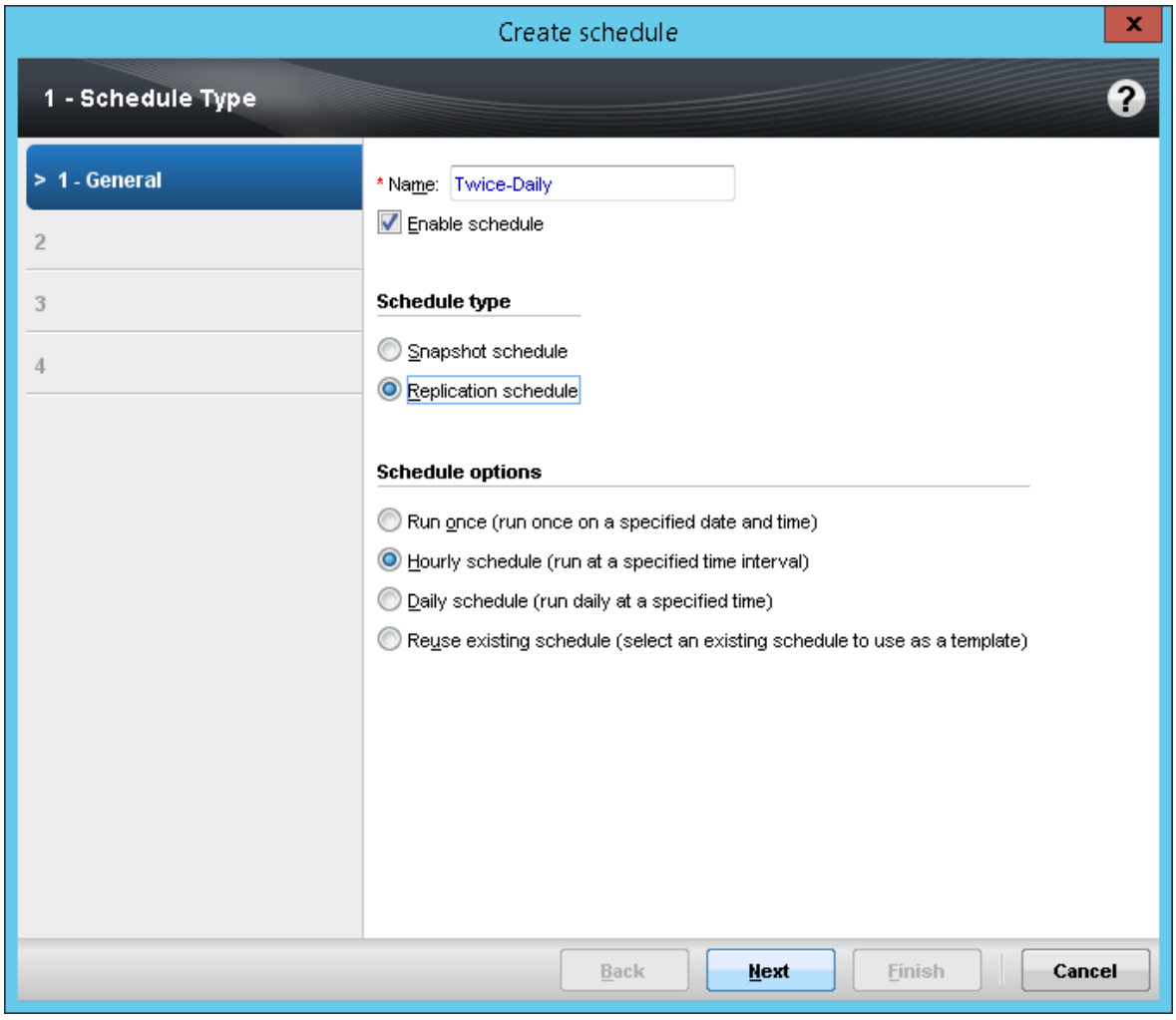
3.1.1 Configuring volume replication schedules

Once replication has been configured for the group (section 3) and desired volumes (section 3.1), you can configure replicas to be created on a schedule.

1. In Group Manager, select the **Volumes** view.
2. Right-click a volume that is already configured for replication (section 3.1) and select **Create schedule**.

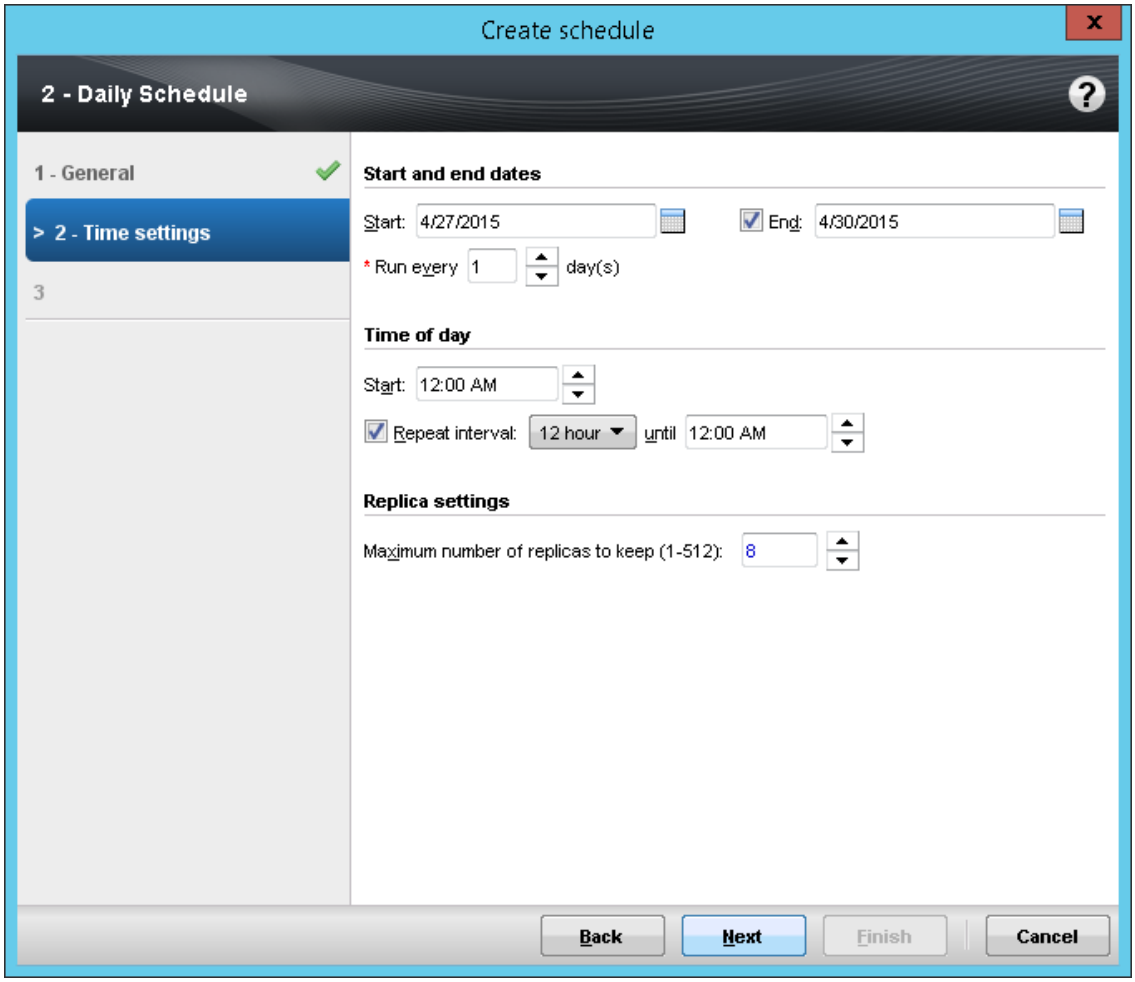
   The following example schedule creates a volume replica every 12 hours for 4 days, keeping 8 replicas, if possible.

   a. Specify a **Name** for the schedule.
   b. Select **Replication Schedule**.
   c. Select a **Schedule option**.
   d. Click **Next**.



Note: The maximum-keep value for a schedule affects only the number of replicas to be retained that were created by the schedule. It does not include replicas created individually, or by another schedule. For this reason, it is important to periodically check the space usage on the partner to make sure you are not inadvertently using up the volume's replica reserve with other replicas.

e. Specify the time settings and click **Next**. Time Settings will vary depending on the previous schedule option selected.



f. Review the summary and click **Finish**.

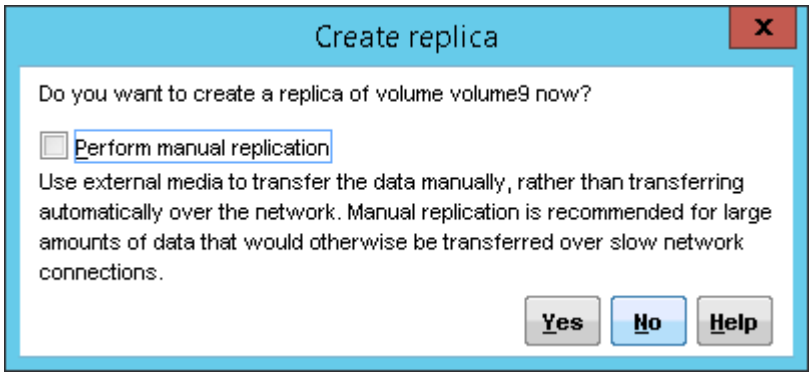
4 Replicating a volume

Once replication has been configured for the group (section 3) and desired volumes (section 3.1), you can create replicas of a volume.

1. In Group Manager, right-click a volume that is already configured for replication (section 3.1) and select **Create replica**.
2. Optionally, select **Perform manual replication** to use external media to transfer the data manually with the Manual Transfer Utility, rather than transferring automatically over the network.

   Manual replication is recommended for large amounts of data that would otherwise be transferred over slow network connections. For additional information on the Manual Transfer Utility, refer to the *Manual Transfer Utility Version 1.2.3 Installation and User's Guide* on eqlsupport.dell.com.

3. Click **Yes** to create a replica immediately, or click **No** to skip this step.



5 Managing replication

Some common replication management tasks, include:

- Monitoring replication
- Monitoring replication space
- Managing delegated space
- Promoting a replica to a recovery volume
- Connecting to a recovery volume
- Replicating a recovery volume
- Failback a recovery volume to primary

5.1.1 Monitoring replication

You can monitor replication from multiple areas in Group Manager of the primary and secondary groups. Replication is outbound from the primary group and inbound to the secondary group.

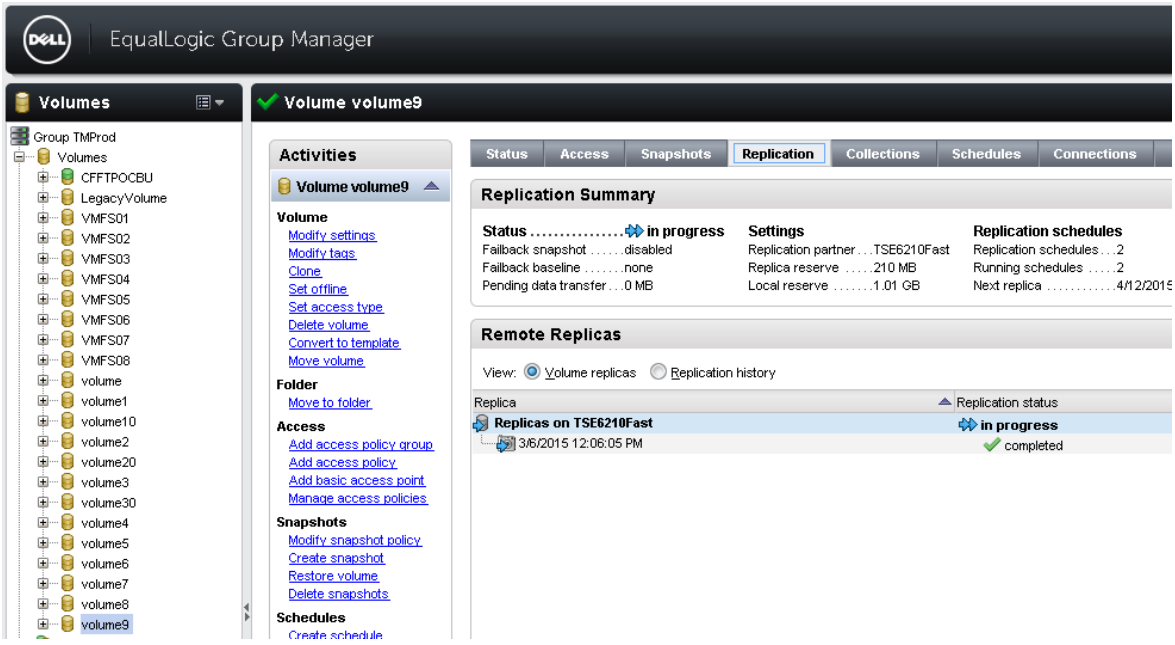


Figure 4 Viewing in-progress and completed replications in the Replication tab of the volume

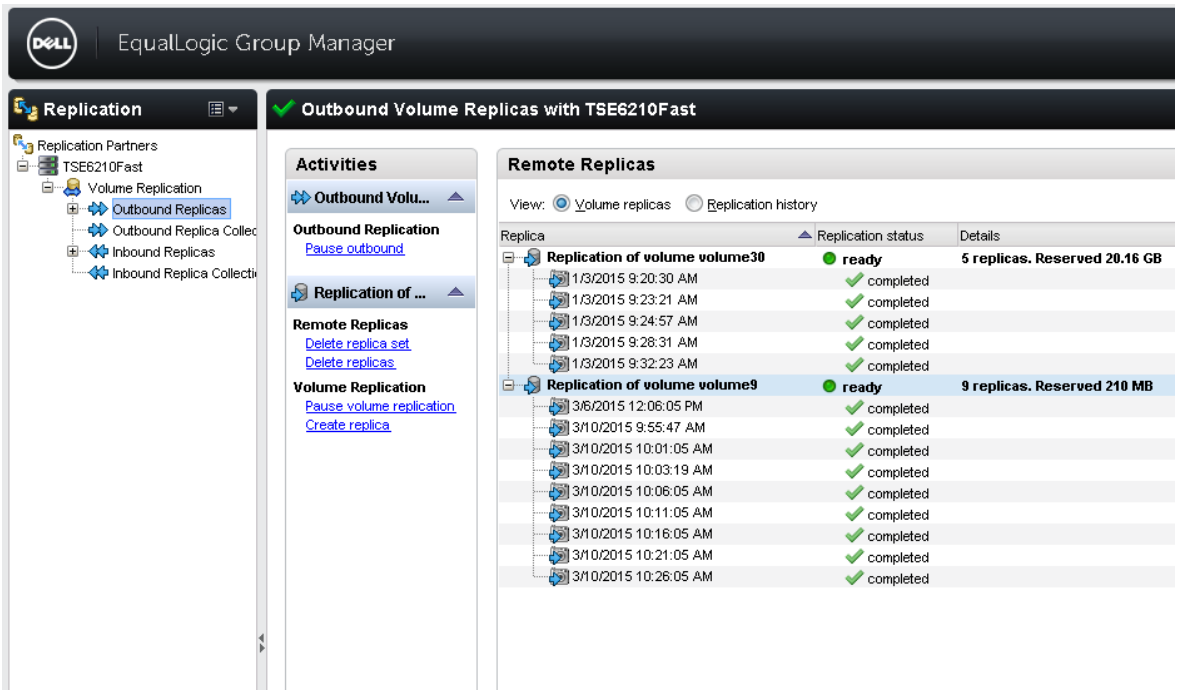


Figure 5 Viewing outbound replicas in the Replication pane of the primary group

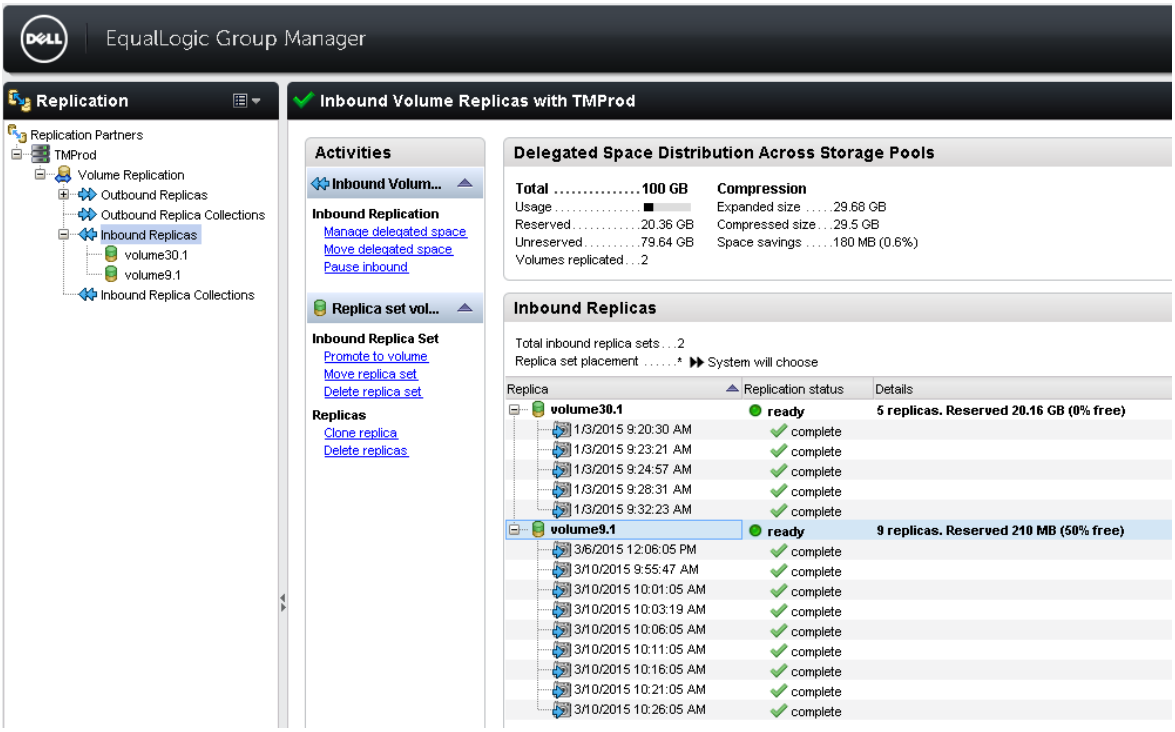


Figure 6 Viewing inbound replicas in the Replication pane of the secondary group

5.1.2 Monitoring replication space

From the Group Manager Replication panel, you can view delegated space statistics, including the amount of configured delegated space, and the percent that is still available.

Note: If you have a replication schedule and you also create replicas on demand (click **Create replica**). All replicas will be part of the replica set for the volume and will compete for its replica reserve.

Note: The maximum-keep value for a schedule affects only the number of replicas to be retained that were created by the schedule. It does not include replicas created individually, or by another schedule. For this reason, it is important to periodically check the space usage on the partner to make sure you are not inadvertently using up the volume's replica reserve with extra replicas.

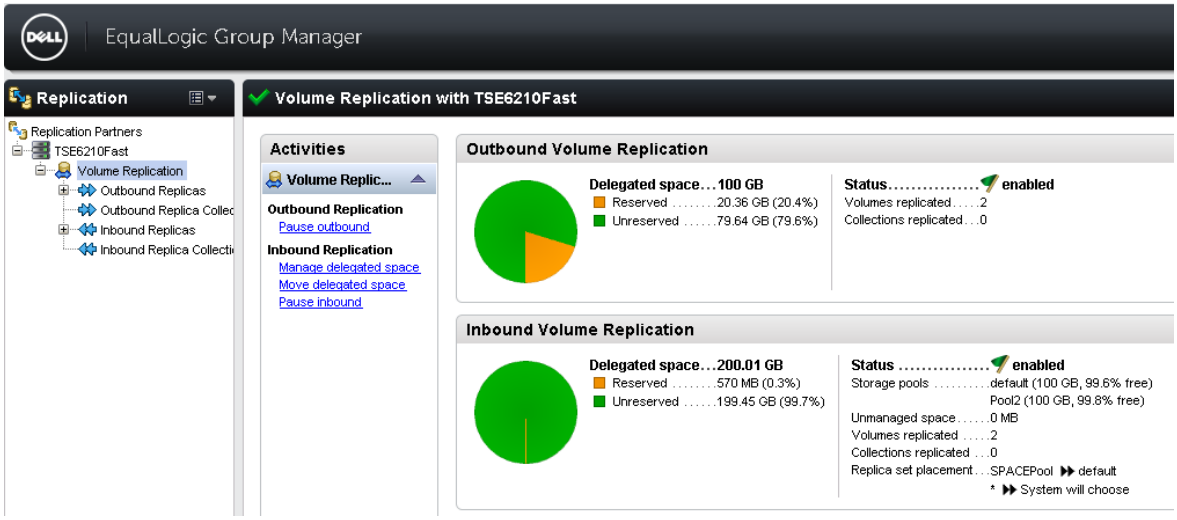


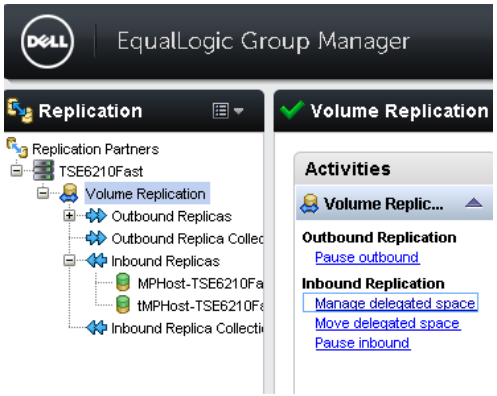
Figure 7 Use of delegated space on the partner

5.1.3 Managing delegated space

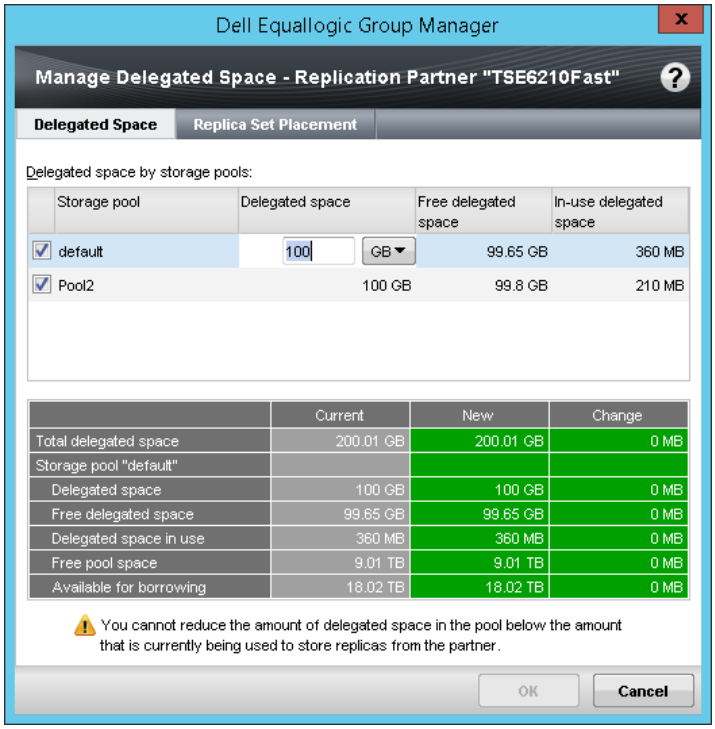
You can modify the space delegated to a partner, however, you cannot decrease the space delegated to a lower capacity than is currently reserved for the partner's replicas.

To modify the space delegated to a partner:

1. In Group Manager of the secondary group, select the **Replication** view.
2. Select **Volume Replication.**
3. In the Activities panel, click **Manage delegated space**.



4. In the **Delegated Space** tab, specify the delegated space for one, or more (PS Series firmware v8 or later) selected storage pools.

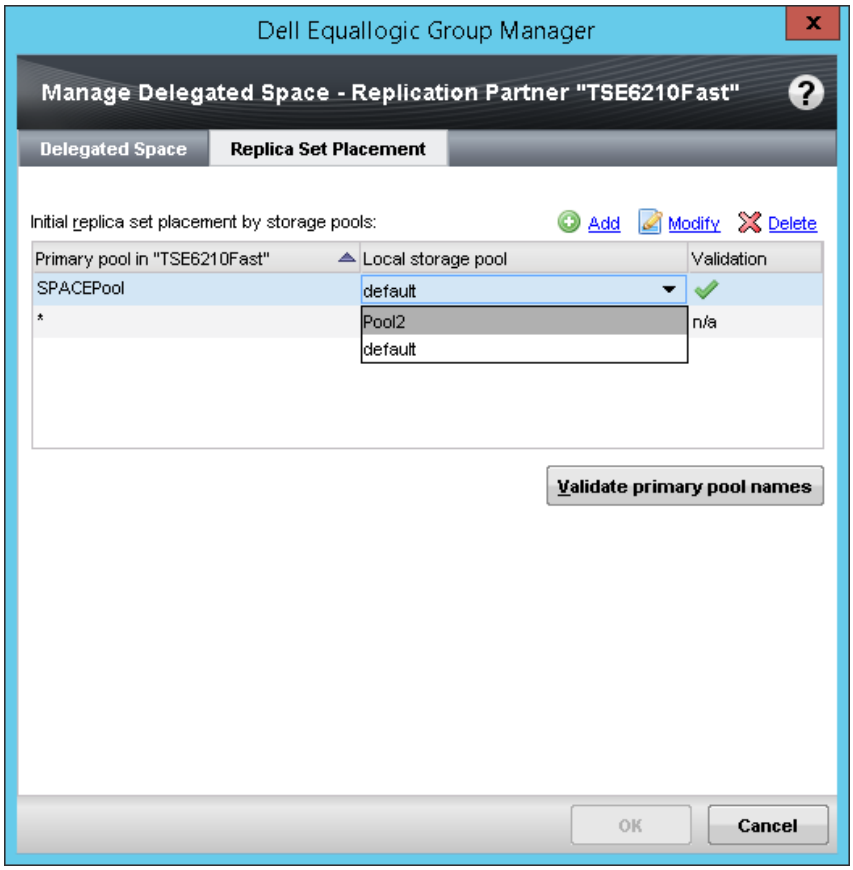


5. In the **Replica Set Placement** tab (PS Series firmware v8 and later), you can optionally configure a mapping between primary Pools and secondary Pools for initial replica set placement (Figure 1).

   If a pool mapping is not manually configured here, the system will automatically choose a pool for replica set placement when creating a replica set, based on available delegated space in the pools.

Note: This pool mapping is only consulted when creating a new replica set, or enabling volume replication on the primary group. When pool mapping changes are made, existing replica sets on the secondary group are not automatically moved, and will continue to reside in their same pool.

   To check if the primary pool names are still valid, and to help ensure the desired mapping will succeed, click **Validate primary pool names**. The status of this validation will appear in the Validation column.



6. Click **OK**.

5.1.3.1 Space borrowing for replication

Dell PS Series firmware version 8.0 provides the ability for snapshots, local and remote replicas, and deleted volumes in the Group Volume Recovery Bin to temporarily borrow space beyond the configured reserves. This feature, called space borrowing, simplifies configuring reserve space, improves space utilization, and enhances management of snapshots and replica reserves.

While it is possible to enable or disable space borrowing for snapshots, space borrowing for replication is automatic and cannot be disabled.

Remote replicas can borrow beyond their total replica reserve, but the total amount of configured reserve space must still fit within the delegated space. If there is insufficient delegated space on the secondary group, the system requires manual administrative intervention to increase the amount of delegated space.

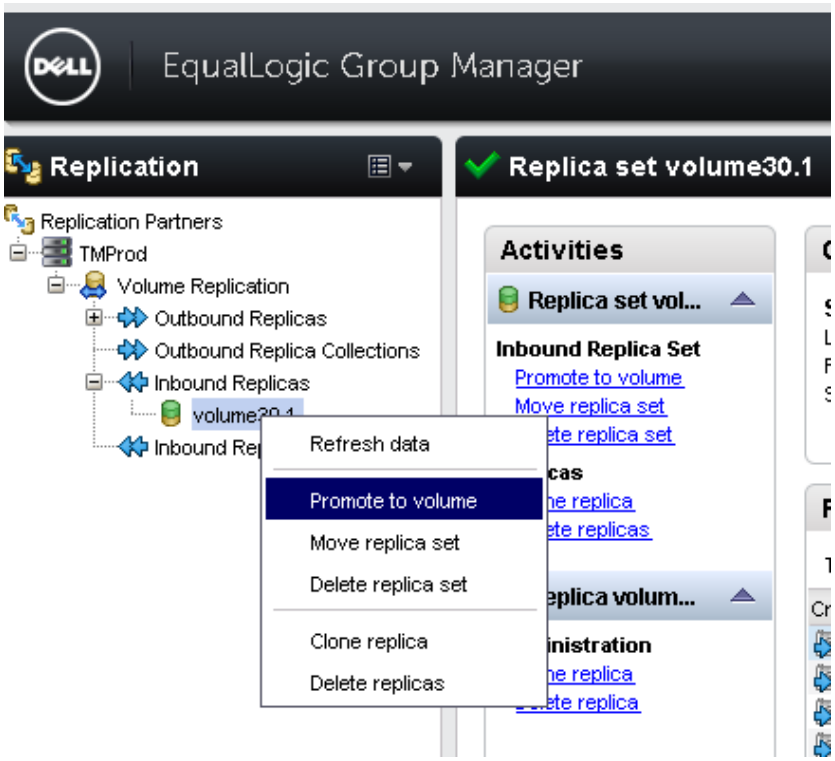
Also, if the replica reserve for a volume is configured with a very low value, such as the minimum 105%, the system can potentially require manual administrative intervention to increase the reserve percentage so that an in-progress replica can continue. In-progress replicas are not eligible to borrow space.

Note: To use space borrowing for replicas, all members in the secondary group must be running Dell PS Series firmware version 8.0 or later. Space borrowing for snapshots requires Dell PS Series firmware v6.0 or later. For more information on space borrowing, refer to *Space Borrowing for Snapshots and Replicas*.

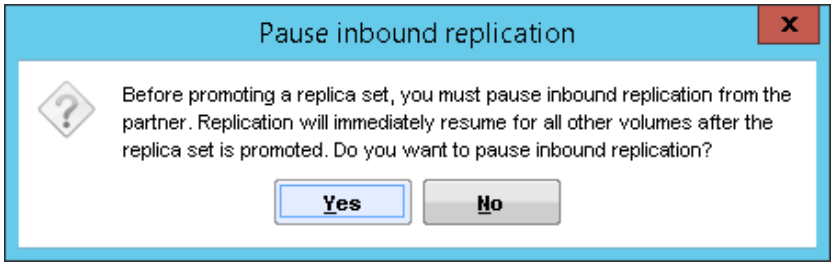
5.1.4 Promoting a replica to a recovery volume

If a failure or maintenance in the primary group makes a volume unavailable, you can fail over to the secondary group by promoting to a recovery volume to allow hosts to access it. If the primary group becomes available, you can failback to the primary group (section 5.1.7).

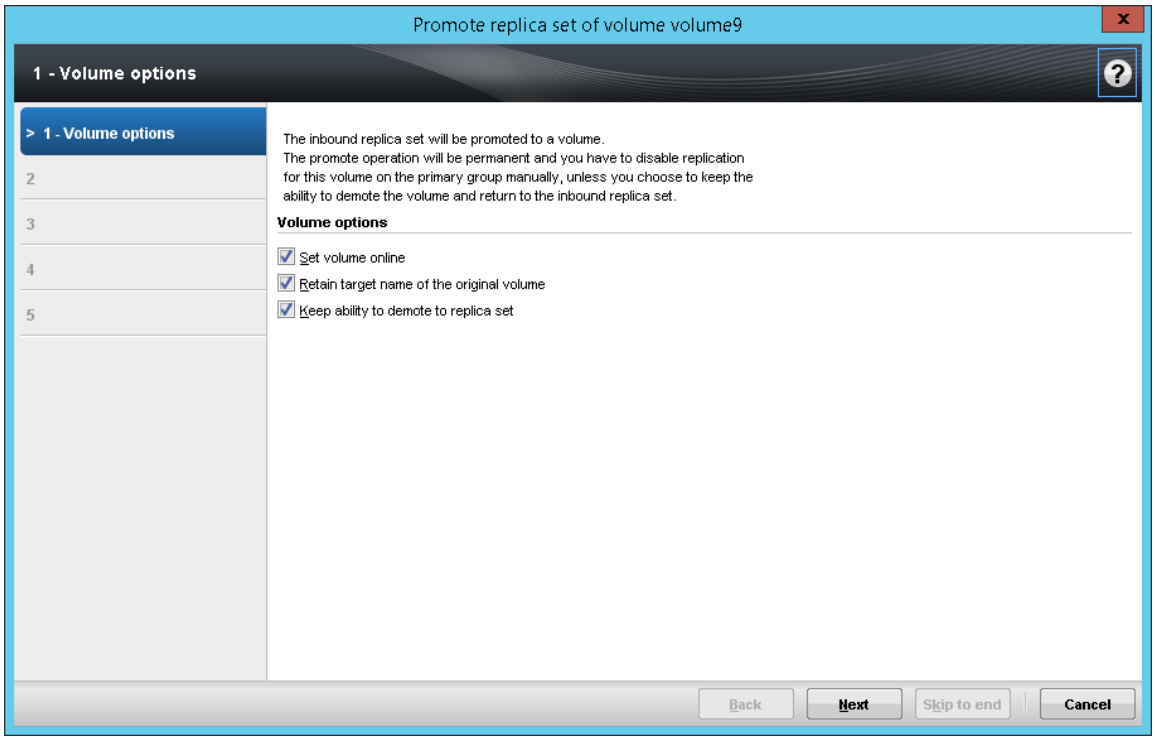
1. In Group Manager of the secondary group, select the **Replication** view.
2. Click **Replication Partners** in the tree view.
3. Expand the replication partner, **Volume Replication**, and **Inbound Replicas**.
4. Right-click the replica set and select **Promote to volume**.



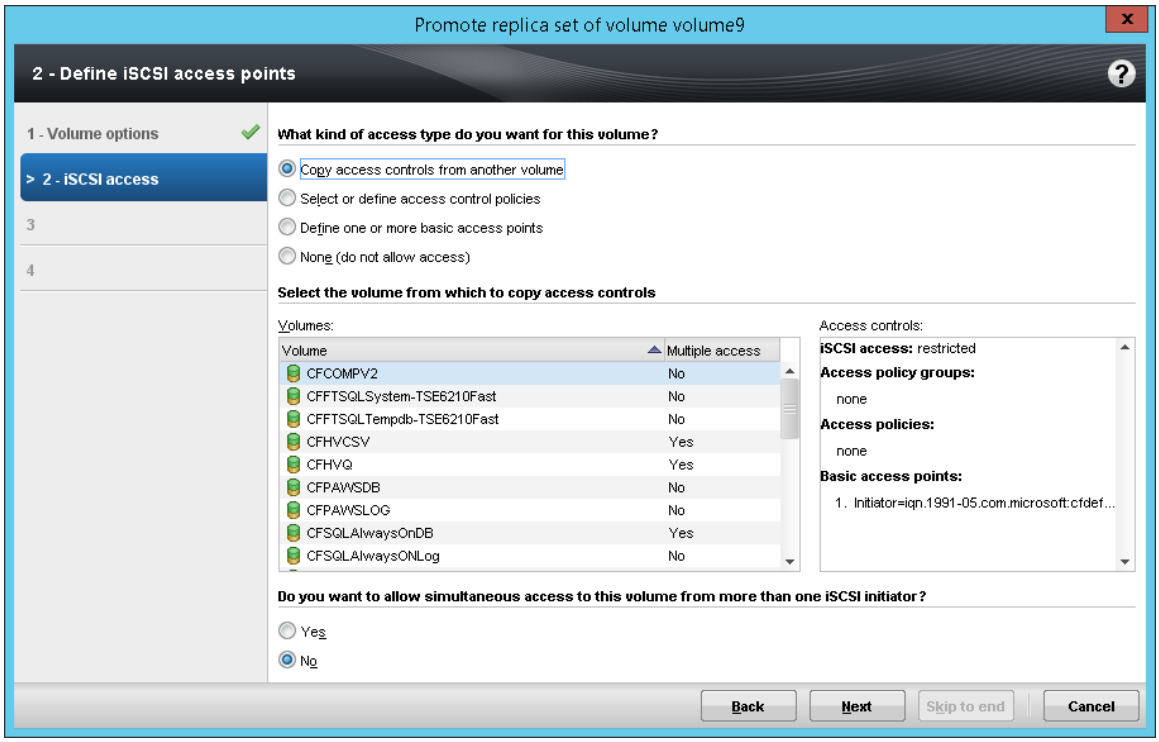
5. Click **Yes** to pause inbound replication.



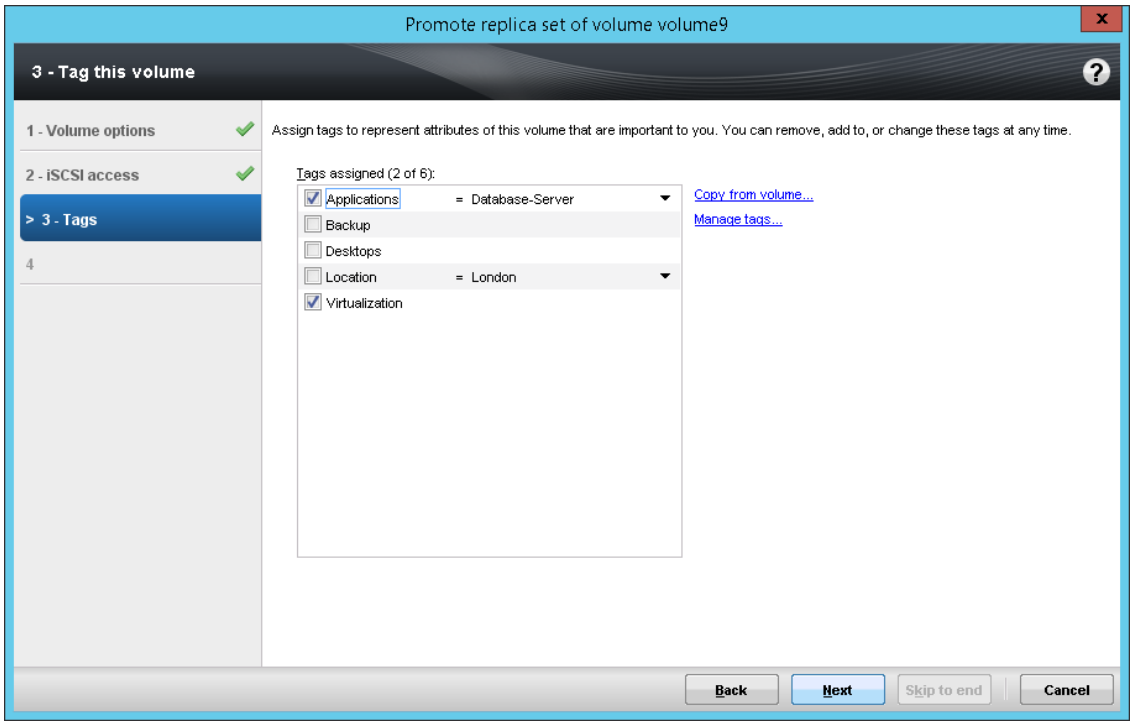
6. Optionally, select the **Volume options**:
   - Set volume online
   - Retain target name of the original volume (this helps initiators discover the recovery volume automatically)
   - Keep ability to demote to replica set
7. Click **Next**.



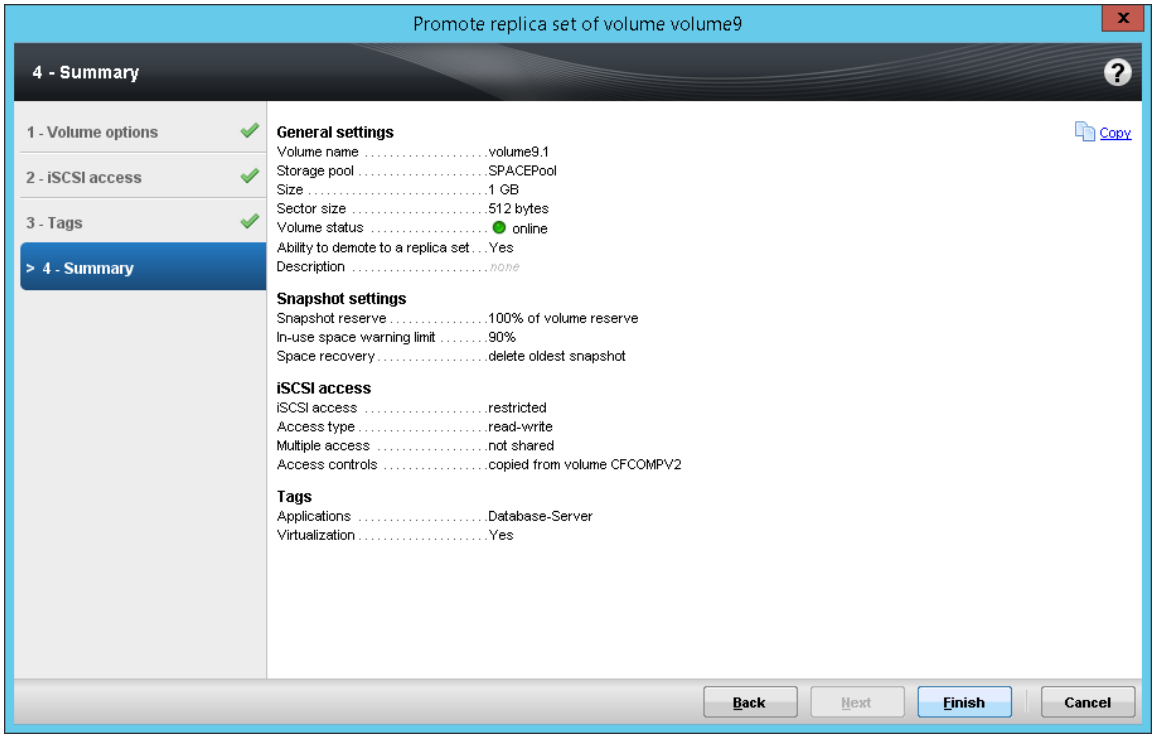
8. Select the access type and define iSCSI access accordingly to allow the appropriate initiator to connect to the recovery volume from a host operating system.
9. Optionally, select **Yes** or **No** when asked, "Do you want to allow simultaneous access to the volume from more than one iSCSI initiator?"
10. Click **Next**.



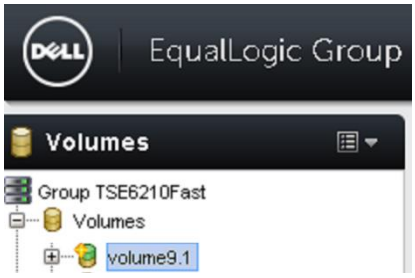
11. Optionally, assign volume tags to the recovery volume.
12. Click **Next**.



13. Review the summary and click **Finish** to promote the Inbound Replica Set to a recovery volume.



In the **Volumes** pane of Group Manager, the recovery volume will display a special icon that indicates it is a recovery volume.



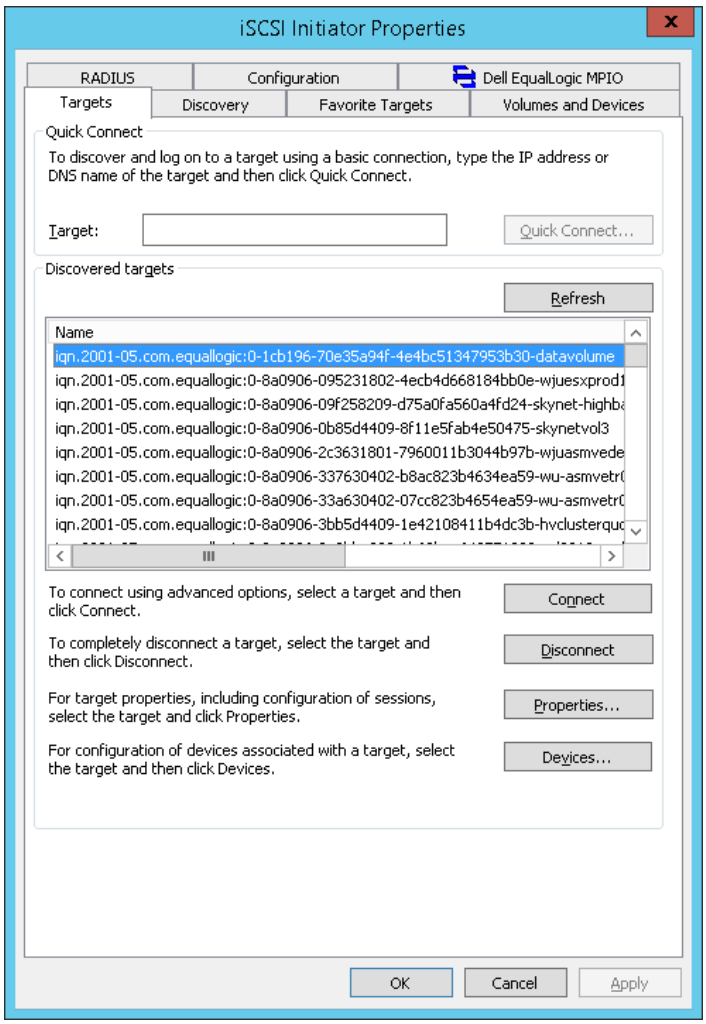
14. You can connect an initiator to the recovery volume (section 5.1.5), allowing hosts to continue to use it as if it were the original volume.

5.1.5 Connecting to a recovery volume

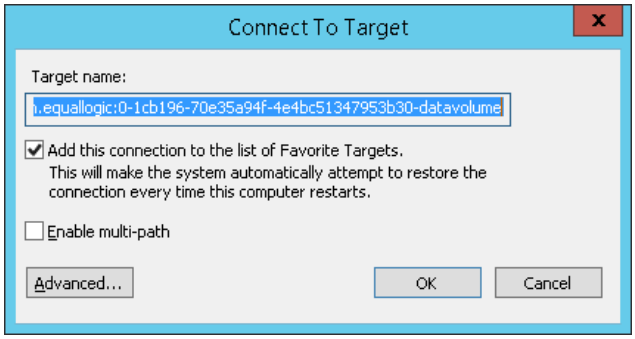
From the host operating system iSCSI initiator, connect to the recovery volume as if it were a regular volume. Use the secondary group IP as the discovery address.

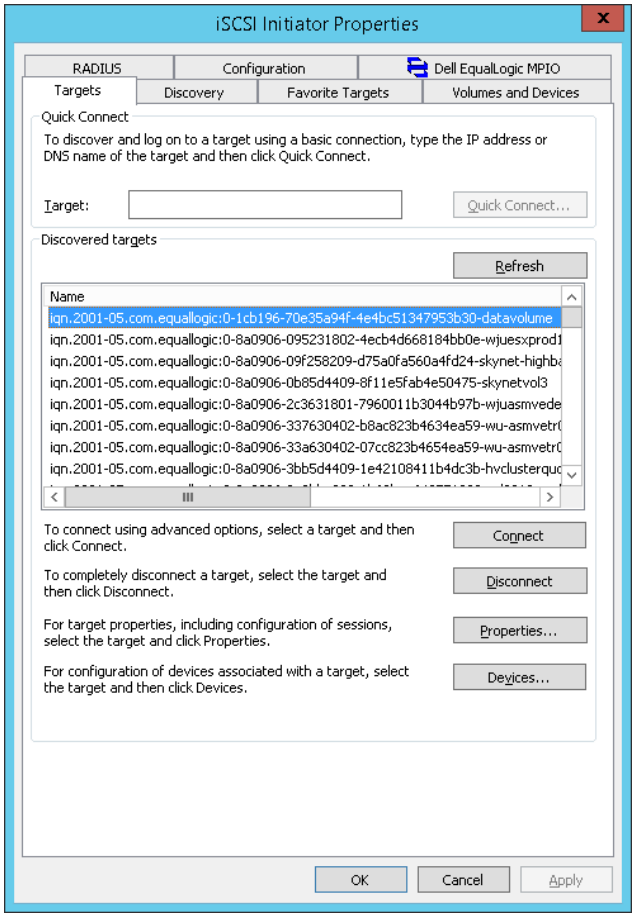
5.1.5.1 Connecting to a recovery volume from Microsoft Windows

1. Launch iSCSI Initiator.
2. Click the **Targets** tab.
3. Click to select the recovery volume.
4. Click **Connect**.



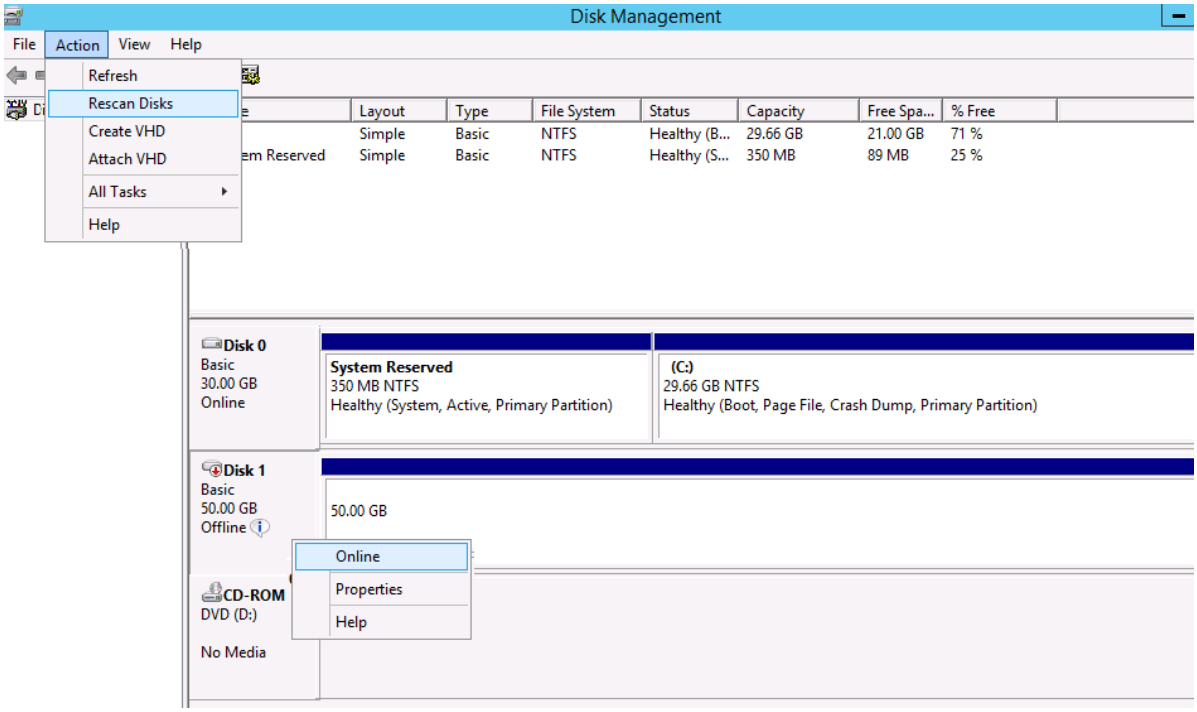
5. Click **OK** in the **Connect to Target** and **iSCSI Initiator Properties** windows.





6. Online the volume from the server (if required)

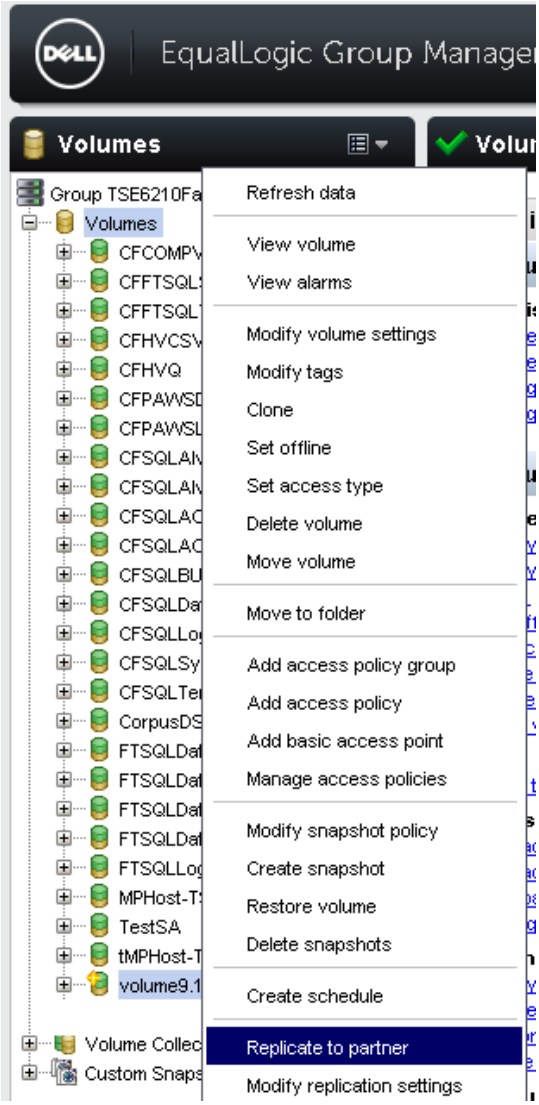
   a. Launch Disk Manager.
   b. Click **Action** > **Rescan Disks**.
   c. Right-click the DR volume and select **Online.**



5.1.6 Replicating a recovery volume

When the primary group and the original volume are back online, you can optionally replicate the new data back to the primary group.

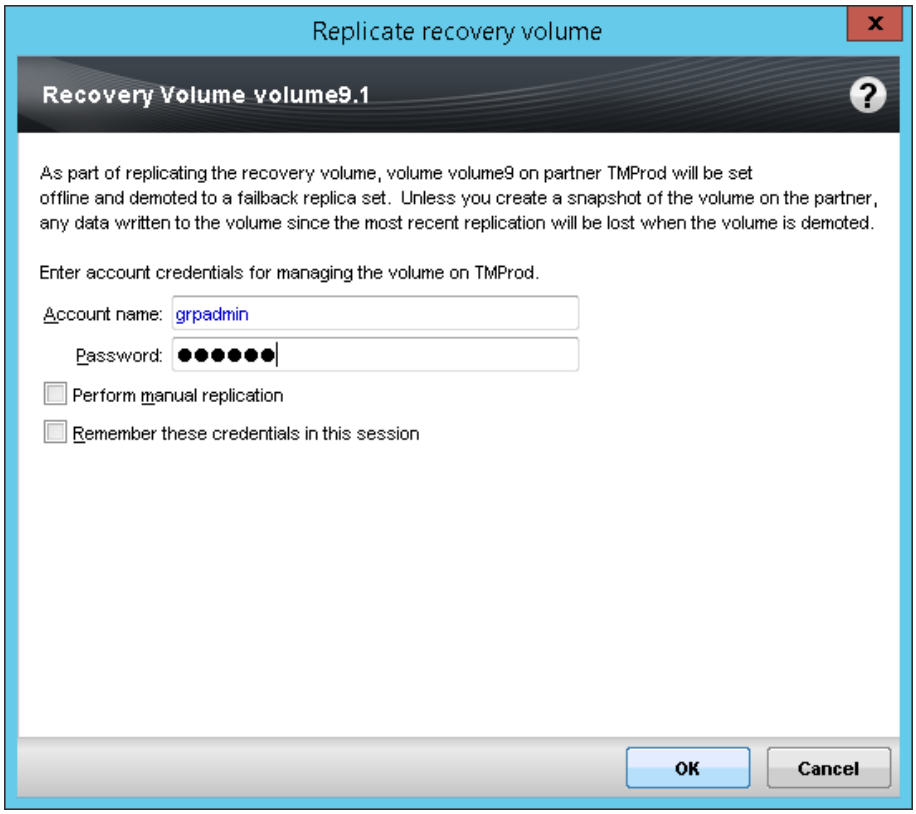
1. On the secondary group, in the Group Manager **Volumes** pane, select the recovery volume and click **Replicate to partner**.



2. Enter the group administrator account and password for the primary group,
3. Optionally, choose to **Perform manual replication** with the Manual Transfer Utility.

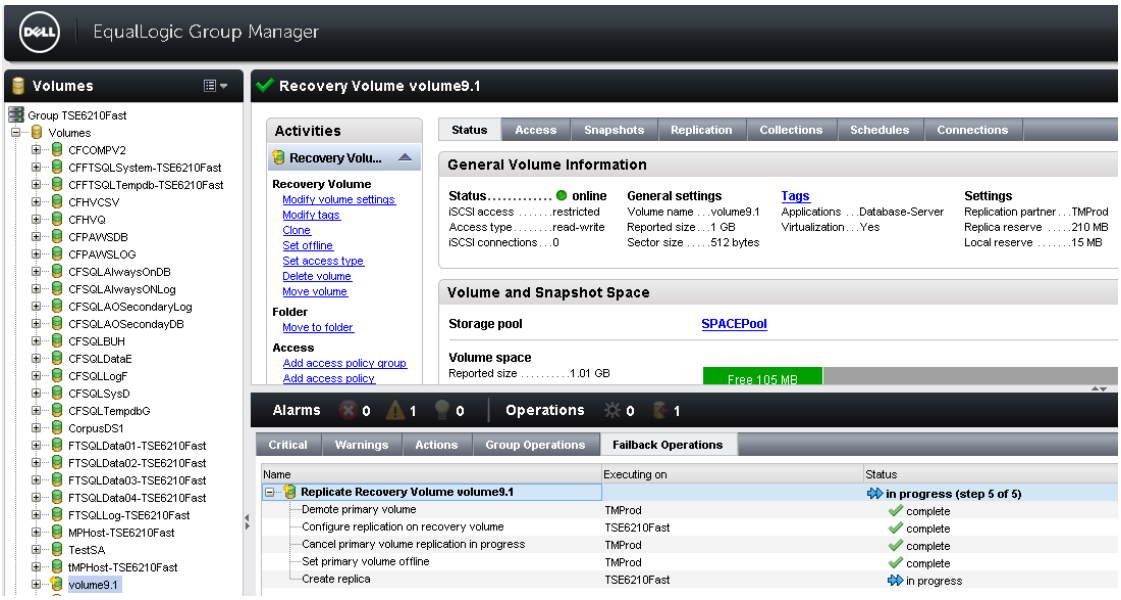
   For additional information on the Manual Transfer Utility, refer to the *Manual Transfer Utility Version 1.2.3 Installation and User's Guide* on eqlsupport.dell.com

4. Optionally, choose to **Remember these credentials in this session**.
5. Click **OK**.

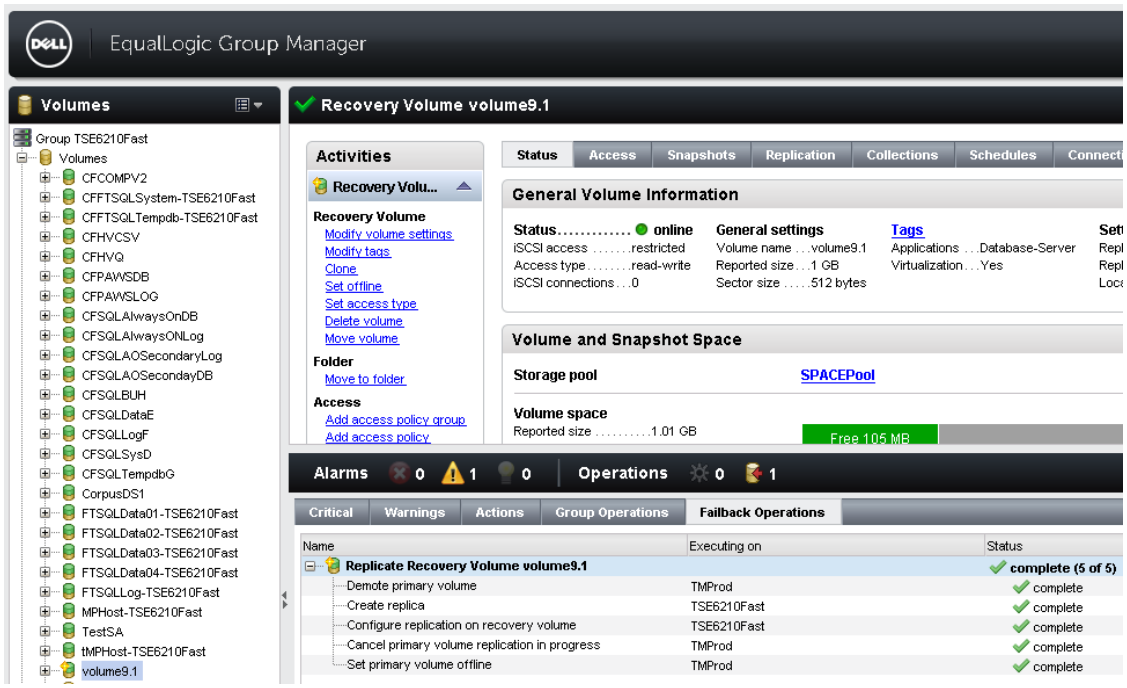


The following occurs:

a. The primary group demotes the original volume to a failback replica set.
b. The secondary group replicates the recovery volume to the primary group (shown below).



6. Replication completes, as shown below.

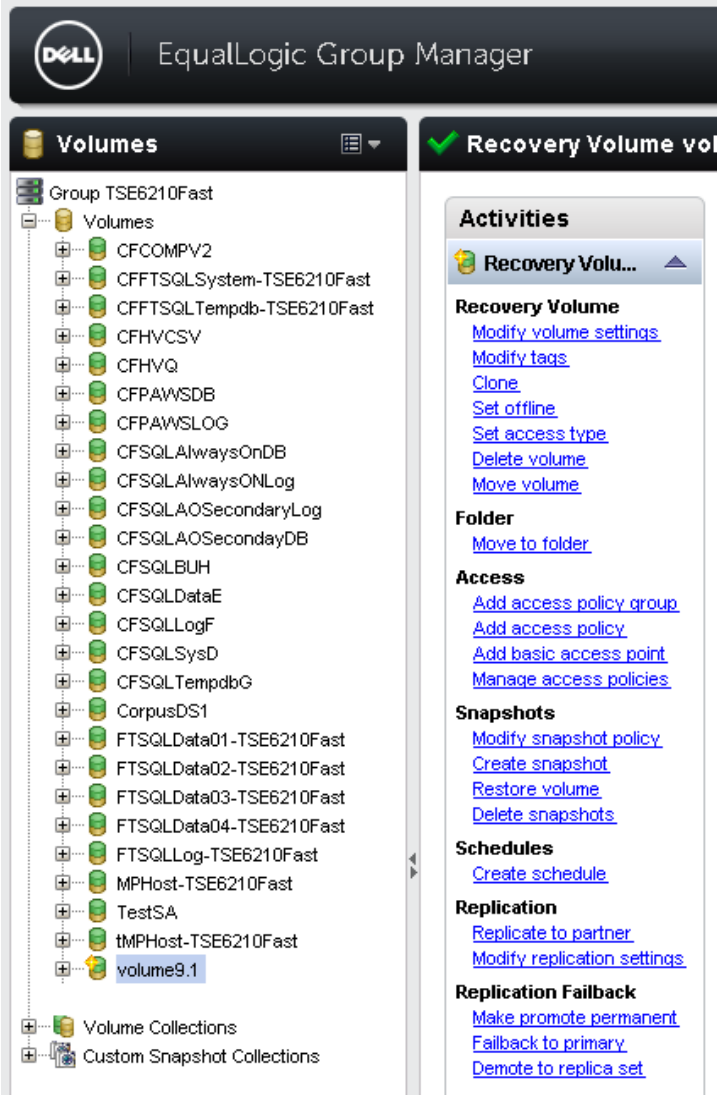


Note: If you do not plan to failback soon, set up a replication schedule on the recovery volume (section 3.1.1).

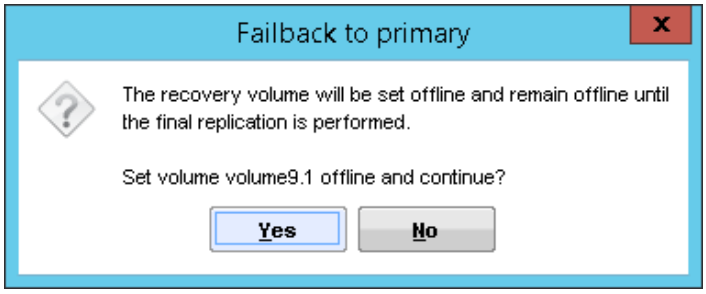
5.1.7 Failback a recovery volume to primary

If a failure or maintenance in the primary group makes a volume unavailable, you can fail over to the secondary group by promoting to a recovery volume (section 5.1.4) to allow hosts to access it. If the primary group becomes available, you can failback to the primary group.

1. From the host operating system, disconnect active connections to the primary volume, if required.
2. In Group Manager, on the secondary group, select the **Volumes** view.
3. Right-click the recovery volume and select **Failback to primary**.



4. Click **Yes** to set the Recovery Volume offline and failback to the primary group.



5. Enter the account name and password.
6. Optionally, choose to **Perform manual replication** with the Manual Transfer Utility.

   For additional information on the Manual Transfer Utility, refer to the *Manual Transfer Utility Version 1.2.3 Installation and User's Guide* on eqlsupport.dell.com

7. Optionally, choose **Remember these credentials in this session**.
8. Click **OK**.

The following occurs:

a. The secondary group performs one final replication to transfer any changes since the last replication. This synchronizes the data between the two groups.
b. The secondary group demotes the recovery volume to a replica set (its original status).
c. The primary group promotes the failback replica set to a volume. It now contains all the data that was in the recovery volume.

9. You can then connect to the volume again (section 5.1.5) from the host operating system using the primary group discovery address.

6 Troubleshooting

This section addresses common problems with replication.

6.1.1 Replication fails due to lack of local replication reserve

Local replication reserve is the amount of space needed on the original group to keep track of changes that occur to the volume while it is being replicated. A volume can run out of local replication reserve if the volume grows in size (for example, a thin-provisioned volume that increases automatically), or if more data is written to the volume than originally planned.

If a replication fails because there is not enough local replication reserve, do one or both of the following:

- Increase the replication reserve if there is enough free space on the group
- Allow the volume to borrow from free pool space (free space must be available). For more information on space borrowing, refer to *Space Borrowing for Snapshots and Replicas*.

6.1.2 Replication times out or cannot complete before the next scheduled replication

If you have a very large, busy volume with data that changes frequently, a lot of data must be replicated at each scheduled interval. If your replication schedule is set to replicate too often, the previous replication may not have had time to complete before the next one is scheduled to begin. You can try any or all of the following:

- Increase the interval between replications to allow more time for transfers to complete.
- If the network is too congested at the times the schedule is trying to run, adjust the run time to a less-busy time of day.
- Increase network bandwidth, or add a WAN optimizer.
- For very large transfers, or if the network bandwidth is insufficient, use the Manual Transfer Utility to transfer the data using removable media, taking the replication completely off the network.

Note: You cannot create a schedule for manual transfers. For additional information on the Manual Transfer Utility, please refer to the *Manual Transfer Utility Version 1.2.3 Installation and User's Guide* on eqlsupport.dell.com.

6.1.3 Not enough replicas are being kept

If you have adjusted the frequency of a replication schedule and are now replicating more often but transferring less data each time, you may want to increase the number of replicas being stored on the partner.

For example, if you originally set up a schedule to replicate once per day and keep a week's worth of replicas (7), but then increase the frequency to twice per day, the replica set will still contain only 7

replicas; that is, 3.5 days' worth of replicas, not 7 days. Therefore, in this scenario, you could increase the maximum-keep value to 14.

You can increase (or decrease) the maximum-keep value at any time. Additionally, you may also consider increasing the volume's replica reserve to handle the increased number of replicas you want to keep.

6.1.4 Interactions with other programs that create replicas

If you are using Dell PS Series Host Integration Tools such as Auto-Snapshot Manager/Microsoft Edition (ASM/ME) or Virtual Storage Manager for VMware (VSM/VMware), it is important to understand the replication interactions with Group Manager.

Administrators of the PS Series group can create replicas manually, through schedules, or both. This is also true for administrators using ASM/ME and VSM/VMware. Replicas created by any of these methods all use the same space on the replication partner. Therefore, if you have a schedule that runs through ASM/ME or VSM/VMware, and a schedule on the same volume running through Group Manager, those replicas will compete for the volume's replica reserve.

Similarly, administrators of both the PS Series group and ASM/ME or VSM/VMware can use replicas to restore volumes and to replicate back to the original group. Therefore, avoid having multiple administrators attempting to replicate the same volume using different methods.

A Additional resources

A.1 Technical support and customer service

Offering online and telephone-based support and service options, Dell support service can answer your questions about PS Series arrays, groups, volumes, array software, and host software. Availability varies by country and product, and some services might not be available in your area.

Visit Dell.com/support or call 800-945-3355 (United States and Canada).

For international support of Dell PS Series products, visit http://www.dell.com/support/contents/us/en/555/article/Product-Support/Dell-Subsidiaries/equallogic

Note: If you do not have access to an Internet connection, contact information is printed on your invoice, packing slip, bill, or Dell product catalog.

For PS Series software and documentation, visit eqlsupport.dell.com.

A.2 Dell online services

Learn more about Dell products and services using this procedure:

1. Visit Dell.com or the URL specified in any Dell product information.
2. Use the locale menu or click on the link that specifies your country or region.

A.3 Dell PS Series storage solutions

To learn more about current and upcoming Dell PS Series solutions, visit the Dell TechCenter site: http://delltechcenter.com/page/EqualLogic. Here you can find articles, demos, online discussions, technical documentation, and more details about the PS Series product family.

For PS Series technical content, visit the EqualLogic Technical Content page on Dell TechCenter.

Dell Storage technical content can be found on the Storage Applications Engineering page.

A.4 Related documentation

See the following referenced or recommended resources related to this document.

- Dell PS Series *Group Manager Administrator's Manual* at eqlsupport.dell.com
- *Manual Transfer Utility Version 1.2.3 Installation and User's Guide* at eqlsupport.dell.com
- Dell PS Series *Group Manager CLI Reference Guide* at eqlsupport.dell.com
- *Dell EqualLogic PS Series Array: Understanding Synchronous Replication (SyncRep)*
- *Space Borrowing for Snapshots and Replicas*