Managing disaster recovery with IBM System Storage SAN Volume Controller and IBM Storwize family

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Abstract

This white paper attempts to provide high-level steps to check the functionality of the IBM System Storage replication feature on IBM Storwize and IBM System Storage SAN Volume Controller (SVC) platforms with various disaster recovery scenarios.

Introduction

The explosive growth of data has triggered a tremendous growth of different data storage devices and protection technologies.

Data is modified on a continuous basis and businesses use the storage replication technologies for data protection and business continuity.

IBM® System Storage® SAN Volume Controller and IBM Storwize® family provides three different replication types for business continuity based on the recovery point objectives (RPOs).

- Metro Mirror
- Global Mirror
- Global Mirror with Change Volume

You can configure these three replication types over Fibre Channel (FC), Fibre Channel over Ethernet (FCoE), or IP-based replication partnerships. However, care must be taken to choose the best combination to suit your specific requirements. For example, Global Mirror with change volume is the recommended method of replication with Storwize native IP-based replications.

This paper describes the SVC and Storwize specific disaster recovery related procedures that include:

- Making the production data available on a disaster recovery storage system for business continuity
- Reverting back to normal (production on primary site and resume normal replication)

All procedures in this paper are described with Global Mirror with Change Volume as the replication type.

Disaster recovery procedures are carried out during disaster recovery tests, drills, or actual disaster recovery exercises to test the usability of the data or to resume production at the disaster recovery site.

Disaster recovery procedures can be classified into the following scenarios.

- Disaster recovery site data validation
- Planned failover
- Unplanned failover
- Fail back to primary site
In the following sections, each scenario is covered with the procedure considering Global Mirror with Change Volume as an example.

**Lab setup and initial state**

In the lab setup, there is an IBM Storwize V5000 system on the primary site and a Storwize V5000 system on the secondary site. As shown in the following figure, there is one consistency group, dc_dr_gmcv, that has four relationships and the replication type is Global Mirror with Change volume.

The initial data copy has completed and Global Mirror with Change Volume is currently running normal replication cycles. The freeze time indicates the time when the last consistent image is present at the disaster recovery site. This is based on when the cycle was last triggered at the data center site and completed after copying the changes to disaster site.

Note that in this setup, the normal replication direction is from the *master* to the *auxiliary* volume which means that the **master volume** is the primary volume.

![Data center site view of consistency group](image)

**Figure 1: Data center site view of consistency group**

**Disaster recovery site data validation**

The objective of a disaster recovery site data validation activity is specifically to test availability and usability of the replicated data at the disaster recovery site without actually affecting the business operations, applications, or databases at the primary site. In this scenario, the production application / database remains up and works from the primary site.

After the data at the disaster recovery site has been validated the replication is resumed in normal direction.
It is a good practice to perform a disaster recovery site data validation soon after the replication is set up and initial data copy is complete. This ensures that the data on the disaster recovery site is usable in case of unavailability of the primary site.

**Procedure to perform disaster recovery site data validation**

You need to perform the following storage-related tasks from either the data center or the disaster recovery Storwize system.

1. For an application consistent copy at the disaster recovery site for testing, place the database in a hot backup mode and wait for the time stamp on the consistency group to update to a time stamp that is after the time the database was put into the backup mode. (This step is not mandatory if the data validation can be performed using a crash consistent copy.)

2. While the database is still in the hot backup mode, go to the Storwize graphical user interface (GUI) and click **Copy Services -> Remote Copy**. Then, right-click the consistency group for which you want to test the data and click **Stop**.

![Figure 2: Stop consistency group at the data center site](image)

3. On the **Stop Remote-Copy Consistency Group** pop-up window, select the **Allow secondary read/write access** check box and click **Stop Consistency Group**.

![Figure 3: Allow read/write access to secondary volumes](image)

4. On the task progress window, click **Close** after the task is completed.
5. Confirm that the consistency group state is **Idling**, as shown in the following figure.

If you had put your database in backup mode at the start of the procedure, you may bring your production database out of the backup mode at this point and proceed with verification of data on the Volumes on the disaster recovery Storwize system (that is, present the volumes to your disaster recovery host, bring up the database and run your test procedures).
After you are done with the testing, perform the following steps to bring the replication to normal cycles.

1. Bring your disaster recovery hosts, application, and database down.
2. Open the Storwize GUI and click **Copy Services → Remote Copy**. Then, right-click the consistency group and click **Start**.

![Figure 6: Start consistency group at the data center site](image)

3. In this example, the normal replication direction is from *master* to *auxiliary*. You need to be careful not to select the wrong option, as that would result in overwriting the primary volume data with the auxiliary volume data.

In the **Start Remote-Copy Consistency Group** window, select *Master is Primary* and click **Start Consistency Group**.

![Figure 7: Choose remote copy direction while starting consistency group](image)

4. On the task progress window, click **Close** after the task is completed.
5. Verify that the consistency group shows the normal replication direction and the freeze time. **Freeze time** will be displayed when one replication cycle gets completed successfully after you start the consistency group.

**Figure 8: Confirmation message after starting consistency group**

![Figure 8: Confirmation message after starting consistency group]

**Figure 9: Remote copy relationship status with freeze time**

![Figure 9: Remote copy relationship status with freeze time]

**Planned failover**

As the name suggests, a planned failover is a controlled failover procedure to test and validate the working of the disaster recovery solution and disaster recovery readiness in case of an actual disaster. Planned failovers are generally carried out for disaster recovery drills or planned maintenance at the primary site.

In a planned failover, production operations are gracefully brought down on the primary site and applications and databases are brought up and hoisted from the disaster recovery site for a known duration.
Procedure to perform a planned failover

To perform a planned failover at the data recovery site in an IBM SVC or a Storwize environment with Global Mirror with Change Volume as the replication type, perform the following steps.

The following screen captures the initial state of the lab setup where there is a consistency group dc_dr_gmcv with four relationships. The initial data copy is complete and the Global Mirror with Change Volume is currently running normal replication cycles. The freeze time indicates the time of the last consistent image that is present at the disaster recovery site. This is based on when the cycle was last triggered at the data center site and completed after copying the changes to disaster site. Note that the current replication direction is from the master volume to the auxiliary volume which means that the master volume is the primary volume.

1. Carefully bring your application / database and host down, and wait for the time stamp on the consistency group to update to a time stamp that is after the time the host was brought down (at least one cycle should have been completed successfully after the application / host was brought down).

2. In the Storwize GUI (for the data center / disaster recovery site), click Copy Services → Remote Copy. Then, right-click the consistency group and click Stop.
3. In the Stop Remote-Copy Consistency Group window, select the **Allow secondary read/write access** check box and click **Stop Consistency Group**.

![Figure 11: Stop remote copy consistency group before starting failover activity](image)

4. In the task progress window, click **Close** after the task is completed.

![Figure 12: Stop consistency group by allowing read/write access to secondary volumes](image)

5. Confirm that the consistency group state is **Idling**, as shown in the following figure.

![Figure 13: Confirmation message after stopping the remote copy consistency group](image)
At this point you may, bring your host, database and application up on the disaster recovery side and proceed with other relevant steps to bring your production environment up from disaster recovery site.

After your production environment is up on the disaster recovery site, you may start replicating the data from the disaster recovery to data center.

Since this is a planned failover, your primary data center systems may still be up and available (unless they are to be brought down for some reasons, for example: maintenance. In that case ignore further steps in this section).

To start replicating the volumes in the Consistency Group from disaster recovery to data center, while you run your production environment from the disaster recovery site, perform the following steps from any of the Storwize systems.

6. In the Storwize GUI, click **Copy Services → Remote Copy**. The following figure shows that the state of the consistency group is **Idling** at this point.
7. Right-click the consistency group and click **Start**.

8. In the **Start Remote Copy Consistency Group** window, select **Auxiliary is Primary** and click **Start Consistency Group** (at this point, production is run from the disaster recovery site, and because the data on this site is more recent, auxiliary should be the source).

9. In the task progress window, click **Close** after the task is completed.
Verify that the replication direction for this consistency group is now from the secondary system to the primary system. After starting the consistency group, verify that there is a freeze time displayed after the first replication cycle.

**Unplanned failover**

An unplanned failover is an actual disaster recovery scenario where the production systems become unavailable unexpectedly. The production application/database is brought up on the disaster recovery site and the disaster recovery serves as the production site till the time the actual production site is available again for a failback.

As this is an unplanned failure of the production site, there might or might not be any data loss depending on whether you were using Metro Mirror, Global Mirror or Global Mirror with Change Volumes.

Data loss with a Metro Mirror is always zero, and that of Global Mirror is near zero. However, Global Mirror with Change Volumes can be configured as per different RPO needs.
Procedure to perform an unplanned failover

In this scenario, access to systems at the primary site is lost. Figure 20 shows that the Secondary Storwize system with consistency group `dc_dr_gmcv" has four relationships. The initial data copy has been completed and Global Mirror with Change Volume was running normal replication cycles when there was a disaster in data center due to which the state of the consistency group is reported as Consistent Disconnected. The freeze time indicates the time when the last consistent image is present at the disaster recovery site. This is based on when the cycle was last triggered at the data center site and completed after copying the changes to disaster site. Note that the replication direction was from the master volume to the auxiliary volume, which means that the master volume is the primary volume.

Figure 20: Remote copy consistency group status is consistent disconnected due disaster at data center

To perform a failover to the disaster recovery site in the IBM SVC / Storwize environment with Global Mirror with Change Volume as the replication type, perform the following steps.

Because the primary Storwize is unreachable in this scenario, the secondary Storwize is used to perform the failover steps.

1. Stop the consistency group with the read/write access to the consistency group target volumes from the command-line interface (CLI).

   ```
   stoprcconsistgrp -access cgname
   ```

   Where `cgname` is the name of the consistency group you are operating on.

   Or,

   ```
   stoprcconsistgrp -access x
   ```

   Where `x` is the ID of the consistency group you are operating on.

   After running the command, the consistency group status changes to Idling Disconnected as shown in the following figure.
2. Bring your host / database / application up on the disaster recovery site and start your production environment from the disaster recovery site.

**Failback**

After the primary site is up and available, perform the failback procedure to resume production environment from the primary site.

**Procedure to perform a failback operation**

At this point, you have brought your data center site up. However, the data on your disaster recovery site is more recent as you have been running your production environment from your disaster recovery site since your primary site went down.

After the data center site comes up and failback operations need to be performed, in the Storwize GUI, click Copy Services → Remote Copy.

As shown in the following figure, the state has now changed from Idling Disconnected to Idling after the link issues are fixed.
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The next step is to start the replication from disaster recovery to data center (because data on your disaster recovery site is more recent).

1. In the Storwize GUI, click **Copy Services → Remote Copy GUI**. Then, right-click the consistency group and click **Start**.

2. In the **Start Remote-Copy Consistency Group** window, select **Auxiliary is primary** and click **Start Consistency Group**.

---

*Figure 22: Remote copy consistency group status changed to idling after fixing the link issue*

*Figure 23: Start remote copy consistency group which is in idling state now*

*Figure 24: Select auxiliary volumes as primary volumes for remote copy and then start consistency group*
You need to select **Auxiliary is primary**, because the data on the auxiliary volumes is more recent and you need to replicate from the disaster recovery site to the data center site.

3. In the task progress window, click **Close** after the task is completed.

![Confirmation message after string remote copy consistency group](image)

**Figure 25: Confirmation message after string remote copy consistency group**

4. Verify that the replication direction for this consistency group is now from the secondary system to the primary system. After starting the consistency group verify that there is a freeze time displayed after the first replication cycle.

![Replication is from disaster recovery site to the data center site](image)

**Figure 26: Replication is from disaster recovery site to the data center site**

The following figure shows that the replication has finished copying the initial data and doing normal cycles now.
At this point, you are ready to perform a failover / failback to the primary Storwize which is currently your disaster recovery counterpart.

Perform the following steps for a failback operation.

1. For an application consistent copy at the data center site for failback, gracefully bring your application / database and host down and wait for the time stamp on the consistency group to update to a time stamp that is after the time the host was brought down.

2. In the Storwize GUI click **Copy Services → Remote Copy**. Then, right-click the consistency group and click **Stop**.

3. On the **Stop Remote-Copy Consistency Group** window, select the **Allow secondary read/write access** check box and click **Stop Consistency Group**.
4. In the task progress window, click **Close** after the task is completed.

Figure 30: Confirmation message after stopping the remote copy consistency group

5. Confirm that the consistency group state is **Idling**, as shown in the following figure.

Figure 31: Remote copy consistency group will be in idling state after stopping the relationship
At this point you might bring your host, database, and application up on the data center site and proceed with other relevant steps to start the production environment from primary data center.

After your production environment is up on the data center site, you may start replicating the data back from the data center to disaster recovery.

To start replicating the consistency group from data center to disaster recovery while you are again running your production environment from the data center site after a failback, perform the following steps from any of the Storwize systems to resume normal replication.

1. In the Storwize GUI, click **Copy Services → Remote Copy**. The following figure shows that the state of the consistency group is **idling** at this point.

   ![Remote copy consistency group in idling state before starting it](image)

   **Figure 32: Remote copy consistency group in idling state before starting it**

2. Right-click the consistency group and click **Start**.

   ![Start remote copy consistency group to start replication from data center to disaster recovery](image)

   **Figure 33: Start remote copy consistency group to start replication from data center to disaster recovery**

3. In the **Start Remote Copy Consistency Group** window, select **Master is primary** and click **Start Consistency Group**.
On the task progress window, click Close after the task is completed.

Verify that the replication direction for this consistency group is now from the primary system to secondary system. After starting consistency group verify that there is a freeze time displayed after the first replication cycle.

At this point, you are back to your business as usual state for replication and running your production environment from your primary site.
Resources

The following websites provide useful references to supplement the information contained in this paper.

- IBM Storwize V7000 Support page
  ibm.com/storage/support/storwize/v7000

- IBM Storwize V7000 home page
  ibm.com/systems/storage/news/center/storwize_v7000/index.html

- IBM Storwize V7000 Supported hardware list
  ibm.com/support/docview.wss?uid=ssg1S1003703

- IBM Storwize V7000 Knowledge Center
  ibm.com/support/knowledgecenter/ST3FR7/welcome

- IBM Redbooks publications about IBM Storwize V7000
  ibm.com/redbooks/cgi-bin/searchsite.cgi?query=v7000

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