Async concepts

SANtricity software

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Async concepts

How asynchronous mirroring works in SANtricity System Manager

Asynchronous mirroring copies data volumes on demand or on a schedule, which minimizes or avoids downtime that might result from data corruption or loss.

Asynchronous mirroring captures the state of the primary volume at a particular point in time and copies just the data that has changed since the last image capture. The primary site can be updated immediately and the secondary site can be updated as bandwidth allows. The information is cached and sent later, as network resources become available.

This type of mirroring is ideal for satisfying the demand for non-stop operations and, in general, is far more network efficient for periodic processes, such as backup and archive. The reasons for using asynchronous mirroring include the following:

- Remote backup consolidation.
- Protect against local or wide-area disasters.
- Application development and testing on a point-in-time image of live data.

Asynchronous mirroring session

Asynchronous mirroring captures the state of the primary volume at a particular point in time and copies just the data that has changed since the last image capture. Asynchronous mirroring allows the primary site to be updated immediately and the secondary site to be updated as bandwidth allows. The information is cached and sent later, as network resources become available.
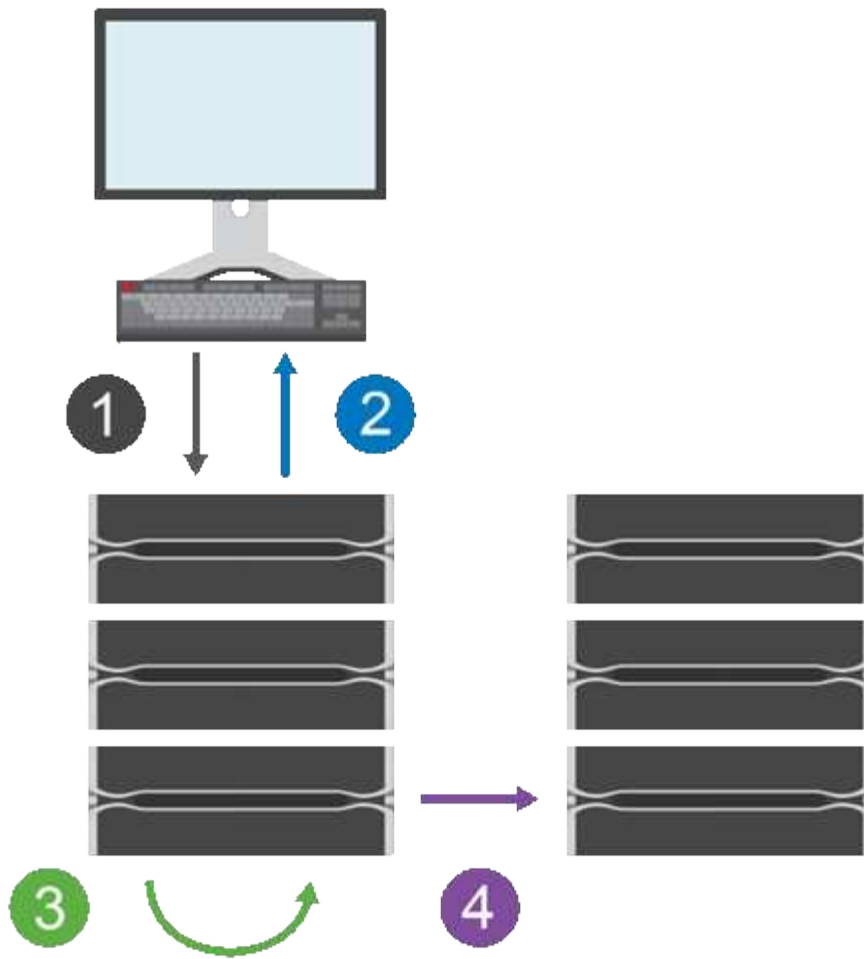
There are four primary steps in an active asynchronous mirroring session.

1. A write operation first occurs on the primary volume's storage array.

2. The status of the operation is returned to the host.

3. All changes on the primary volume are logged and tracked.

4. All changes are sent to the secondary volume's storage array as a background process.

These steps are repeated according to the defined synchronization intervals or the steps can be repeated manually if no intervals are defined.

Asynchronous mirroring transfers data to the remote site only at set intervals, so local I/O is not affected nearly as much by slow network connections. Because this transfer is not tied to the local I/O, it does not affect application performance. Therefore, asynchronous mirroring can use slower connections, such as iSCSI, and run across longer distances between the local and remote storage systems.

The storage arrays must have a minimum firmware version of 7.84. (They can each run different OS versions.)

Mirror consistency groups and mirrored pairs

You create a mirror consistency group to establish the mirroring relationship between the local storage array and the remote storage array. The asynchronous mirroring relationship consists of a mirrored pair: a primary volume on one storage array and a secondary volume on another storage array.

The storage array containing the primary volume is usually located at the primary site and serves the active hosts. The storage array containing the secondary volume is usually located at a secondary site and holds a replica of the data. The secondary volume typically contains a backup copy of the data and is used for disaster

recovery.

Synchronization settings

When you create a mirrored pair, you also define the synchronization priority and resynchronization policy that the mirrored pair uses to complete the resynchronization operation after a communication interruption.

When you create a mirror consistency group, you also define the synchronization priority and resynchronization policy for all mirrored pairs within the group. The mirrored pairs use the synchronization priority and resynchronization policy to complete the resynchronization operation after a communication interruption.

The primary and secondary volumes in a mirrored pair can become unsynchronized when the primary volume's storage array is unable to write data to the secondary volume. This condition can be caused by the following issues:

- Network problems between the local and remote storage arrays.
- A failed secondary volume.
- Synchronization being manually suspended on the mirrored pair.
- Mirror group role conflict.

You can synchronize data on the remote storage array either manually or automatically.

Reserved capacity and asynchronous mirroring

Reserved capacity is used to keep track of differences between the primary and secondary volume when synchronization is not occurring. It also keeps track of synchronization statistics for each mirrored pair.

Each volume in a mirrored pair requires its own reserved capacity.

Configuration and management

To enable and configure mirroring between two arrays, you must use the Unified Manager interface. Once mirroring is enabled, you can manage mirrored pairs and synchronization settings in System Manager.

Learn about asynchronous mirroring terminology in SANtricity software

Learn how the asynchronous mirroring terms apply to your storage array.

Term	Description
Local storage array	The local storage array is the storage array that you are acting upon. When you see **Primary** in the Local Role column, it indicates that the storage array contains the volume that holds the primary role in the mirror relationship. When you see **Secondary** in the Local Role column, it indicates that the storage array contains the volume that holds the secondary role in the mirror relationship.

Term	Description
Mirror consistency group	A mirror consistency group is a container for one or more mirrored pairs. For asynchronous mirroring operations, you must create a mirror consistency group.
Mirrored pair	A mirrored pair is comprised of two volumes, a primary volume and a secondary volume. In asynchronous mirroring, a mirrored pair always belongs to a mirror consistency group. Write operations are performed first to the primary volume and then replicated to the secondary volume. Each mirrored pair in a mirror consistency group share the same synchronization settings.
Primary volume	The primary volume of a mirrored pair is the source volume to be mirrored.
Remote storage array	The remote storage array is usually designated as the secondary site, which usually holds a replica of the data in a mirroring configuration.
Reserved capacity	Reserved capacity is the physical allocated capacity that is used for any copy service operation and storage object. It is not directly readable by the host.
Role change	Role change is assigning the primary role to the secondary volume and vice versa.
Secondary volume	The secondary volume of a mirrored pair is usually located at a secondary site and holds a replica of the data.
Synchronization	Synchronization occurs at initial synchronization between the local storage array and the remote storage array. Synchronization also occurs when the primary and secondary volumes become unsynchronized after a communication interruption. When the communication link is working again, any unreplicated data is synchronized to the secondary volume's storage array.

Mirror a volume asynchronously in SANtricity software

You configure asynchronous mirroring using the following workflow.

1. Perform the initial configuration in Unified Manager:

   a. Select the local storage array as the source for the data transfer.

   b. Create or select an existing mirror consistency group, which is a container for the primary volume on the local array and the secondary volume on the remote array. The primary and secondary volumes are referred to as the "mirrored pair." If you are creating the mirror consistency group for the first time, you specify whether you want to perform manual or scheduled synchronizations.

   c. Select a primary volume from the local storage array, and then determine its reserved capacity. Reserved capacity is the physical allocated capacity to be used for the copy operation.

   d. Select a remote storage array as the destination of the transfer, a secondary volume, and then determine its reserved capacity.

e. Begin the initial data transfer from the primary volume to the secondary volume. Depending on the volume size, this initial transfer could take several hours.

2. Check the progress of the initial synchronization:

    a. In Unified Manager, launch System Manager for the local array.

    b. In System Manager, view the status of the mirroring operation. When mirroring is complete, the status of the mirrored pair is "Optimal."

3. **Optional:** You can reschedule or manually perform subsequent data transfers in System Manager. Only new and changed blocks are transferred from the primary volume to the secondary volume.

> (i) Because asynchronous replication is periodic, the system can consolidate the changed blocks and conserve network bandwidth. There is minimal impact on write throughput and write latency.

Requirements for using asynchronous mirroring in SANtricity software

If you plan to use asynchronous mirroring, keep the following requirements in mind.

Unified Manager

To enable and configure mirroring between two arrays, you must use the Unified Manager interface. Unified Manager is installed on a host system along with the Web Services Proxy.

- The Web Services Proxy service must be running.
- Unified Manager must be running on your local host through an HTTPS connection.
- Unified Manager must be showing valid SSL certificates for the storage array. You can accept a self-signed certificate or install your own security certificate using Unified Manager and navigating to **Certificate › Certificate Management**.

Storage arrays

- You must have two storage arrays.
- Each storage array must have two controllers.
- The two storage arrays must be discovered in Unified Manager.
- Each controller in both the primary array and secondary array must have an Ethernet management port configured and must be connected to your network.
- The storage arrays have a minimum firmware version of 7.84. (They can each run different OS versions.)
- You must know the password for the local and remote storage arrays.
- You must have enough free capacity on the remote storage array to create a secondary volume equal to or greater than the primary volume that you want to mirror.
- Your local and remote storage arrays are connected through a Fibre Channel fabric or iSCSI interface.

Supported connections

Asynchronous mirroring can use either FC or iSCSI connections, or both for communication between local and

remote storage systems. At the time of creating a mirror consistency group, the administrator can select either FC or iSCSI for that group if both are connected to the remote storage array. There is no failover from one channel type to the other.

Asynchronous mirroring uses the storage array's host-side I/O ports to convey mirrored data from the primary side to the secondary side.

- **Mirroring through a Fibre Channel (FC) interface**

  Each controller of the storage array dedicates its highest numbered FC host port to mirroring operations.

  If the controller has both base FC ports and host interface card (HIC) FC ports, the highest numbered port is on an HIC. Any host logged on to the dedicated port is logged out, and no host login requests are accepted. I/O requests on this port are accepted only from controllers that are participating in mirroring operations.

  The dedicated mirroring ports must be attached to an FC fabric environment that supports the directory service and name service interfaces. In particular, FC-AL and point-to-point are not supported as connectivity options between the controllers that are participating in mirror relationships.

- **Mirroring through an iSCSI interface**

  Unlike FC, iSCSI does not require a dedicated port. When asynchronous mirroring is used in iSCSI environments, it is not necessary to dedicate any of the storage array's front-end iSCSI ports for use with asynchronous mirroring; those ports are shared for both asynchronous mirror traffic and host-to-array I/O connections.

  The controller maintains a list of remote storage systems with which the iSCSI initiator attempts to establish a session. The first port that successfully establishes an iSCSI connection is used for all subsequent communication with that remote storage array. If communication fails, a new session is attempted using all available ports.

  iSCSI ports are configured at the array level on a port-by-port basis. Intercontroller communication for configuration messaging and data transfer uses the global settings, including settings for:

  - VLAN: Both local and remote systems must have the same VLAN setting to communicate
  - iSCSI listening port
  - Jumbo frames
  - Ethernet priority

    ⓘ The iSCSI intercontroller communication must use a host connect port and not the management Ethernet port.

  Asynchronous mirroring uses the storage array's host-side I/O ports to convey mirrored data from the primary side to the secondary side. Because asynchronous mirroring is intended for higher-latency, lower-cost networks, iSCSI (and thus TCP/IP-based) connections are a good fit for it. When asynchronous mirroring is used in iSCSI environments, it is not necessary to dedicate any of the array's front-end iSCSI ports for use with asynchronous mirroring; those ports are shared for both asynchronous mirror traffic and host-to-array I/O connections

ⓘ E4000 does not support asynchronous mirroring while using iSCSI protocol.

Mirrored volume candidates

- RAID level, caching parameters, and segment size can be different on the primary and secondary volumes of an asynchronous mirrored pair.

> ⓘ For EF600 and EF300 controllers, the primary and secondary volumes of an asynchronous mirrored pair must match the same protocol, tray level, segment size, security type, and RAID level. Non-eligible asynchronous mirrored pairs will not appear in the list of available volumes.

- The secondary volume must be at least as large as the primary volume.

- A volume can participate in only one mirror relationship.

- Volume candidates must share the same Data Security capabilities.
    - If the primary volume is FIPS capable, the secondary volume must be FIPS capable.
    - If the primary volume is FDE capable, the secondary volume must be FDE capable.
    - If the primary volume is not using Drive Security, the secondary volume must not be using Drive Security.

- Primary and secondary volumes must share the same drive type. Mixing of NVMe and SAS drives between primary and secondary volumes is not supported.

- Primary and secondary volumes must not have Resource Partitioning enabled.

Reserved capacity

- A reserved capacity volume is required for a primary volume and for a secondary volume in a mirrored pair for logging write information to recover from controller resets and other temporary interruptions.

- Because both the primary volume and the secondary volume in a mirrored pair require additional reserved capacity, you must ensure that you have free capacity available on both storage arrays in the mirror relationship.

- The reserved capacity volume must share the same drive type as its associated mirror volumes.
    - If the reserved capacity volume is created on NVMe drives, its mirror volumes must also be created on NVMe drives.
    - If the reserved capacity volume is created on SAS drives, its mirror volumes must also be created on SAS drives.

Drive Security feature

- If you are using secure-capable drives, the primary volume and the secondary volume must have compatible security settings. This restriction is not enforced; therefore, you must verify it yourself.

- If you are using secure-capable drives, the primary volume and the secondary volume should use the same drive type. This restriction is not enforced; therefore, you must verify it yourself.

- If you are using Data Assurance (DA), the primary volume and the secondary volume must have the same DA settings.

View asynchronous mirror status in SANtricity System Manager

The mirror status defines the state of mirror consistency groups and mirrored volume pairs.

Status for mirror consistency groups

Status	Description
Synchronizing (initial sync)	The progress of the initial data synchronization that has been completed between the mirrored volume pairs. During an initial synchronization, the volumes can transition to the following states: Degraded/Failed/Optimal/Unknown.
Synchronizing (interval sync)	The progress of the periodic data synchronization that has been completed between the mirrored volume pairs.
System suspended	Storage system-suspended synchronization of data on all mirrored pairs at the mirror consistency group level. At least one mirrored pair in the mirror consistency group is in a Stopped or Failed state.
User suspended	User-suspended synchronization of data on all mirrored pairs at the mirror consistency group level. This state helps to reduce any performance impact to the host application that might occur while any changed data on the local storage array is copied to the remote storage array.
Paused	Data synchronization process has temporarily paused due to an error accessing the remote storage array.
Orphan	An orphaned mirrored pair volume exists when a member volume in a consistency mirror group has been removed on one side of the consistency mirror group (either the primary side or secondary side) but not on the other side. Orphaned mirrored pair volumes are detected when inter-array communication is restored and the two sides of the mirror configuration reconcile mirror parameters. You can remove a mirrored pair to correct an orphaned mirrored pair state.
Role change pending/in-progress	A role change between the mirror consistency groups is pending or in progress. The role reversal change (to either a primary role or secondary role) affects all asynchronous mirrored pairs within the selected mirror consistency group. You can cancel a pending role change, but not an in-progress role change.

Status	Description
Role conflict	A role conflict occurred between mirror consistency groups due to a communication problem between the local storage array and the remote storage array during a role change operation. When the communication problem has been resolved, a Role Conflict occurs. Use the Recovery Guru to recover from this error. A forced promotion is not allowed when resolving a role conflict.

Status for mirrored pairs

A mirrored pair's status indicates whether the data on the primary volume and on the secondary volume is synchronized.

Status	Description
Synchronizing	The progress of initial or periodic data synchronization that has been completed between the mirrored pairs. There are two types of synchronization: initial synchronization and periodic synchronization. The initial synchronization progress is also displayed in the Long Running Operations dialog box.
Optimal	The volumes in the mirrored pair are synchronized, which indicates that the connection between the storage arrays is operational and each volume is in the desired working condition.
Incomplete	The asynchronous mirrored pair is incomplete on the remote storage array because the mirrored pair creation sequence was initiated on a storage array that is not supported with System Manager and the mirrored pair has not been completed on the secondary. The mirrored pair creation process is complete when a volume is added to the mirror consistency group on the remote storage array. This volume becomes the secondary volume in the asynchronous mirrored pair. The mirrored pair completes automatically if the remote storage array is managed by System Manager.
Failed	The asynchronous mirroring operation is unable to operate normally due to a failure with the primary volumes, secondary volumes, or the mirror reserved capacity.

Status	Description
Orphan	An orphaned mirrored pair volume exists when a member volume in a consistency mirror group has been removed on one side of the consistency mirror group (either the primary side or secondary side) but not on the other side. Orphaned mirrored pair volumes are detected when communication is restored between the two storage arrays and the two sides of the mirror configuration reconcile mirror parameters. You can remove a mirrored pair to correct an orphaned mirrored pair state.
Stopped	The mirrored pair is in a Stopped state because the mirror consistency group is in a system-suspended state.

Learn about volume ownership in asynchronous mirroring in SANtricity software

You can change the preferred controller owner in a mirrored pair.

If the primary volume of the mirrored pair is owned by controller A, then the secondary volume will also be owned by controller A of the remote storage array. Changing the primary volume's owner will automatically change the owner of the secondary volume to ensure that both volumes are owned by the same controller. Current ownership changes on the primary side automatically propagate to corresponding current ownership changes on the secondary side.

For example, a primary volume is owned by controller A, and then you change the controller owner to controller B. In this case, the next remote write changes the controller owner of the secondary volume from controller A to B. Because controller ownership changes on the secondary side are controlled by the primary side, they do not require any special intervention by the storage administrator.

Controller resets

A controller reset causes a volume ownership change on the primary side from the preferred controller owner to the alternate controller in the storage array.

Sometimes a remote write is interrupted by a controller reset or a storage array power cycle before it can be written to the secondary volume. The controller does not need to perform a full synchronization of the mirrored pair in this case.

When a remote write has been interrupted during a controller reset, the new controller owner on the primary side reads information stored in a log file in the reserved capacity volume of the preferred controller owner. The new controller owner then copies the affected data blocks from the primary volume to the secondary volume, eliminating the need for a full synchronization of the mirrored volumes.

Change mirror consistency group roles in SANtricity software

You can change the role between mirrored pairs in a mirror consistency group. You can do this by demoting the primary mirror consistency group to the secondary role, or by

promoting the secondary mirror consistency group to the primary role.

Review the following information about the role change operation:

- The role change affects all mirrored pairs within the selected mirror consistency group.
- When a mirror consistency group is demoted to the secondary role, all the mirrored pairs within that mirror consistency group are also demoted to the secondary role and vice versa.
- When the primary mirror consistency group is demoted to the secondary role, hosts that have been assigned to the member volumes within that group no longer have write access to them.
- When a mirror consistency group is promoted to the primary role, any hosts that are accessing the member volumes within that group are now able to write to them.
- If the local storage array is unable to communicate with the remote storage array, you can force the role change on the local storage array.

Force role change

You can force a role change between mirror consistency groups when a communication problem between the local storage array and the remote storage array is preventing the promotion of the member volumes within the secondary mirror consistency group or the demotion of the member volumes within the primary mirror consistency group.

You can force the mirror consistency group on the secondary side to transition to the primary role. Then the recovery host is able to access the newly promoted member volumes within that mirror consistency group, and business operations can continue.

When is a forced promotion allowed and not allowed?

Forced promotion of a mirror consistency group is allowed only if all member volumes of the mirror consistency group have been synchronized and have consistent recovery points.

Forced promotion of a mirror consistency group is not allowed under the following conditions:

- Any of the member volumes of a mirror consistency group are in the process of an initial synchronization.
- Any of the member volumes of a mirror consistency group do not have a point-in-time image of the recovery point (for example, due to a full reserved capacity error).
- The mirror consistency group does not contain member volumes.
- The mirror consistency group is in the Failed, Role-Change-Pending, or Role-Change-In-Progress states, or if any of the associated member volumes or reserved capacity volumes are failed.

Mirror group role conflict

When a communication problem between the local and remote storage arrays has been resolved, a Mirror Group Role Conflict condition occurs. Use the Recovery Guru to recover from this error. A forced promotion is not allowed when resolving a dual-role conflict.

To avoid the Mirror Group Role Conflict condition and subsequent recovery steps, wait until the connection between the storage arrays is operational to force the role change.

Role change in-progress state

If two storage arrays in a mirroring configuration become disconnected, and the primary side of a mirror consistency group is force demoted to a secondary role, and the secondary side of a mirror consistency group is force promoted to a primary role, then when communication is restored, the mirror consistency groups on both storage arrays are placed in the Role-Change-In-Progress state.

The system will complete the role change process by transferring the change logs, re-synchronizing, setting the mirror consistency group state back to a normal operating state, and continuing with periodic synchronizations.