

QReplica 3.0

XCubeSAN Series White Paper

February 2021

ANNOUNCEMENT

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NOTICES

This document is applicable to the following models:

XCubeSAN Storage System 4U 19" Rack Mount Models

MODEL NAME	CONTROLLER TYPE	FORM FACTOR, BAY COUNT, RACK UNIT
XS5224D	Dual Controller	LFF 24-disk 4U Chassis
XS5224S	Single Controller	LFF 24-disk 4U Chassis
XS3224D	Dual Controller	LFF 24-disk 4U Chassis
XS3224S	Single Controller	LFF 24-disk 4U Chassis
XS1224D	Dual Controller	LFF 24-disk 4U Chassis
XS1224S	Single Controller	LFF 24-disk 4U Chassis

XCubeSAN Storage System 3U 19" Rack Mount Models

MODEL NAME	CONTROLLER TYPE	FORM FACTOR, BAY COUNT, RACK UNIT
XS5216D	Dual Controller	LFF 16-disk 3U Chassis
XS5216S	Single Controller	LFF 16-disk 3U Chassis
XS3216D	Dual Controller	LFF 16-disk 3U Chassis
XS3216S	Single Controller	LFF 16-disk 3U Chassis
XS1216D	Dual Controller	LFF 16-disk 3U Chassis
XS1216S	Single Controller	LFF 16-disk 3U Chassis

XCubeSAN Storage System 2U 19" Rack Mount Models

MODEL NAME	CONTROLLER TYPE	FORM FACTOR, BAY COUNT, RACK UNIT
XS5212D	Dual Controller	LFF 12-disk 2U Chassis
XS5212S	Single Controller	LFF 12-disk 2U Chassis
XS3212D	Dual Controller	LFF 12-disk 2U Chassis
XS3212S	Single Controller	LFF 12-disk 2U Chassis
XS1212D	Dual Controller	LFF 12-disk 2U Chassis
XS1212S	Single Controller	LFF 12-disk 2U Chassis
XS5226D	Dual Controller	SFF 26-disk 2U Chassis
XS5226S	Single Controller	SFF 26-disk 2U Chassis
XS3226D	Dual Controller	SFF 26-disk 2U Chassis
XS3226S	Single Controller	SFF 26-disk 2U Chassis
XS1226D	Dual Controller	SFF 26-disk 2U Chassis
XS1226S	Single Controller	SFF 26-disk 2U Chassis

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This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

PREFACE

Executive Summary

Data is usually one of the most valuable assets of an enterprise. This makes data a critical part of the organization's daily operations. Disruptions can occur at any time. Whether it is a planned or unplanned outage, ensuring that the data integrity to the enterprise is always available is a top priority. It is recommended to prepare a plan for critical data to prevent costly interruptions. Data replication solutions can ensure business continuity, high availability and data protection.

QSAN QReplica 3.0 (Remote Replication) provides synchronous and asynchronous replication solutions. These solutions enable you to replicate data to other systems, whether they are located at the same site or remote facilities. Having a remote copy of the data protects you from the failure of the primary system and allows you to recover quickly and easily on the target system. The solutions will help you protect your data and achieve your business goals in terms of data availability and protection.

In short, QReplica 3.0 can provide a complete backup solution for all business scales.

Audience

This document provides technical guidance for designing and implementing “Disaster Recovery” through remote replication feature, and it is intended for use by system administrators, SAN designers, storage consultants, or anyone who has purchased this product and is familiar with server and computer network, network administration, storage system installation and configuration, network attached storage management, and relevant protocols. Any settings which are configured with basic operations will not be detailed in this document. If there is any question, please refer to the user manuals of products, or contact QSAN support for further assistance.

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- Via Telephone: +886-2-77206355
- (Service hours: 09:30 - 18:00, Monday - Friday, UTC+8)
- Via Skype Chat, Skype ID: qsan.support
- (Service hours: 09:30 - 02:00, Monday - Friday, UTC+8, Summer time: 09:30 - 01:00)
- Via Email: support@qsan.com

Information, Tip, and Caution

This document uses the following symbols to draw attention to important safety and operational information.



INFORMATION

INFORMATION provides useful knowledge, definition, or terminology for reference.



TIP

TIP provides helpful suggestions for performing tasks more effectively.



CAUTION

CAUTION indicates that failure to take a specified action could result in damage to the system.

1. INTRODUCTION

QSAN QReplica 3.0 (Remote Replication) provides synchronous and asynchronous replication solutions. With QReplica 3.0 feature, DR (Disaster Recovery) can be achieved with simple and easy orchestration between QSAN platforms. In this document, synchronous and asynchronous replication concepts and detail procedures will be introduced for having best practice of DR mechanism with QSAN platform.

1.1. Start with Disaster Recovery

DR (Disaster Recovery) is about preventing total failure of mission critical business systems and to recover within minimum time and impact. Preventing data loss requires a continuous data protection method. This includes preparation for and recovery from events of human error, software and hardware failure, network down, internal or external power failure and all other events. To beat this challenge, IT managers must plan for redundancy of one or more backup systems at different locations. This involves constant or periodically data duplication to infrastructures at different sites to ensure business continuity from constant availability.

1.1.1. Understanding RPO and RTO

RPO (Recovery Point Objective) and RTO (Recovery Time Objective) are the two most important parameters in a disaster recovery. To achieve continuous data protection, you must understand these 2 key indicators that measure acceptable business risk. These goals can guide companies in choosing the best data backup plan.

- **RPO (Recovery Point Objective):** RPO refers to the maximum amount of data loss that the system can tolerate. It refers to the time point corresponding to the recovered data after the business is restored. The RPO depends on the update level of the data recovery. This update level can be the last day. The backup data can also be 1 hour ago data. This is related to the frequency of data backup. In order to improve RPO, the frequency of data backup must be increased. RPO is an indicator that reflects the integrity of data restored.
- **RTO (Recovery Time Objective):** RTO is the duration of time the system can tolerate service interruption. For example, if the service needs to be restored within half an hour after the occurrence, the RTO value is 30 minutes. The RTO is only the time period between the occurrence of a failure, from the moment when the system goes down and the application

stops, to the time when it is restored to support the operation. RTO is an indicator reflecting the timeliness of business recovery. It indicates the time required for business to recover from interruption to normal. The smaller the RTO value, the stronger the data recovery capability of the disaster recovery system. The IT administrators can deploy many disaster recovery systems. Obtain the smallest RTO, but it means investing a lot of money.

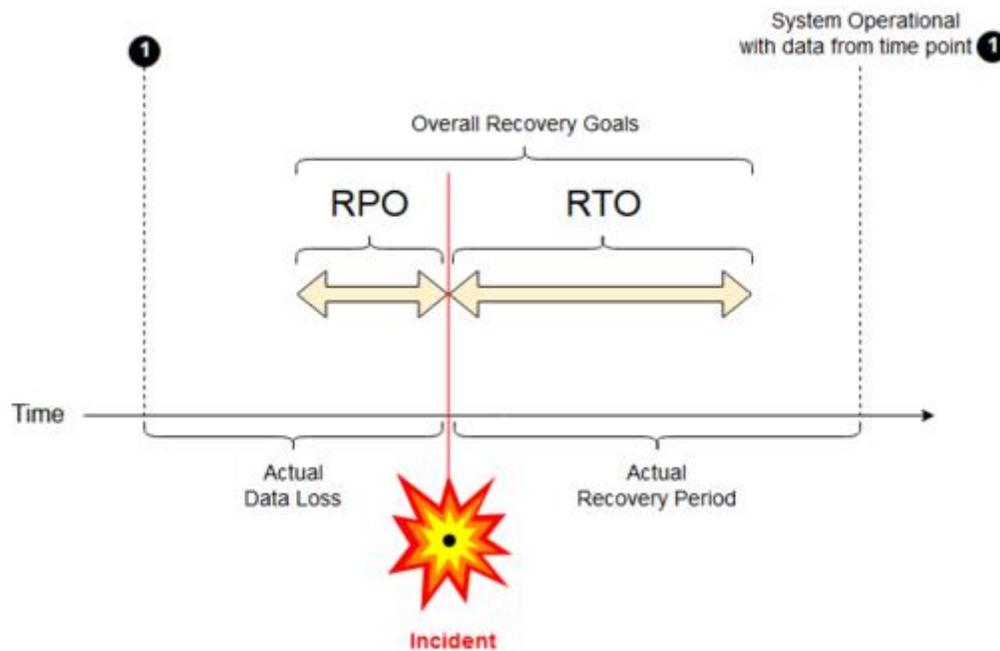


Figure 1-1 RPO and RTO Schematic Representation (from Wikipedia)

In Figure 1-1, the RPO indicator comes from before the failure occurs, and the RTO indicator comes from after the failure occurs. The smaller the value of the two is, the time interval can be effectively shortened from business transition period to normal.



INFORMATION

DR (Disaster Recovery) exercises must be performed regularly to achieve the target RPO (Recovery Point Objective) and RTO (Recovery Time Objective) according to your DR Plan.

1.1.2. How RPO and RTO Impact Business Continuity

In Figure 1-2, traditional backup and recovery techniques (such as tape backup or disk-to-disk) are measured in hours. It will take a long time for them to recover, such as several hours to several days.

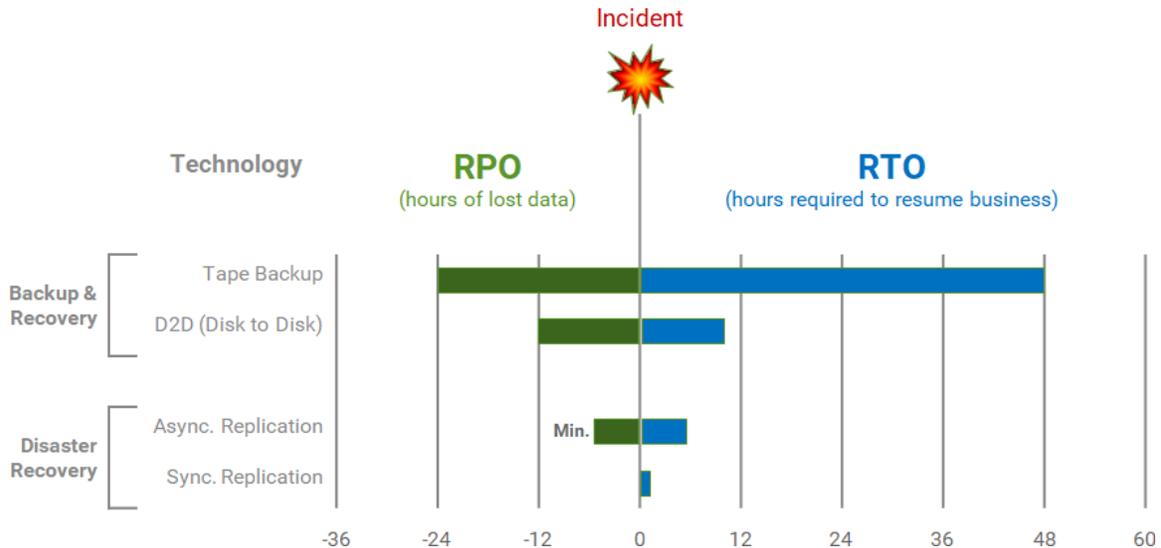


Figure 1-2 The Relationship between Backup Technologies and RPO / RTO

Disaster recovery techniques such as asynchronous replication are usually measured in minutes. In the event of an accident, the recovery time will be reduced to a few minutes. Another more stringent business continuity goal is measured in seconds, usually with no data loss at all. Synchronous replication technology can achieve this.

1.2. Introduce to Replication

This section briefly introduces synchronous and asynchronous replication technologies.

1.2.1. Synchronous Replication

Synchronous replication can ensure data consistency between the replication source and target. This can be achieved by ensuring that every write I/O requested from the applications on the host will be completed after the host obtains the confirmation between the source and the target. If the write I/O cannot be committed on the source or target, the write operation will

not be committed to ensure consistency. In addition, write failures are sent back to its applications on the host. Then, application error handling will determine the next appropriate step for the pending transaction.

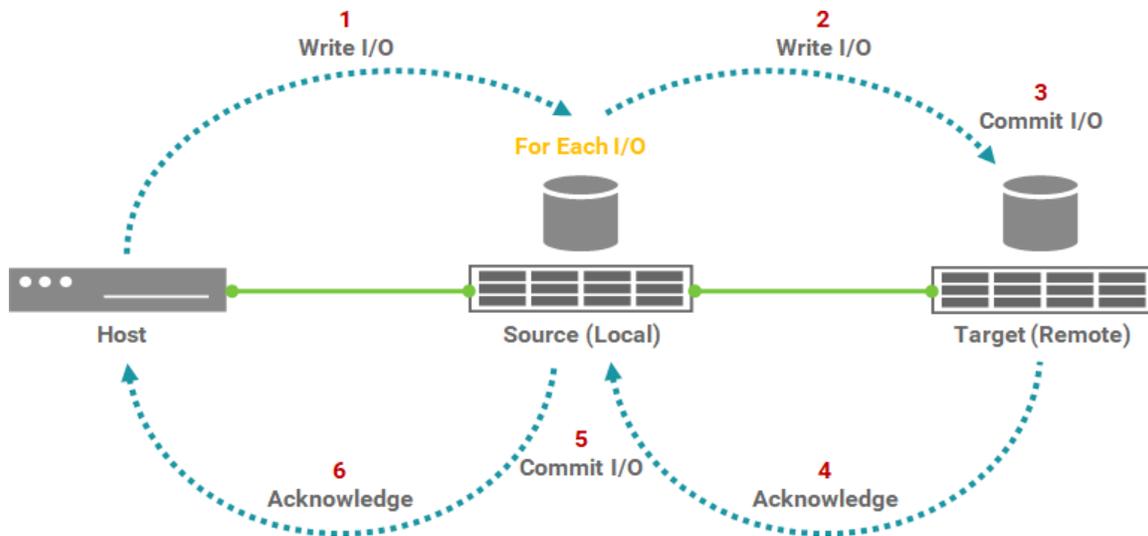


Figure 1-3 Write I/O Sequence of Synchronous Replication

Figure 1-3 describes the write I/O pattern sequence with synchronous replication:

1. The application on the host sends a write request to the source volume.
2. The write I/O copies to the target volume.
3. The write I/O at the target is committed to the target volume.
4. The write commit at the target is confirmed back to the source.
5. The write I/O is committed to the source volume.
6. Finally, the write acknowledgement will be sent to the application on the host.

1.2.2. Asynchronous Replication

Asynchronous replication can achieve the same data protection goals. However, the method and frequency of data replication are different from synchronous replication. Asynchronous replication commit writes at the source, and then send the acknowledgement to the application on the host. The accumulated writes committed on the source volume will be copied to the target volume in batches at scheduled intervals.

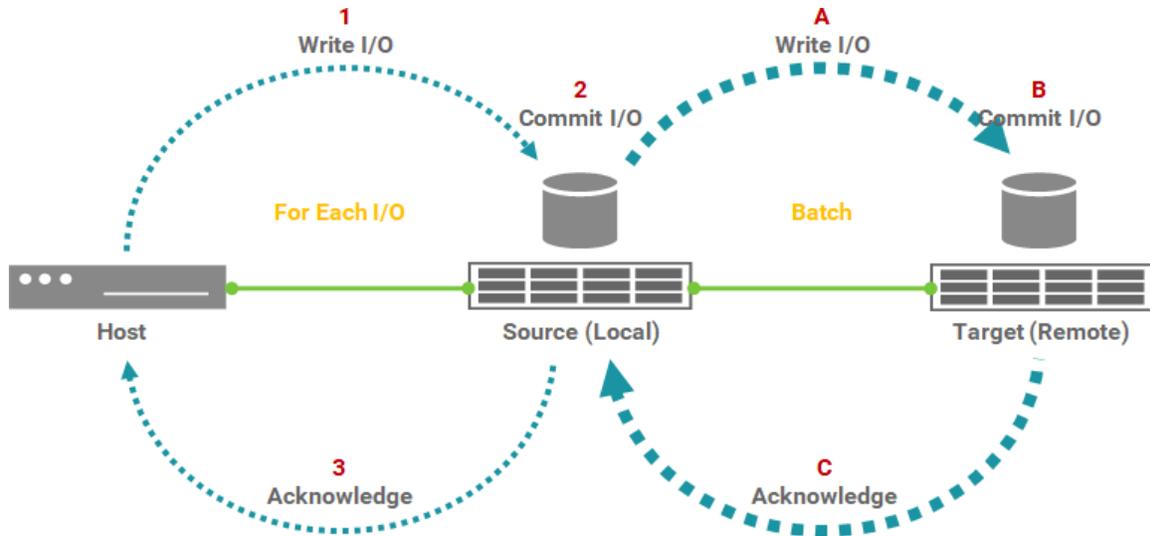


Figure 1-4 Write I/O Sequence of Asynchronous Replication

Figure 1-4 describes the write I/O sequence with asynchronous replication:

1. The application on the host sends a write request to the source volume.
2. The write I/O is committed to the source volume.
3. The write acknowledgement will be sent to the application on the host.

The process is repeated for each write I/O requested by the application on the host.

- A. Periodically copy a batch of write I/O that has been submitted to the source volume to the target volume.
- B. Commit to the target volume.
- C. Batch confirmation is sent to the source.

1.3. Synchronous vs. Asynchronous Replication

Both synchronous and asynchronous replications have their advantages and disadvantages. Before choosing a backup method, you must understand the risks of disaster recovery.

Synchronous replication ensures that every data written to storage is saved locally and also remotely. This can ensure zero data loss in the event of a disaster. So RPO is zero. In a synchronous replication solution, there are also trade-offs. Since each write needs to be saved locally and remotely, any problems affecting the source or target storage or the replication link between these two will affect the application in terms of latency and availability. As the distance between the source and target increases, this response time also increases. It is

recommended to ensure that the link delay between the source and target is less than 10 ms (millisecond). The converted distance is about 100 km (kilometer).

Synchronous replication is mainly used for mission critical applications that require instant failover when the source site fails. Although synchronous replication is usually used for disaster recovery, it is preferred for applications that cannot tolerate data loss and have a short recovery time.

Table 1-1 Synchronous and Asynchronous Comparison

ITEM	SYNCHRONOUS REPLICATION	ASYNCHRONOUS REPLICATION
RPO (Recovery Point Objective)	= 0	Last sync of incremental data
RTO (Recovery Time Objective)	0 ~ Very low	Time of next sync
Delay between Source and Target	< 10 ms	No limit, preferably < 1 sec.
Distance between Source and Target	100 km	No limit
Application	Mission critical	Business critical
License Required	Yes	No

Asynchronous replication is mainly used to replicate data over long distances. It does not affect host I/O latency, because once host writes are saved to the source storage, they are acknowledged. Since write operations are not immediately copied to the target, all writes will be tracked on the source. This data will be copied during the next synchronization. Therefore, RPO should be an acceptable amount of data, which may be lost due to failure. And RTO is equal to the period of the next synchronization. This time increment also affects the amount of data that needs to be replicated during the next synchronization and the amount of potential data loss in the event of a disaster.

Of course, the perfect solution is that both RTO and RPO are zero. This means that when a fault occurs, the system will respond immediately, and there will be no data loss. To achieve this goal, the system design is extremely complicated and the cost is very expensive. So it should avoid

falling into the vicious circle of simply pursuing the improvement of the two indicators, and combining the actual situation, appropriately improving the two indicators according to local conditions is the right way.

2. SYNCHRONOUS REPLICATION

This chapter will discuss the synchronous replication feature which allows users to create synchronous replication tasks for block storage between supported systems. All configuration and management operations in this section will be demonstrated in SANOS (SAN Operation System). The following sections of this chapter will discuss:

- How the synchronous replication feature works
- The license requirements for the synchronous replication feature
- The configuration and management operations for synchronous replication



INFORMATION

Synchronous replication is available in SANOS firmware 2.0.0.

2.1. Theory of Operation

Synchronous replication is a block-level volume backup function through LAN or WAN. It is a timely replication function that can always synchronize source and target data. It uses iSCSI function to establish a replication connection. The replication task can use the full bandwidth of the assigned network port to allow the best backup speed.

We assume that the synchronization source port must be greater than or equal to 10 Gbps to ensure normal operation. However, the synchronization source port in the source storage is not limited to the dedicated one. In order to balance replication traffic, it is still recommended to separate the port of incoming data from the host and the synchronization source port to the target storage.

If replication tasks require more bandwidth, replication can increase bandwidth by allowing multiple connections per task to intelligently balance backup tasks.

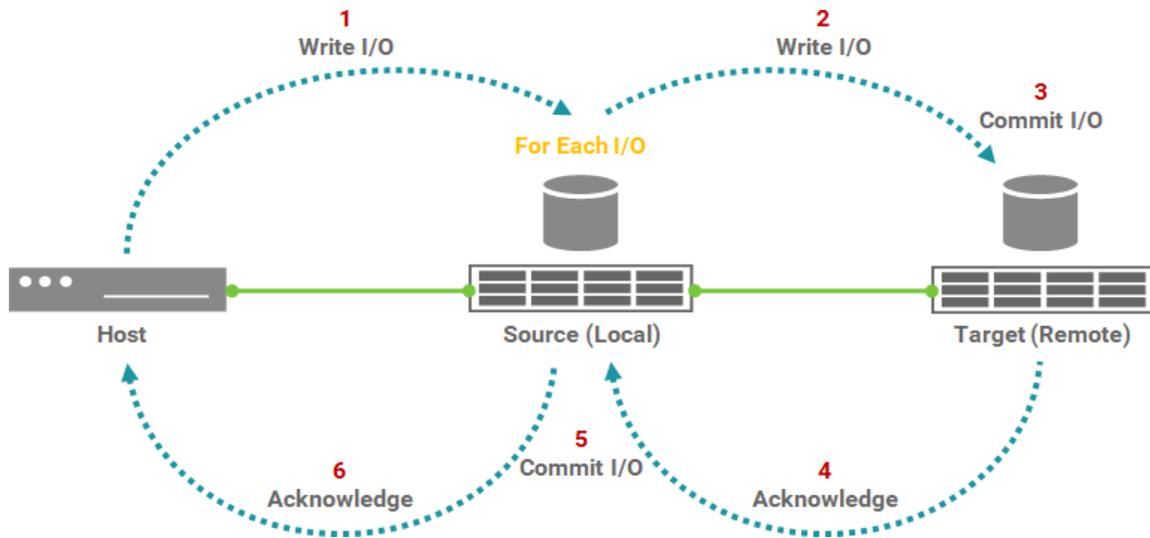


Figure 2-1 Synchronous Replication



TIP

The synchronous source port must be greater than or equal to 10 Gbps.

When a user creates a synchronous replication task, it will automatically copy all data from the source volume to the target at the beginning. This is also called **full replication**. At the same time, the source system will record a **fracture log** to maintain the block whether has been synchronized. The fracture log is a bitmap saved in the source storage to indicate which block of the source have been updated.

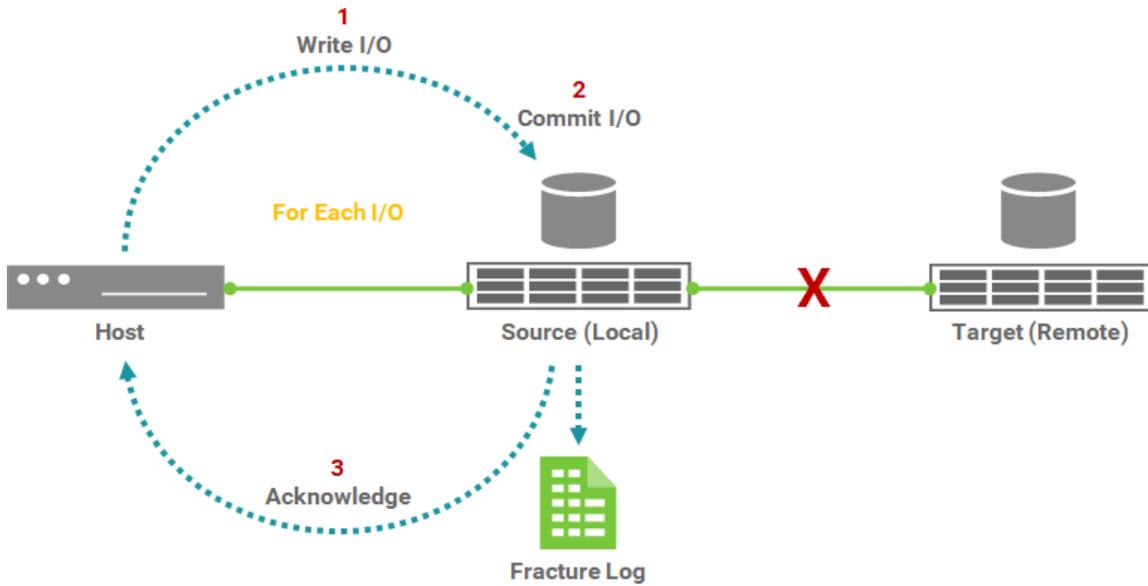


Figure 2-2 Fracture Log in Synchronous Replication

It is invoked when the target of a replication connection is lost for any reason and becomes out of sync. For example, when an incident such as a network interruption occurs, the source cannot replicate the data to the target, I/O from the host will still continue to be written to Source. The fracture log is kept update until the incident is resolved. The source will learn about the unsynchronized blocks and replicate them to the synchronized state.

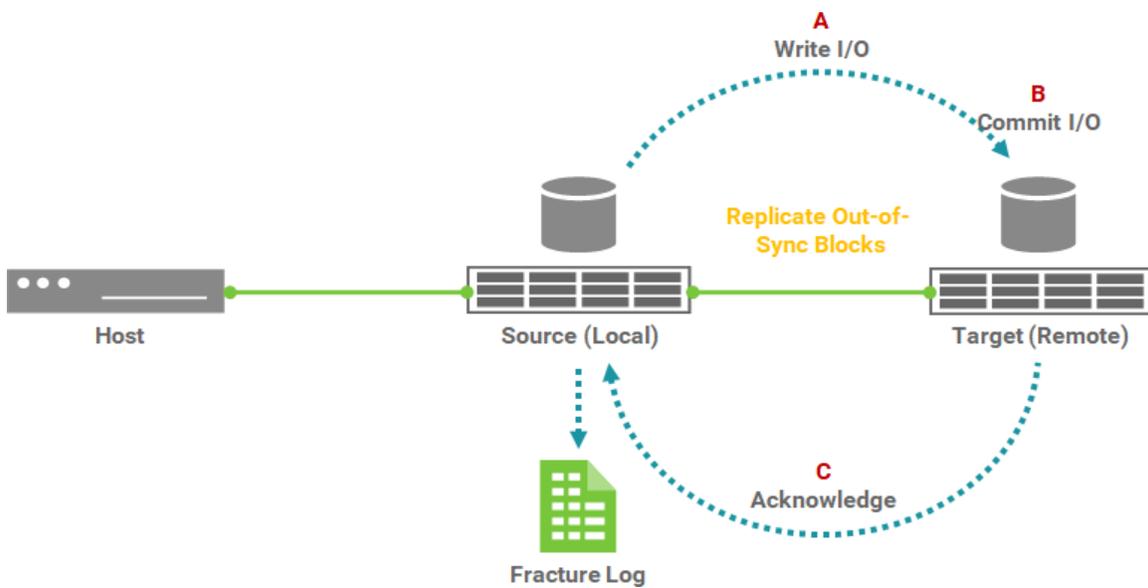


Figure 2-3 Replicate Out-of-Sync Blocks

If a network error still occurs and the replication is blocked, the system will issue a warning every 20 seconds and enter the failed state after 60 seconds. Therefore, the task will be stopped. At this point, if you want to continue the task, you have to start it manually.

Another operation is that the user can manually stop the task until the user manually resumes the task, the situation is the same. If you are not sure whether the target has been touched, you can also perform a **Full Replication** first when restarting the task.



INFORMATION

Currently, the synchronous replication DOES NOT support local cloning task into a remote replication task.

2.2. License

For XCubeSAN series, synchronous replication license must be purchased to enable the feature. There is also a 30-day free trial license for evaluation.

2.2.1. Enable Synchronous Replication License

The synchronous replication function is optional. Before using it, you have to enable synchronous replication license. Select the **Update** function tab in the **Maintenance** function submenu, download **Request License** file and send to your local sales to obtain a License Key. After getting the license key, click the **Choose File** button to select it, and then click the **Apply** button to enable. When the license is enabled, please reboot the system. Each license key is unique and dedicated to a specific system. If you have already enabled, this option will be invisible.

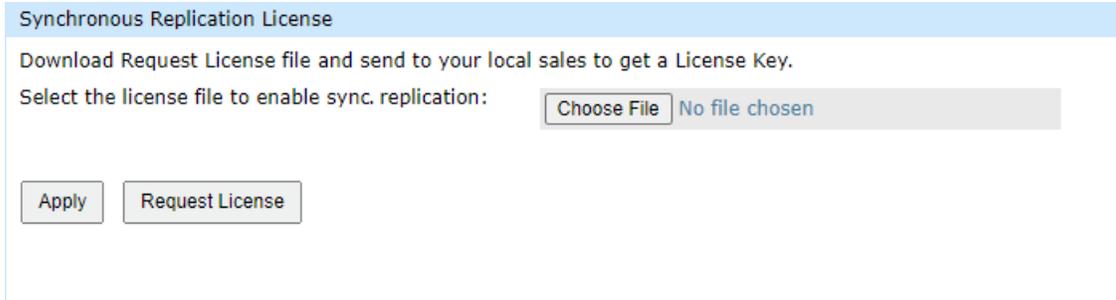


Figure 2-4 Enable Synchronous Replication License

2.3. Configure Synchronous Replication

Select the **Remote Replications** function submenu to create synchronous replication tasks, and also start, stop, or delete tasks.

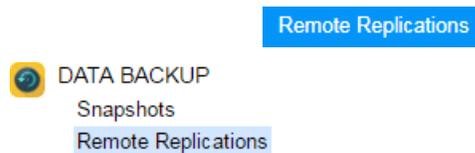


Figure 2-5 Remote Replication Function Submenu

The maximum replication task quantity per volume is 1, and the maximum replication task quantity per system is 32 which including both synchronous and asynchronous replication tasks.

Table 2-1 Synchronous Replication Parameters

ITEM	VALUE
Maximum remote replication task quantity per volume (Maximum remote replication pairs per source volume)	1
Maximum remote replication task quantity per system (include synchronous and asynchronous)	32
Maximum iSCSI multi-path quantity in a remote replication task	2
Maximum iSCSI multiple connection quantity per remote replication task path	4

Create a Synchronous Replication Task

This is an example of creating a synchronous replication task from the source volume to the target volume. Suppose we defined the name and IP address in the example.



Figure 2-6 Example of Creating a Synchronous Replication Task

Site A (Source Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.1
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.2
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.3
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.4
- Source Volume Name: Source-Vol-1

Site B (Target Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.101
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.102
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.103
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.104
- Target Volume: Name: Target-Vol-2

Operate the SANOS Web UI of Site B (Target Unit):

1. Before replication, it must have a backup volume on the target unit. Select the **Volumes** function submenu, click the **Create Volume** button. And then select **Volume Type** as **Backup Volume**.

The screenshot shows the 'Create Volume' web interface. On the left, there are tabs for 'General', 'Advanced', and 'Summary', with 'General' selected. The main area is titled 'Volume General Settings' and contains the following fields:

- Volume Name :** Target-Vol-2
- Pool Name :** Pool-1 (Available : 931 GB)
- Capacity :** 11 GB
- Volume Type :** RAID Volume (dropdown menu is open, showing 'RAID Volume' and 'Backup Volume' options)

Below the 'Volume Type' dropdown, there is a note: 'Select RAID Volume for Backup Volume for backup usage such as the target volume of local clone or remote replication.'

At the bottom right, there are 'Next' and 'Cancel' buttons.

Figure 2-7 Create a Target Volume at Site B

2. Here is the target volume.

<< first < prev 1 next > last >>

	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name
▼	Target-Vol-2	Online	Optimal	11.00 GB	Backup Volume	Disabled	1.58 GB / 11.00 GB	0	N/A	WB	Pool-1

<< first < prev 1 next > last >>

Create Volume Local Clone Options

Figure 2-8 List the Target Volume at Site B

3. Map a LUN of the target volume.

Operate the SANOS Web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, and then click the **Create** button.
2. If the synchronous license is enabled, you will see the replication **Mode**. Click the drop-down box and select the **Synchronous**.
3. Select a source volume and click the **Next** button.

Remote Replication - Select a Source Volume

Mode: Asynchronous ▼
 Asynchronous
 Synchronous

<< first last >>

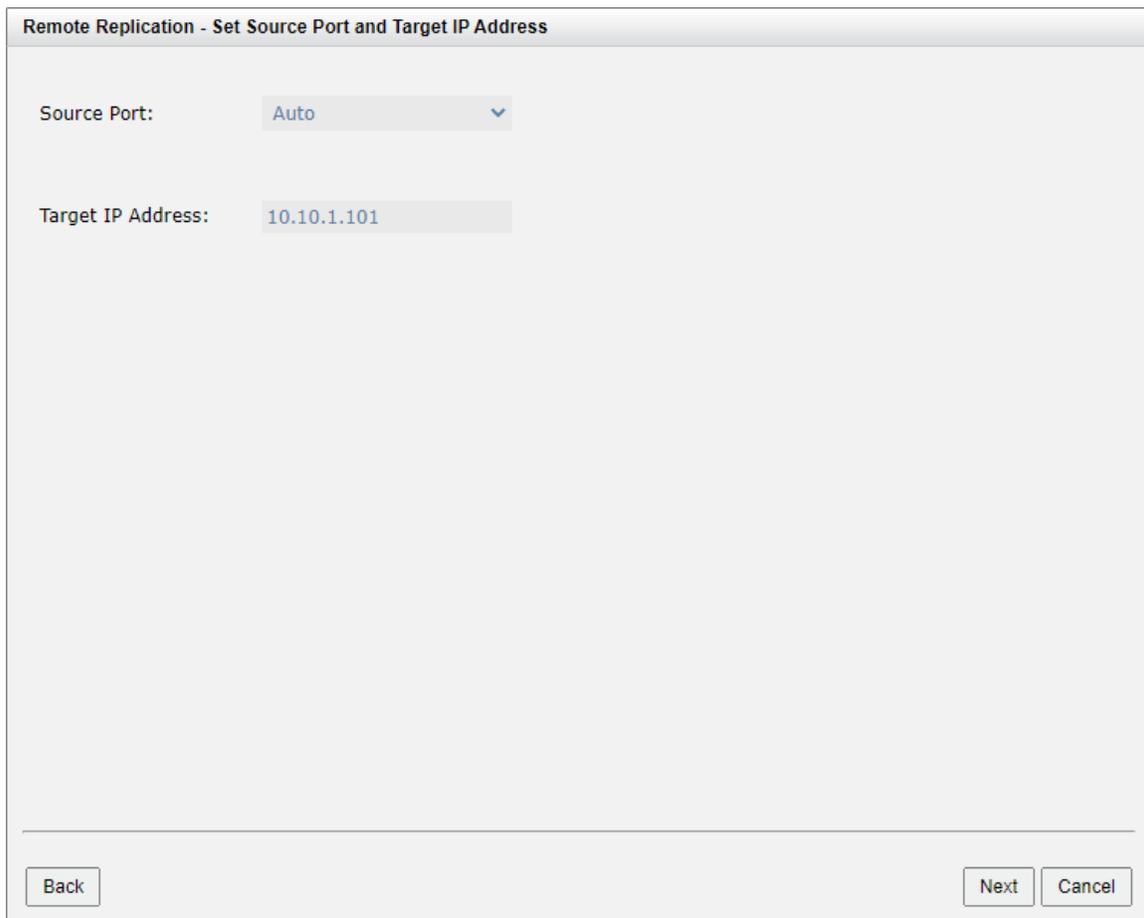
	Volume Name	Capacity	Status	LUN	Snapshots	Pool Name
<input checked="" type="radio"/>	Source-Vol-1	10.00 GB	Online	None	0	Pool-1

<< first < prev 1 next > last >>

Next Cancel

Figure 2-9 Create a Synchronous Replication Task Step 1

4. Select the **Source Port** and enter the **Target IP Address**, and then click the **Next** button.



Remote Replication - Set Source Port and Target IP Address

Source Port: Auto

Target IP Address: 10.10.1.101

Back Next Cancel

Figure 2-10 Create a Synchronous Replication Task Step 2



TIP

The source port for synchronous must be greater than or equal to 10 Gbps. If you do not want to assign a fixed port, please leave the setting of **Source Port** as **Auto**. The system will try to connect to the target IP address automatically.

5. Select an **Authentication Method**, and then enter the **CHAP Username** and **CHAP Password** as required. Select a **Target Name** and click the **Next** button.

Remote Replication - Set Authentication Method and Select a Target Name

Select an Authentication Method

No Authentication Method

CHAP

CHAP Username: 

CHAP Password: 

Select a Target Name

	No.	Target Name
<input checked="" type="radio"/>	1	iqn.2004-08.com.qsan:xs1224-000d32028:dev0_ctr1

Figure 2-11 Create a Synchronous Replication Task Step 3



TIP

This CHAP account is iSCSI authentication for Site B (Target Unit). If CHAP is not enabled in Site B, please select **No Authentication Method**.

6. Select a Target LUN in Site B (Target Unit). Finally, click the **Finish** button.

Remote Replication - Select a Target LUN

	No.	LUN	Volume Name	Capacity	Manufacturer	Model	WWN
<input checked="" type="radio"/>	1	0	Target-Vol-2	11.00 GB	Qsan	XS1224	20320013780c5900

Back Finish Cancel

Figure 2-12 Create a Synchronous Replication Task Step 4

- The replication task has been created. At this point, the full copy will start automatically. The **Status** shows **Syncing**, and the % shows the percentage of synchronization completed.

Task:

No.	Source Volume	Status	Type	%	Shaping	Speed	Target Volume	Capacity	Schedule	Time Created	Manufacturer	Model	WWN
▼ 1	Source-Vol-1	Syncing	Sync.	35%	N/A	0 MB	Target-Vol-2	11.00 GB	N/A	Tue Dec 29 17:44:20 2020	Qsan	XS1224	20320013780c5900

Task 'Source-Vol-1' Path:

No.	Source Port	Target IP Address	Target Name	LUN	Status
▼ 1	Auto	10.10.1.101	iqn.2004-08.com.qsan.xs1224-000d32028-dev0.ctr1	0	Connected

Create Rebuild Remote Replication Options Traffic Shaping Configuration

Figure 2-13 A Synchronous Replication Task Has Been Created



TIP

When the synchronous replication task has been created, the full replication will start automatically.

Stop Synchronous Replication Task

To stop the replication task, follow the steps below.

Operate the SANOS web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Stop**.
2. Click the **OK** button to stop the replication task.

Start Synchronous Replication Task

To start the replication task, follow the steps below.

Operate the SANOS web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Start**.
2. It will pop up dialog box asking if you want to resume the task or perform a full replication. After selecting, click the **OK** button.

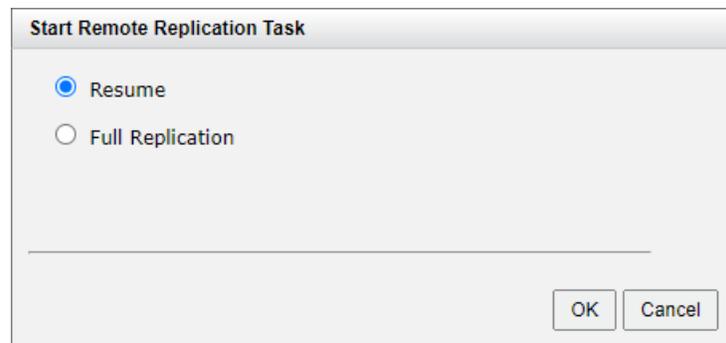


Figure 2-14 Start Dialog

The option **Resume** will replicate the out-of-sync part. If you can not sure whether the target has been touched, you can also perform a **Full Replication**.

Delete Remote Replication Task

To delete the replication task, follow the steps below.

Operate the SANOS web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Delete**.
2. Click the **OK** button to delete the replication task.

2.4. Configure MPIO in Remote Replication Task

In the remote replication scenario, MPIO (Multi-Path I/O) supports redundancy. Usually, the remote replication task runs on the master controller (usually CTRL 1) of the source unit. The data is replicated from the master controller of source unit to the target unit, and the target unit is set with the target IP address (usually also CTRL 1) when creating the remote replication task. The second path from the source unit can be added to the CTRL 2 of the target unit. The maximum MPIO in a remote replication task is 2 paths. The following is a remote replication MPIO diagram.

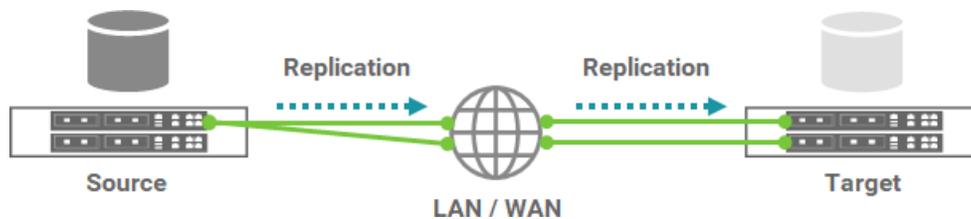


Figure 2-15 Remote Replication MPIO Diagram

How Redundancy Is Used with Remote Replication

If CTRL 1 fails on the source unit, the replication connection will be taken over by CTRL 2 and the replication task will continue running.

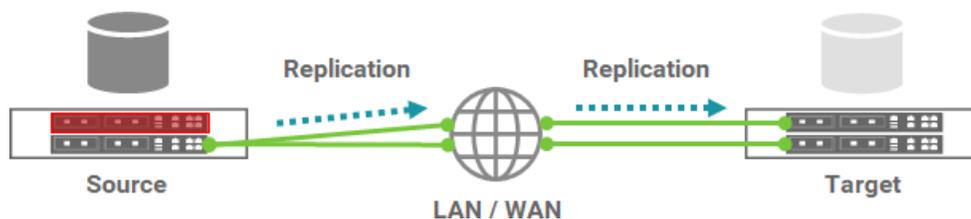


Figure 2-16 Remote Replication Source Controller Fail Diagram

In another case, when CTRL 1 fails on the target unit, the replication connection will fail over to the second path from CTRL 1 of the source unit to CTRL 2 of the target unit.

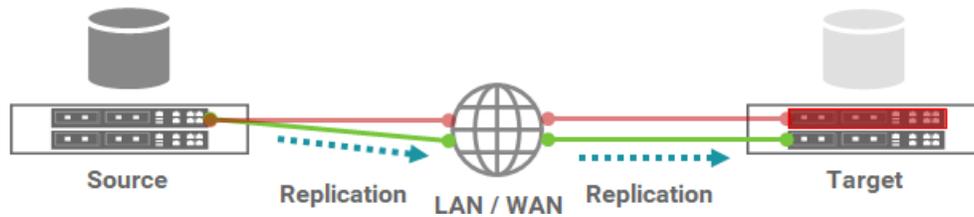


Figure 2-17 Remote Replication Target Controller Fail Diagram

Add Multipath in Remote Replication Task

Here's an example of adding the second path in the remote replication. Suppose we defined the IP addresses in the example.

Site A (Source Unit) Configuration:

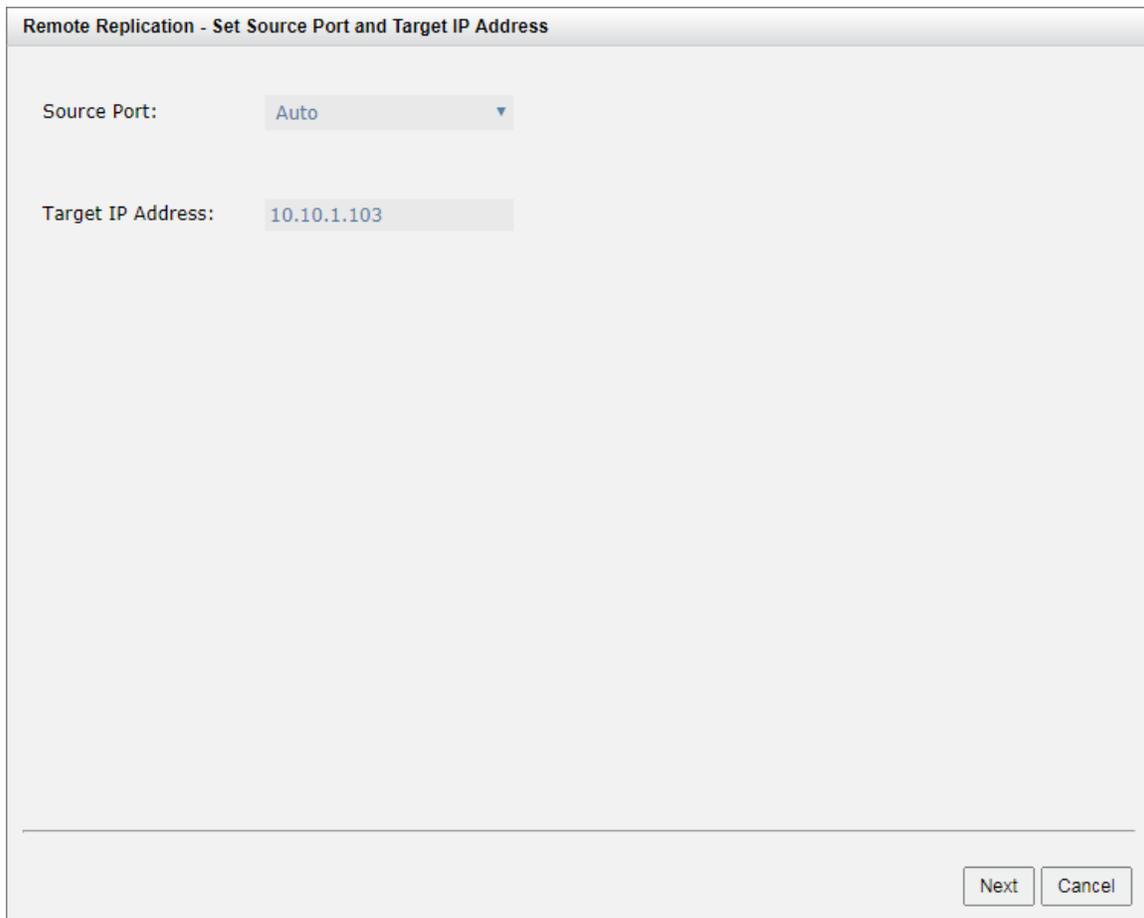
- Controller 1, Onboard LAN 1 IP Address: 10.10.1.1
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.2
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.3
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.4
- Source Volume Name: Source-Vol-1

Site B (Target Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.101
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.102
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.103
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.104
- Target Volume: Name: Target-Vol-2

Operate the SANOS Web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Add Multipath**.
2. Select the **Source Port** and enter the **Target IP Address**, and then click the **Next** button.



The screenshot shows a dialog box titled "Remote Replication - Set Source Port and Target IP Address". It contains two input fields: "Source Port" with a dropdown menu set to "Auto", and "Target IP Address" with the text "10.10.1.103". At the bottom right, there are two buttons: "Next" and "Cancel".

Figure 2-18 Add Multipath in Remote Replication Step 1



TIP

The source port for synchronous must be greater than or equal to 10 Gbps. If you do not want to assign a fixed port, please leave the setting of **Source Port** as **Auto**. The system will try to connect to the target IP address automatically.

3. Select an **Authentication Method**, and then enter the **CHAP Username** and **CHAP Password** as required. Select a **Target Name** and click the **Next** button.

Remote Replication - Set Authentication Method and Select a Target Name

Select an Authentication Method

No Authentication Method

CHAP

CHAP Username: 

CHAP Password: 

Select a Target Name

	No.	Target Name
<input checked="" type="radio"/>	1	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr2

Back Next Cancel

Figure 2-19 Add Multipath in Remote Replication Step 2



TIP

This CHAP account is iSCSI authentication for Site B (Target Unit). If CHAP is not enabled in Site B, please select **No Authentication Method**.

4. Select a Target LUN in Site B (Target Unit). Finally, click the **Finish** button.

Remote Replication - Select a Target LUN

When a remote replication task completes, it will take a snapshot on its target volume. Please make sure the snapshot space of the backup volume on the target side is properly configured.

	No.	LUN	Volume Name	Capacity	Manufacturer	Model	WWN
<input checked="" type="radio"/>	1	0	Target-Vol-2	11.00 GB	QSAN	XS5216	205a0013780a21c0

Back Finish Cancel

Figure 2-20 Add Multipath in Remote Replication Step 3

5. Added the second path in the remote replication task.

Tasks

	No.	Source Volume	Status	%	Shaping	Speed	Target Volume	Capacity	Schedule	Time
▼	1	Source-Vol-1	Online		N/A	0 MB	Target-Vol-2	11.00 GB	N/A	Thu

Task Paths

	No.	Source Port	Target IP Address	Target Name	LUN	Status
▼	1	Auto	10.10.1.101	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr1	0	Connected
▼	2	Auto	10.10.1.103	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr2	0	Connected

Create Rebuild Remote Replication Options Traffic Shaping Configuration

Figure 2-21 List Multipath in Remote Replication Task

Delete Multipath in Remote Replication Task

To delete the multipath of the replication task, follow the steps below.

Operate the SANOS Web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task path, and then click ▼ -> **Delete Path**.
2. Click the **OK** button to delete the path.

2.5. Configure MC/S in Remote Replication Task Path

MC/S (Multiple Connections per Session) is another feature in remote replication. If there are multiple iSCSI ports available on the source unit and they can be connected to other iSCSI ports on the target unit, you can add MC/S to increase the replication speed. The maximum MC/S for each task path is 4 connections.

Add Connections in Remote Replication Task Path

This is an example of adding a second connection in a remote replication task. Suppose we defined the IP address in the example.

Site A (Source Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.1
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.2
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.3
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.4
- Source Volume Name: Source-Vol-1

Site B (Target Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.101
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.102
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.103
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.104

- Target Volume: Name: Target-Vol-2

Operate the SANOS Web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task path, and then click ▼ -> **Add Connection**.
2. Select the **Source Port** and enter the **Target IP Address**, and then click the **OK** button.

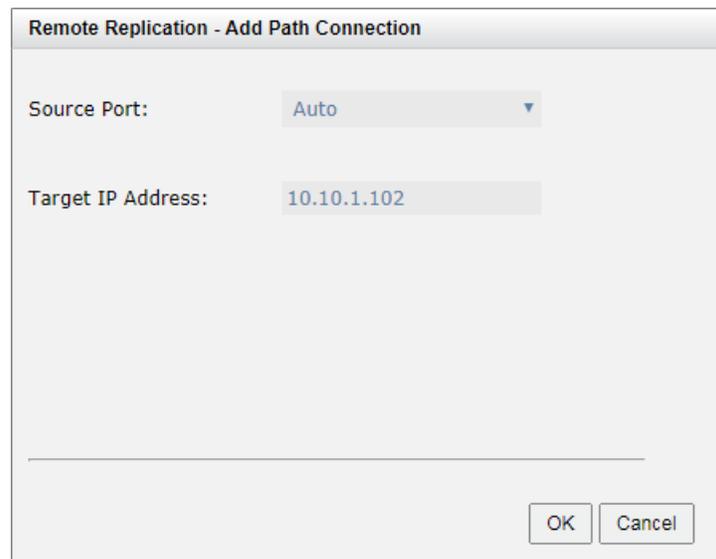


Figure 2-22 Add Path Connection



TIP

The source port for synchronous must be greater than or equal to 10 Gbps. If you do not want to assign a fixed port, please leave the setting of **Source Port** as **Auto**. The system will try to connect to the target IP address automatically.

3. Added the second connection in the remote replication task path. If necessary, click ▼ -> **Add Connection** to add another.

Tasks

	No.	Source Volume	Status	%	Shaping	Speed	Target Volume	Capacity	Schedule	Time
▼	1	Source-Vol-1	Online		N/A	0 MB	Target-Vol-2	11.00 GB	N/A	Thu .

Task Paths

	No.	Source Port	Target IP Address	Target Name	LUN	Status
▼	1	Auto	10.10.1.101	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr1	0	Connected
▼		Auto	10.10.1.102	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr1	0	Connected

Create Rebuild Remote Replication Options Traffic Shaping Configuration

Figure 2-23 List Multiple Connections in Remote Replication Task Path

Delete Connections in Remote Replication Task Path

To delete multiple connections in each session of the replication task path, follow the steps below.

Operate the SANOS Web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task path, and then click ▼ -> **Delete Connection**.
2. Select the connection(s) you want to delete, and then click the **OK** button.

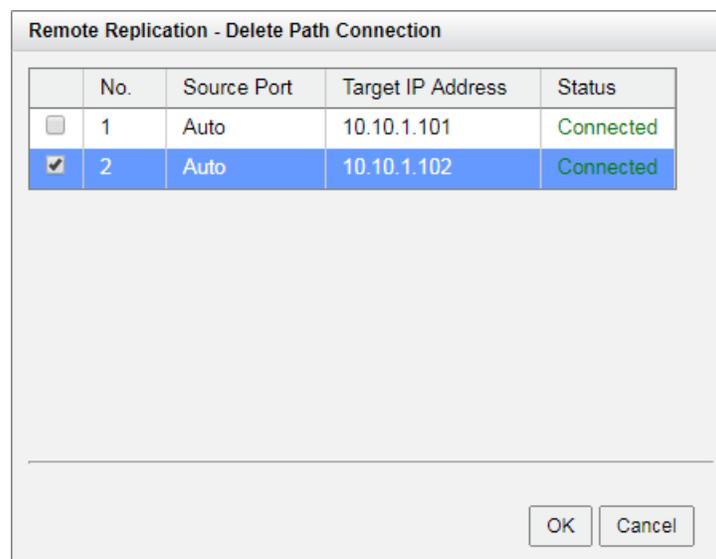


Figure 2-24 Delete Path Connection

3. The multiple connection(s) are deleted.



TIP

When deleting multiple connections, please note that at least one connection must remain.

3. ASYNCHRONOUS REPLICATION

This chapter will discuss the asynchronous replication feature which allows users to create asynchronous replication tasks for block storage between supported systems. All configuration and management operations in this section will be demonstrated in SANOS (SAN Operation System). The following sections of this chapter will discuss:

- How the asynchronous replication feature works
- The configuration and management operations for asynchronous replication

3.1. Theory of Operation

Asynchronous replication is a block-level, differential remote volume backup function through LAN or WAN. It has many powerful features such as unlimited bandwidth, traffic shaping, and multiple connections per replication task, etc.



Figure 3-1 Remote Replication Diagram

In the beginning, replication will copy all data from the source volume to the target. It is also called a **full replication**. After that, use snapshot technology to perform incremental replication.



TIP

Please be fully aware that incremental copies require snapshots to compare data differences. Therefore, it is very important to provide enough snapshot space for the volume.

Generally, asynchronous replication operates in the following manner.

1. Create an asynchronous replication task. Over time, a snapshot is taken on the Source Volume.
2. Copy the data from the Source Snapshot T1 to the Target Volume.
3. The Target Snapshot T1 is refreshed and becomes a base.
4. The host continuously writes new data to the Source Volume.
5. In the next synchronization, the Source Snapshot T2 will be refreshed and only the changes since the last synchronization will be copied.
6. The Target Snapshot T2 is refreshed and becomes the next base.

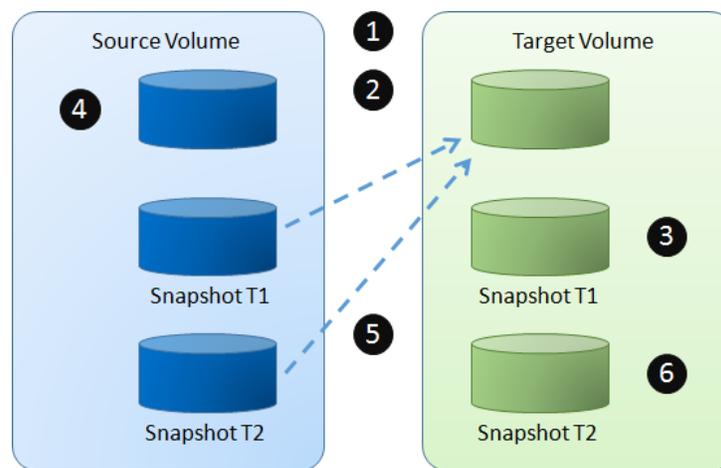


Figure 3-2 Asynchronous Replication Steps

Asynchronous replication uses the iSCSI function to establish a replication connection. It can use the full bandwidth of the allocated network port to achieve the best backup speed. However, in order to balance replication traffic and non-replication traffic, the traffic shaping function can help reserve the necessary bandwidth for non-replication I/O.

If replication tasks require more bandwidth, replication can increase bandwidth by allowing multiple connections per task to intelligently balance backup tasks.



Figure 3-3 Local Clone Transfers to Remote Replication

Support manual and scheduled replication tasks to achieve flexible management. In order to handle remote replication of large amounts of data, asynchronous replication allows local cloning tasks to be converted into remote replication tasks. You can perform a local clone of the full copy first. Then, use the disk roaming function to physically transfer the disk drive containing the cloned volume to the remote site. Finally, use the function of converting from a local clone task to a remote replication task.

3.2. Configure Asynchronous Replication

Select the **Remote Replications** function submenu to create asynchronous replication tasks, and also start, stop, delete tasks. In addition, features include setting up replication schedules and traffic shaping options.

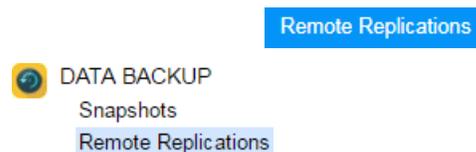


Figure 3-4 Snapshot Function Submenu

The maximum replication task quantity per volume is 1, and the maximum replication task quantity per system is 32 which including both synchronous and asynchronous replication tasks. The maximum traffic shaping quantity per system is 8.

Table 3-1 Asynchronous Replication Parameters

ITEM	VALUE
Maximum remote replication task quantity per volume (Maximum remote replication pairs per source volume)	1
Maximum remote replication task quantity per system (include synchronous and asynchronous)	32
Maximum traffic shaping quantity per system	8
Maximum iSCSI multi-path quantity in a remote replication task	2
Maximum iSCSI multiple connection quantity per remote replication task path	4

Create an Asynchronous Replication Task

This is an example of creating a synchronous replication task from the source volume to the target volume. Suppose we defined the name and IP address in the example.



Figure 3-5 Example of Creating an Asynchronous Replication Task

Site A (Source Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.1
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.2
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.3
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.4
- Source Volume Name: Source-Vol-1

Site B (Target Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.101
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.102
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.103
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.104
- Target Volume: Name: Target-Vol-2

Operate the SANOS Web UI of site B (Target Unit):

1. Before replication, it must have a backup volume on the target unit. Select the **Volumes** function submenu, click the **Create Volume** button. And then select **Volume Type** as **Backup Volume**.

The screenshot shows the 'Create Volume' dialog box in the SANOS Web UI. The 'Volume General Settings' section is active, displaying the following configuration:

- Volume Name: Target-Vol-2
- Pool Name: Pool-1 (Available: 1107 GB)
- Capacity: 11 GB
- Volume Type: Backup Volume (selected from a dropdown menu)

The dropdown menu for Volume Type shows two options: RAID Volume and Backup Volume. The Backup Volume option is highlighted. Below the dropdown, there is a note: 'Select RAID Volume for RAID Volume for backup usage such as the target volume of local clone or remote replication.'

At the bottom right of the dialog box, there are two buttons: 'Next' and 'Cancel'.

Figure 3-6 Create a Target Volume at Site B

2. After creating a target volume, please set the snapshot space. Therefore, the snapshot of the source volume can be replicated to the target volume.

<< first < prev **1** next > last >>

	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name
▼	Target-Vol-2	Online	Optimal	11.00 GB	Backup Volume	Disabled	1.58 GB / 11.00 GB	0	N/A	WB	Pool-1

<< first < prev **1** next > last >>

Create Volume Local Clone Options

Figure 3-7 List Target Volume in Site B

3. Map a LUN of the target volume.

Operate the SANOS Web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, and then click the **Create** button.
2. Select a source volume and click the **Next** button.

Remote Replication - Select a Source Volume

<< first < prev **1** next > last >>

	Volume Name	Capacity	Status	LUN	Snapshots	Pool Name
<input checked="" type="radio"/>	Source-Vol-1	10.00 GB	Online	None	0	Pool-1

<< first < prev **1** next > last >>

Next Cancel

Figure 3-8 Create an Asynchronous Replication Task Step 1

3. If the synchronous license is enabled, you will see the replication **Mode**. Click the drop-down box and select the **Asynchronous**.

Remote Replication - Select a Source Volume

Mode:

<< first last >>

	Volume Name	Capacity	Status	LUN	Snapshots	Pool Name
<input checked="" type="radio"/>	Source-Vol-1	10.00 GB	Online	None	0	Pool-1

<< first < prev 1 next > last >>

Figure 3-9 Create an Asynchronous Replication Task Step 1

4. Select the **Source Port** and enter the **Target IP Address**, and then click the **Next** button.

The screenshot shows a dialog box titled "Remote Replication - Set Source Port and Target IP Address". It contains two input fields: "Source Port" with a dropdown menu set to "Auto", and "Target IP Address" with the text "10.10.1.101". At the bottom of the dialog, there are three buttons: "Back" on the left, and "Next" and "Cancel" on the right.

Figure 3-10 Create an Asynchronous Replication Task Step 2



TIP

If you do not want to assign a fixed port, please leave the setting of **Source Port** as **Auto**. The system will try to connect to the target IP address automatically.

5. Select an **Authentication Method**, and then enter the **CHAP Username** and **CHAP Password** as required. Select a **Target Name** and click the **Next** button.

Remote Replication - Set Authentication Method and Select a Target Name

Select an Authentication Method

No Authentication Method

CHAP

CHAP Username: 

CHAP Password: 

Select a Target Name

	No.	Target Name
<input checked="" type="radio"/>	1	iqn.2004-08.com.qsan:xs1224-000d32028:dev0_ctr1

Figure 3-11 Create an Asynchronous Replication Task Step 3



TIP

This CHAP account is iSCSI authentication for Site B (Target Unit). If CHAP is not enabled in Site B, please select **No Authentication Method**.

6. Select a Target LUN in Site B (Target Unit). Finally, click the **Finish** button.

Remote Replication - Select a Target LUN

When a remote replication task completes, it will take a snapshot on its target volume. Please make sure the snapshot space of the backup volume on the target side is properly configured.

	No.	LUN	Volume Name	Capacity	Manufacturer	Model	WWN
<input checked="" type="radio"/>	1	0	Target-Vol-2	11.00 GB	Qsan	XS1224	20320013780c5900

Back Finish Cancel

Figure 3-12 Create an Asynchronous Replication Task Step 4



TIP

When a remote replication task completes, it will take a snapshot on its target volume. Please make sure the snapshot space of the backup volume on the target side is properly configured.

- The replication task has been created. At this time, if the source volume does not have snapshot space, it will automatically allocate snapshot space for replication. The capacity of the snapshot space depends on the parameter of replication options.

Task:

No.	Source Volume	Status	Type	%	Shaping	Speed	Target Volume	Capacity	Schedule	Time Created	Manufacturer	Model	WWN
▼ 1	Source-Vol-1	Online	Asyn.		N/A	0 MB	Target-Vol-2	11.00 GB	N/A	Tue Dec 29 17:47:24 2020	Qsan	XS1224	20320013780c5900

Task 'Source-Vol-1' Path:

No.	Source Port	Target IP Address	Target Name	LUN	Status
▼ 1	Auto	10.10.1.101	iqn.2004-08.com.qsan.xs1224-000d32028.dev0.ctr1	0	Connected

Create Rebuild Remote Replication Options Traffic Shaping Configuration

Figure 3-13 An Asynchronous Replication Task Has Been Created

Start Asynchronous Replication Task

To start the replication task, follow the steps below.

Operate the SANOS web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Start**.
2. Click the **OK** button. The source volume will take a snapshot, and then the remote replication task.

Stop Asynchronous Replication Task

To stop the replication task, follow the steps below.

Operate the SANOS web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Stop**.
2. Click the **OK** button to stop the replication task.

Delete Remote Replication Task

To delete the replication task, follow the steps below.

Operate the SANOS web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Delete**.
2. Click the **OK** button to delete the replication task.

3.3. Configure Traffic Shaping

The traffic shaping function can help reserve the necessary bandwidth for non-replication I/O operations. Eight shaping groups can be set. In each shaping group, peak and off-peak time slots are provided for different bandwidths. Here's an example of setting up a shaping group.

Configure Traffic Shaping

To configure traffic shaping groups, follow the steps below.

Operate the SANOS web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu and click the **Traffic Shaping Configuration** button.

Replication - Traffic Shaping Configuration

Shaping Group: Shaping Group1 (Peak: 100MB; Off-peak: N/A) ▼

Peak: 100 MB

Enable Off-Peak

Off-Peak: 200 MB

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sun	<input checked="" type="checkbox"/>																							
Mon	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
Tue	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
Wed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
Thu	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
Fri	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						
Sat	<input checked="" type="checkbox"/>																							

OK Cancel

Figure 3-14 Shaping Setting Configuration

2. Select a **Shaping Group** to set.
3. Enter the bandwidth (MB) during **Peak** hours.
4. If necessary, check the **Enable Off-Peak** box, and then enter the bandwidth (MB) during the **Off-Peak** time. And define the off-peak hours.
5. Click the **OK** button.

Set Traffic Shaping on Remote Replication Task

To set up a shaping group on the remote replication task, follow the steps below.

Operate the SANOS web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Set Traffic Shaping**.

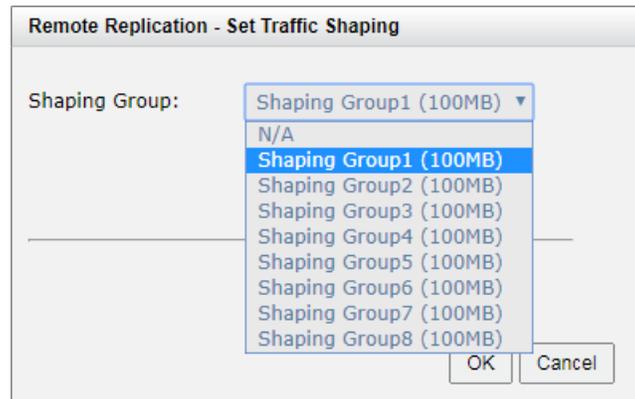


Figure 3-15 Set Traffic Shaping

2. Select a **Shaping Group** from the drop-down list. Then click the **OK** button.
3. The shaping group will be applied to the remote replication task.



TIP

Synchronous replication DOES NOT require traffic shaping.

3.4. Configure Schedule Remote Replication Tasks

You can set up replication tasks on a schedule such as hourly or daily. Please follow the steps below.

Operate the SANOS web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Schedule**.
2. Check the required schedule. It can be set monthly, weekly, daily or hourly. Click the **OK** button to apply.

Remote Replication - Set Remote Replication Schedule

Set Remote Replication Schedule: Source-Vol-1

Months in the Year: All
 01 02 03 04
 05 06 07 08
 09 10 11 12

Weeks in the Month: All
 1 2 3 4
 5

Days of the Week: All
 Sun Mon Tue Wed
 Thu Fri Sat

Hours in the Day: All
 00 01 02 03
 04 05 06 07
 08 09 10 11
 12 13 14 15
 16 17 18 19
 20 21 22 23

Minutes in the Hour: All
 00 15 30 45

Figure 3-16 Schedule Remote Replication



INFORMATION

Daily snapshots will be taken at 00:00 every day.

Weekly snapshots will be taken at 00:00 every Sunday.

Monthly snapshots will be taken at 00:00 on the first day of each month.



TIP

Synchronous replication DOES NOT require task scheduling.

3.5. Replication Options

Select the **Remote Replications** function submenu, click the **Remote Replications Options** button. Three options are described below.

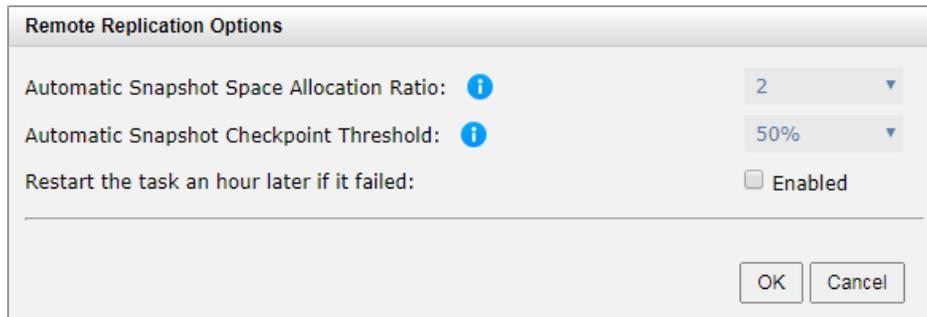


Figure 3-17 Replication Options

- Automatic Snapshot Space Allocation Ratio:** This setting is the ratio of the source volume and the snapshot space. If the ratio is set to 2, when no snapshot space is allocated for the volume, the system will automatically reserve a free pool space to set it to have twice the volume of the snapshot space. The options are 0.5 ~ 3.
- Automatic Snapshot Checkpoint Threshold:** This setting will take effect when scheduled replication is enabled. This threshold will monitor the usage of snapshot space. When the used snapshot space reaches the threshold, the system will create a snapshot and automatically start the replication process. The purpose of the threshold is to prevent incremental copy failure immediately when the snapshot space is exhausted. For example, the default threshold is 50%. The system will check the snapshot space every hour. When the snapshot space usage exceeds 50%, the system will automatically start the replication task. Then continue to monitor the snapshot space. When 50% of the remaining snapshot space has been used, that is, 75% of the total snapshot space has been used, the system will start the replication task again.
- Restart the task an hour later if failed:** This setting will take effect when scheduled replication is enabled. When the snapshot space is used up, the volume replication process will stop because there is no more snapshot space available. If this option is checked, the system will clear the snapshots of replication to automatically release the snapshot space, and the replication task will restart in one hour. This task will start a full copy.



CAUTION

The default snapshot space allocated by the system is twice the capacity of the source volume. This is the best value we recommend. If the user manually sets the snapshot space to be less than the default value, the snapshot space is insufficient and the replication task will fail, so you should bear the risk.



TIP

The **Remote Replication Options** is only applicable to asynchronous replication.

3.6. Configure MPIO in Remote Replication Task

In the remote replication scenario, MPIO (Multi-Path I/O) supports redundancy. Usually, the remote replication task runs on the master controller (usually CTRL 1) of the source unit. The data is replicated from the master controller of source unit to the target unit, and the target unit is set with the target IP address (usually also CTRL 1) when creating the remote replication task. The second path from the source unit can be added to the CTRL 2 of the target unit. The maximum MPIO in a remote replication task is 2 paths. The following is a remote replication MPIO diagram.

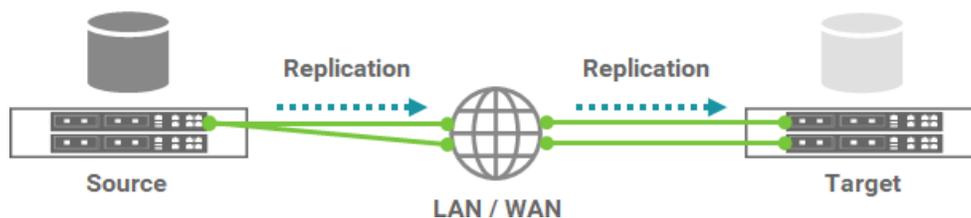


Figure 3-18 Remote Replication MPIO Diagram

How Redundancy Is Used with Remote Replication

If CTRL 1 fails on the source unit, the replication connection will be taken over by CTRL 2 and the replication task will continue running.

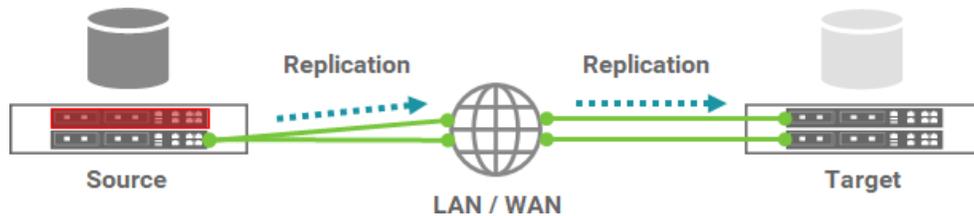


Figure 3-19 Remote Replication Source Controller Fail Diagram

In another case, when CTRL 1 fails on the target unit, the replication connection will fail over to the second path from CTRL 1 of the source unit to CTRL 2 of the target unit.

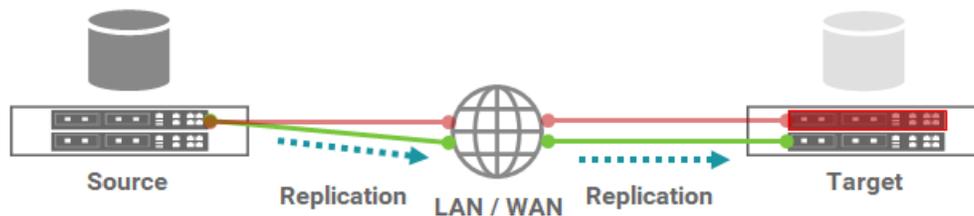


Figure 3-20 Remote Replication Target Controller Fail Diagram

Add Multipath in Remote Replication Task

Here's an example of adding the second path in the remote replication. Suppose we defined the IP addresses in the example.

Site A (Source Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.1
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.2
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.3
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.4
- Source Volume Name: Source-Vol-1

Site B (Target Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.101
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.102
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.103
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.104
- Target Volume: Name: Target-Vol-2

Operate the SANOS Web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task, and then click ▼ -> **Add Multipath**.

The screenshot shows a web-based configuration window titled "Remote Replication - Set Source Port and Target IP Address". It contains two main input fields: "Source Port" with a dropdown menu currently showing "Auto", and "Target IP Address" with a text input field containing "10.10.1.103". At the bottom right of the window, there are two buttons: "Next" and "Cancel".

Figure 3-21 Add Multipath in Remote Replication Step 1

2. Select the **Source Port** and enter the **Target IP Address**, and then click the **Next** button.

Remote Replication - Set Authentication Method and Select a Target Name

Select an Authentication Method

No Authentication Method

CHAP

CHAP Username: 

CHAP Password: 

Select a Target Name

	No.	Target Name
<input checked="" type="radio"/>	1	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr2

Figure 3-22 Add Multipath in Remote Replication Step 2



TIP

If you do not want to assign a fixed port, please leave the setting of **Source Port** as **Auto**. The system will try to connect to the target IP address automatically.

3. Select an **Authentication Method**, and then enter the **CHAP Username** and **CHAP Password** as required. Select a **Target Name** and click the **Next** button.

Remote Replication - Select a Target LUN

When a remote replication task completes, it will take a snapshot on its target volume. Please make sure the snapshot space of the backup volume on the target side is properly configured.

	No.	LUN	Volume Name	Capacity	Manufacturer	Model	WWN
<input checked="" type="radio"/>	1	0	Target-Vol-2	11.00 GB	QSAN	XS5216	205a0013780a21c0

Figure 3-23 Add Multipath in Remote Replication Step 3



TIP

This CHAP account is iSCSI authentication for Site B (Target Unit). If CHAP is not enabled in Site B, please select **No Authentication Method**.

4. Select a Target LUN in Site B (Target Unit). Finally, click the **Finish** button.

Tasks										
	No.	Source Volume	Status	%	Shaping	Speed	Target Volume	Capacity	Schedule	Time
▼	1	Source-Vol-1	Online		N/A	0 MB	Target-Vol-2	11.00 GB	N/A	Thu .

Task Paths						
	No.	Source Port	Target IP Address	Target Name	LUN	Status
▼	1	Auto	10.10.1.101	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr1	0	Connected
▼	2	Auto	10.10.1.103	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr2	0	Connected

Figure 3-24 List Multipath in Remote Replication Task

5. Added the second path in the remote replication task.

Delete Multipath in Remote Replication Task

To delete the multipath of the replication task, follow the steps below.

Operate the SANOS Web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task path, and then click ▼ -> **Delete Path**.
2. Click the **OK** button to delete the path.

3.7. Configure MC/S in Remote Replication Task Path

MC/S (Multiple Connections per Session) is another feature in remote replication. If there are multiple iSCSI ports available on the source unit and they can be connected to other iSCSI ports on the target unit, you can add MC/S to increase the replication speed. The maximum MC/S for each task path is 4 connections.

Add Connections in Remote Replication Task Path

This is an example of adding a second connection in a remote replication task. Suppose we defined the IP address in the example.

Site A (Source Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.1

- Controller 1, Onboard LAN 2 IP Address: 10.10.1.2
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.3
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.4
- Source Volume Name: Source-Vol-1

Site B (Target Unit) Configuration:

- Controller 1, Onboard LAN 1 IP Address: 10.10.1.101
- Controller 1, Onboard LAN 2 IP Address: 10.10.1.102
- Controller 2, Onboard LAN 1 IP Address: 10.10.1.103
- Controller 2, Onboard LAN 2 IP Address: 10.10.1.104
- Target Volume: Name: Target-Vol-2

Operate the SANOS Web UI of Site A (Source Unit):

1. Select the **Remote Replications** function submenu, select a task path, and then click ▼ -> **Add Connection**.

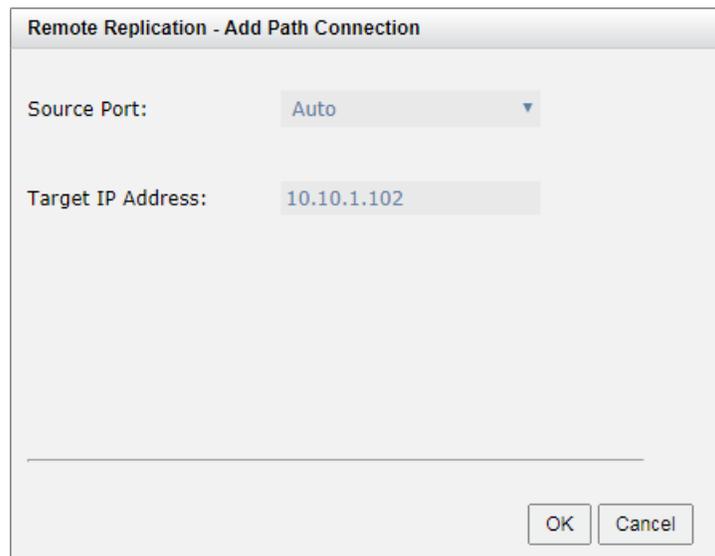


Figure 3-25 Add Path Connection

2. Select the **Source Port** and enter the **Target IP Address**, and then click the **Next** button.

Tasks

	No.	Source Volume	Status	%	Shaping	Speed	Target Volume	Capacity	Schedule	Time
▼	1	Source-Vol-1	Online		N/A	0 MB	Target-Vol-2	11.00 GB	N/A	Thu .

Task Paths

	No.	Source Port	Target IP Address	Target Name	LUN	Status
▼	1	Auto	10.10.1.101	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr1	0	Connected
▼		Auto	10.10.1.102	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr1	0	Connected

Create Rebuild Remote Replication Options Traffic Shaping Configuration

Figure 3-26 List Multiple Connections in Remote Replication Task Path



TIP

If you do not want to assign a fixed port, please leave the setting of **Source Port** as **Auto**. The system will try to connect to the target IP address automatically.

- Added the second connection in the remote replication task path. If necessary, click ▼ -> **Add Connection** to add another.

Delete Connections in Remote Replication Task Path

To delete multiple connections in each session of the replication task path, follow the steps below.

Operate the SANOS Web UI of Site A (Source Unit):

- Select the **Remote Replications** function submenu, select a task path, and then click ▼ -> **Delete Connection**.

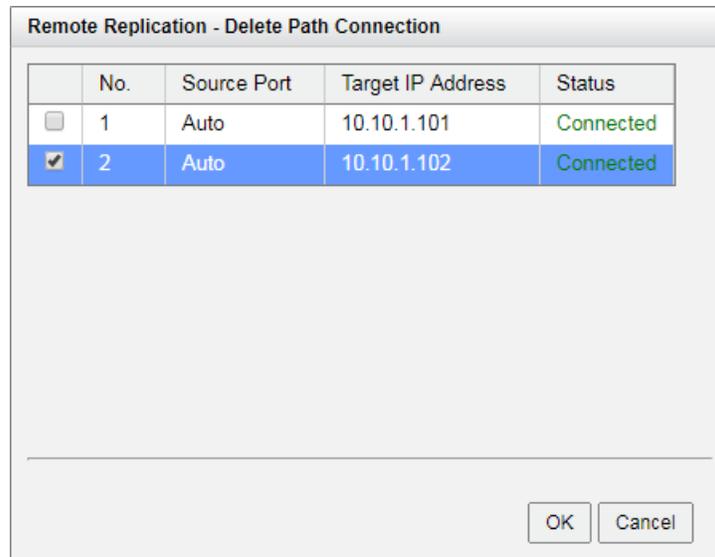


Figure 3-27 Delete Path Connection

2. Select the connection(s) you want to delete, and then click the **OK** button.
3. The multiple connection(s) are deleted.



TIP

When deleting multiple connections, please note that at least one connection must remain.

3.8. Local Clone Transfers to Remote Replication

When performing a replication task for the first time, full replication via LAN or WAN is always a problem. With limited network bandwidth, it may take days or weeks to copy data from the source to the target. We provide two methods to help users shorten the time to execute a full copy.

1. One is to skip the full copy on a new, clean volume. The term **clean** means that no data has been written to the volume since it was created. For a newly created volume that has not

been accessed, when a replication copy task is created on the volume for the first time, the system will recognize the volume and automatically skip the full copy.



TIP

Any I/O access to the newly created volume will make it **unclean** even if the **Erase** function is executed when the volume is just created. In this case, a full copy will be made.

- Another method is to use the local volume clone function, which is a local data copy function between volumes so that a full copy can be performed for the first time. Then carry all the physical disk drives of the target volume and move to the target unit. Finally, convert the local clone task to a remote replication task with a replica.

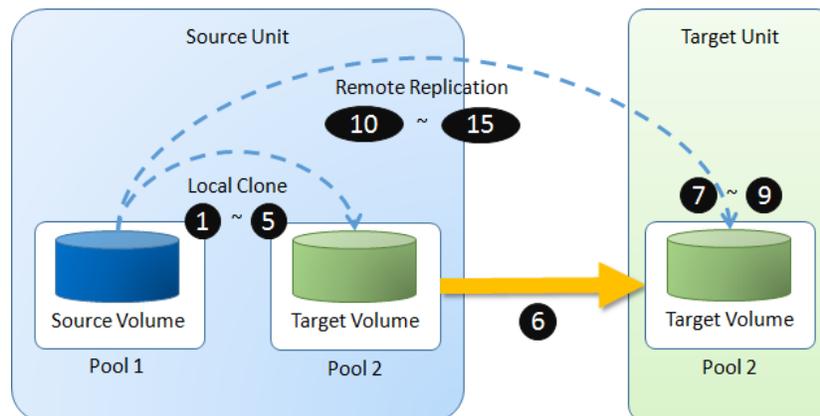


Figure 3-28 Local Clone Transfers to Remote Replication Diagram

To transfer volume disk local clone to remote replication, please follow the steps below.

Operate the SANOS Web UI of Site A (Source Unit):

- Select the **Volumes** function submenu, select a source volume, and click ▼ -> **Create Local Clone** to create a local clone task.
- Click ▼ -> **Start Local Clone** to execute full copy the data from source volume to target one.

- Click ▼ -> **Covert to Remote Replication** to change the local clone task to a remote replication task.

<< first < prev 1 next > last >>

	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name
▼	Source-Vol-1	Online	Optimal	10.00 GB	RAID Volume	Disabled	3.04 GB / 23.04 GB	1	QRep	WB	Pool-1
▼	Target-Vol-2	Online	Optimal	11.00 GB	Backup Volume	Disabled	0 MB / 0 MB	0	N/A	WB	Pool-2

<< first < prev 1 next > last >>

Create Volume Local Clone Options

Figure 3-29 List Source and Target Volumes for Local Clone

- The **Clone** column of the source volume will be changed from the name of the target volume into **QRep**.



CAUTION

Converting a local clone task to a remote replication one is only available when the clone task has been finished. This change is irreversible.

- Select the **Pools** function submenu, select the pool, and click ▼ -> **Deactive**.
- Unplug all physical disk drives and bring them to Site B, insert them into the target unit.

Operate the SANOS Web UI of Site B (Target Unit):

- Select the **Pools** function submenu, select the pool, and click ▼ -> **Active**.
- Select the **Volumes** function submenu, and set the snapshot space. Therefore, the snapshot of the source volume can be replicated to the target volume.
- Map a LUN of the target volume.

Operate the SANOS Web UI of Site A (Source Unit):

- Select the **Remote Replications** function submenu, click the **Rebuild** button to rebuild the remote replication task changed from the previous clone task.
- Select the source volume and click the **Next** button.

Rebuild the Clone Relationship - Select a Source Volume

<< first < prev **1** next > last >>

	Volume Name	Capacity	Status	LUN	Snapshots	Pool Name
<input checked="" type="radio"/>	Source-Vol-1	10.00 GB	Online	None	1	Pool-1

<< first < prev **1** next > last >>

Next Cancel

Figure 3-30 Rebuild Clone Relationship Step 1

3. Select the **Source Port** and enter the **Target IP Address**, and then click the **Next** button.

The screenshot shows a dialog box titled "Remote Replication - Set Source Port and Target IP Address". It contains two input fields: "Source Port" with a dropdown menu set to "Auto", and "Target IP Address" with the text "10.10.1.101". At the bottom of the dialog, there are three buttons: "Back" on the left, and "Next" and "Cancel" on the right.

Figure 3-31 Rebuild Clone Relationship Step 2



TIP

If you do not want to assign a fixed port, please leave the setting of **Source Port** as **Auto**. The system will try to connect to the target IP address automatically.

4. Select an **Authentication Method**, and then enter the **CHAP Username** and **CHAP Password** as required. Select a **Target Name** and click the **Next** button.

Remote Replication - Set Authentication Method and Select a Target Name

Select an Authentication Method

No Authentication Method

CHAP

CHAP Username: 

CHAP Password: 

Select a Target Name

	No.	Target Name
<input checked="" type="radio"/>	1	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr1

Figure 3-32 Rebuild Clone Relationship Step 3



TIP

This CHAP account is iSCSI authentication for Site B (Target Unit). If CHAP is not enabled in Site B, please select **No Authentication Method**.

5. Select a Target LUN in Site B (Target Unit). Finally, click the **Finish** button.

Remote Replication - Select a Target LUN

When a remote replication task completes, it will take a snapshot on its target volume. Please make sure the snapshot space of the backup volume on the target side is properly configured.

	No.	LUN	Volume Name	Capacity	Manufacturer	Model	WWN
<input checked="" type="radio"/>	1	0	Target-Vol-2	11.00 GB	QSAN	XS5216	205a0013780a21c0

Back Finish Cancel

Figure 3-33 Rebuild Clone Relationship Step 4

6. The replication task from the local clone has been rebuilt.

Tasks

	No.	Source Volume	Status	%	Shaping	Speed	Target Volume	Capacity	Schedule	Time Created	Manufacturer	Model	WWN
▼	1	Source-Vol-1	Online		N/A	0 MB	Target-Vol-2	11.00 GB	N/A	Thu Jul 13 17:50:14 2017	QSAN	XS5216	205a0013780a21c0

Task Paths

	No.	Source Port	Target IP Address	Target Name	LUN	Status
▼	1	Auto	10.10.1.101	iqn.2004-08.com.qsan.xs5216-000d40228.dev0.ctr1	0	Connected

Create Rebuild Remote Replication Options Traffic Shaping Configuration

Figure 3-34 Remote Replication Task Has Been Created

4. USE CASES

This chapter will introduce some use cases for remote replications.

4.1. Remote Replication Topologies

Remote replication supports multiple topologies to suit various disaster recovery configurations. They are one-directional, bi-directional, one-to-many, many-to-one, and many-to-many. Both the source volume and destination volume in a replication connection are exclusive to the pair. Either one can NOT be served as the source or destination volume of a different replication connection. Below are the supported topologies.

One-Directional



Figure 4-1 One-Directional Remote Replication

A Source Volume (S) in Site A is replicating to a Target Volume (T) in Site B. This is the most basic remote replication topology.

Bi-Directional

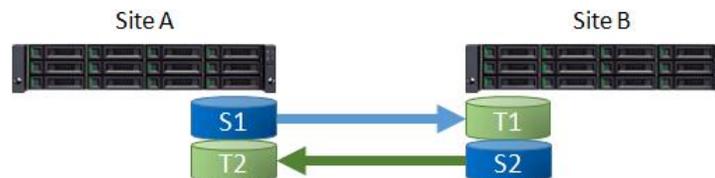


Figure 4-2 Bi-Directional Remote Replication

Each system in a two system topology acts as a replication target for the other's production data. A Source Volume (S1) in Site A is replicating to a Target Volume (T1) in Site B. And a Source Volume (S2) in Site B is replicating to a Target Volume (T2) in Site A.

One-to-Many

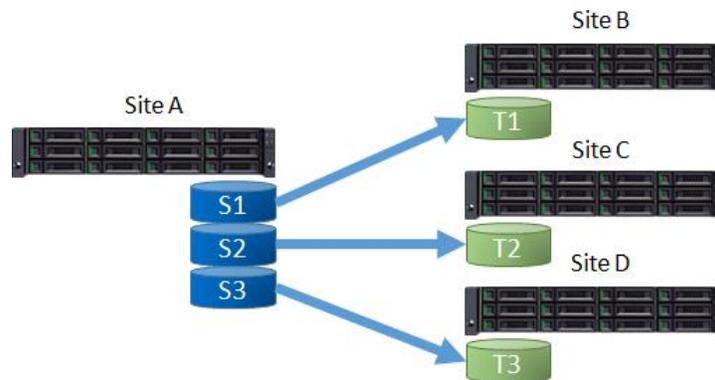


Figure 4-3 One-to-Many Remote Replication

A single source system replicates different storage resources to multiple target systems. A Source Volume (S1) in Site A is replicating to a Target Volume (T1) in Site B. At the same time, a Source Volume (S2) in Site A is replicating to a Target Volume (T2) in Site C. So does S3 in Site A to T3 in Site D.

Many-to-One

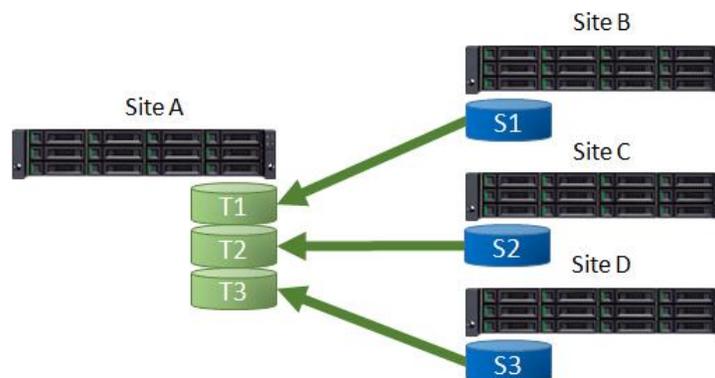


Figure 4-4 Many-to One Remote Replication

Multiple source systems replicate to a single target system. A Source Volume (S1) in Site B is replicating to a Target Volume (T1) in Site A. At the same time, a Source Volume (S2) in Site C is replicating to a Target Volume (T2) in Site A. So does S3 in Site D to T3 in Site A.

Many-to-Many

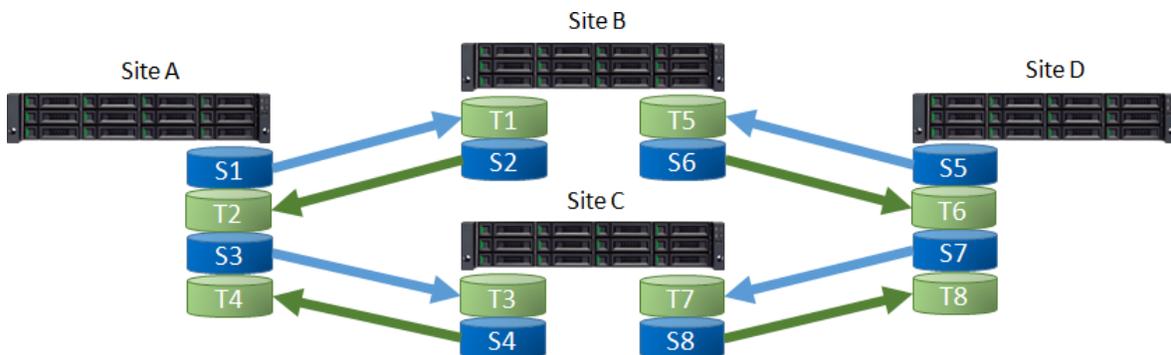


Figure 4-5 Many-to Many Remote Replication

Combination with bi-Directional, one-to-many, and many-to-one, remote replication also supports Many-to-Many topology. Multiple source systems replicate to multiple target systems. A Source Volume (S1) in Site A is replicating to a Target Volume (T1) in Site B. At the same time, a Source Volume (S2) in Site B is replicating to a Target Volume (T2) in Site A. And does S3 to T3, S4 to T4, ..., S8 to T8.



TIP

Note that for each individual replication session in the topology, all supported topologies have a one-to-one configuration. For example, you cannot set a volume as a replication source and target at the same time. Similarly, a volume cannot be the source of synchronous or asynchronous replication at the same time.

4.2. Synchronous Replication Failover

Initially, you can set up normal usage of synchronous replication. The I/O sequence (blue lines) will go from Host to Source, and then Source to Target.

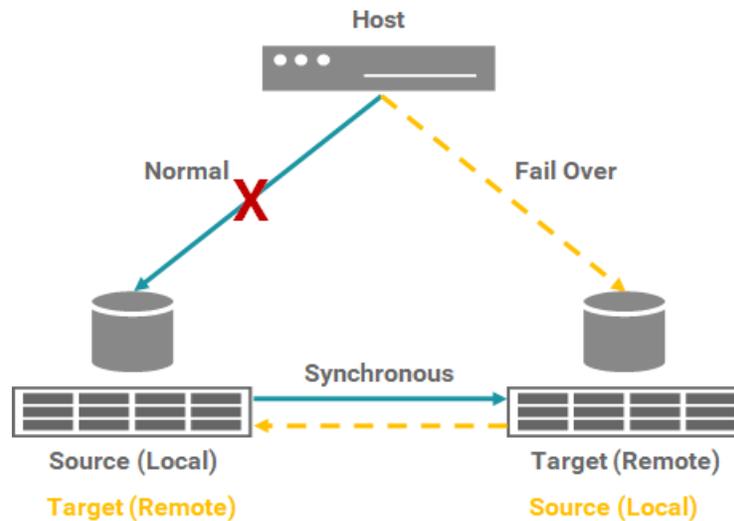


Figure 4-6 Synchronous Replication Failover

If an accident occurs and the Source is disconnected, you can manually failover to the target and let the I/O sequence (orange lines) go to the Target. At the same time, you can also switch Source and Target roles.

4.3. Synchronous Replication + C2F Solution

As we know, a volume with WT (Write-through) capability writes I/O to drives. This ensures that data is definitely written to the drives. In contrast, a volume with WB (Write-back) capability temporarily writes I/O to cache and writes it to the drive in batches as planned. Generally, a volume with write-back capability has better performance than a write-through volume.

If you use write-back parameter to set the volume, there are still risks. When the power is off unexpectedly, the data in the cache will disappear. C2F (Cache to Flash) solution can prevent this. Both Source and Target have to add the C2F modules.

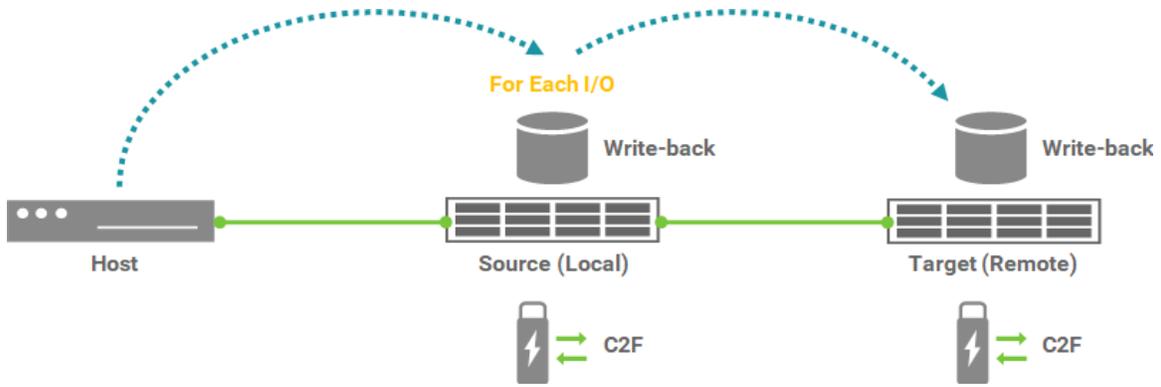


Figure 4-7 Synchronous Replication + C2F Solution

The best practice of volume write-back plus C2F solution can balance performance and data integrity.

5. CONCLUSION

This document discusses the various replication solutions. Configuring a data protection solution helps prevent unexpected situations, such as data loss. We provide local and remote data protection solutions to help easily recover in the event of a disaster. By using both synchronous and asynchronous replication solutions, data protection can be configured to meet the needs of enterprises.

Synchronous replication usually writes data to source unit and replicas at the same time. In this way, the primary copy and the replica are always in sync. In the event of a disaster, synchronous replication can provide maximum protection and ensure zero data loss.

Asynchronous replication first writes the data to the source unit and then copies the data to the replica, so there will be a certain delay in copying the data to the target unit. Asynchronous replication utilizes the snapshot technology to provide a consistent point-in-time copy that can be used in the event of a disaster. When using asynchronous replication, there will be no impact on host I/O because data will not be replicated when it enters the system. When data needs to be replicated over long distances, asynchronous replication can meet the needs of the enterprise.

6. APPENDIX

6.1. Apply To

Synchronous replication requires a **License** to enable the feature. We also provide a 30-day free **Trial License** for evaluation. The synchronous replication function is applicable to the following models.

- XCubeSAN XS5200 / XS3200 / XS1200 FW 2.0.0 and later

6.2. Related Documents

Some related documents can be downloaded from the website.

- [All XCubeSAN Documents](#)
- [XCubeSAN QIG \(Quick Installation Guide\)](#)
- [XCubeSAN Hardware Manual](#)
- [XCubeSAN Configuration Worksheet](#)
- [XCubeSAN SANOS 4.0 Software Manual](#)
- [Compatibility Matrix](#)
- [White Papers](#)
- [Application Notes](#)