JetStor SAS 724HS 10G Series User Manual

SAS 724HS 10G
SAS 724HSD 10G

Version 8.52
October 2014

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Firmware Versions

FW 3.4.0
Storage Service Provider: V2.0.6

Login Information

Management IP Address: 192.168.1.234
User Name: admin
Password: 00000000

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0 Preface

About This Manual

This manual is the introduction of JetStor storage system and it aims to help users know the operations of the disk array system easily. Information contained in this manual has been reviewed for accuracy, but not for product warranty because of the various environments / OS / settings. Information and specification will be changed without further notice. For any update information, please visit http://www.acnc.com and your contact windows.

Before reading this manual, it assumes that you are familiar with computer skills such as hardware, storage concepts and network technology. It also assumes you have basic knowledge of Redundant Array of Independent Disks (RAID), Storage Area Network (SAN), Fibre Channel (FC), Internet SCSI (iSCSI), Serial-attached SCSI (SAS), Serial ATA (SATA), technology.

CAUTION:
Do not attempt to service, change, disassemble or upgrade the equipment's components by yourself. Doing so may violate your warranty and expose you to electric shock. Refer all servicing to authorized service personnel. Please always follow the instructions in this user's manual.

Technical Support

Thank you for using AC&NC products; if you have any questions, please e-mail us at support@acnc.com. We will answer your question as soon as possible.

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Tips and Cautions

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

Symbol	Meaning	Description
	TIP	Tips provide helpful information, guidelines, or suggestions for performing tasks more effectively.
	CAUTION	Cautions indicate that failure to take a specified action could result in damage to the software or hardware.

Conventions

The following table describes the typographic conventions used in this manual.

Conventions	Description
Bold	Indicates text on a window, other than the window title, including menus, menu options, buttons, fields, and labels. Example: Click **OK** button.
<*Italic*>	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: copy <source-file> <target-file>.
[ ] square brackets	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a | b } indicates that you must choose either a or b.
| vertical bar	Indicates that you have a choice between two or more options or arguments.
/ Slash	Indicates all options or arguments.
underline	Indicates the default value. Example: [a | b]

FCC and CE statements

FCC Statement

This device has been shown to be in compliance with and was tested in accordance with the measurement procedures specified in the Standards and Specifications listed below and as indicated in the measurement report number: xxxxxxxx-F

Technical Standard: FCC Part 15 Class A (Verification)
IC ICES-003

CE Statement

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This device has been shown to be in compliance with and was tested in accordance with the measurement procedures specified in the Standards and Specifications listed below and as indicated in the measurement report number: xxxxxxxx-E

Technical Standard:	EMC DIRECTIVE 2004/108/EC
	(EN55022 / EN55024)

UL Statement

Rack Mount Instructions - The following or similar rack-mount instructions are included with the installation instructions:

1. Elevated Operating Ambient - If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer.
2. Reduced Air Flow - Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised.
3. Mechanical Loading - Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.
4. Circuit Overloading - Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.
5. Reliable Earthing - Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g. use of power strips).

CAUTION:
The main purpose of the handles is for rack mount use only. Do not use the handles to carry or transport the systems.

The ITE is not intended to be installed and used in a home, school or public area accessible to the general population, and the thumbscrews should be tightened with a tool after both initial installation and subsequent access to the panel.

Warning: Remove all power supply cords before service

This equipment intended for installation in restricted access location.

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- Access can only be gained by SERVICE PERSONS or by USERS who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken.
- Access is through the use of a TOOL or lock and key, or other means of security, and is controlled by the authority responsible for the location.

CAUTION: (English)
Risk of explosion if battery is replaced by incorrect type. Please replace the same or equivalent type battery use and dispose of used batteries according to the instructions.

ATTENTION: (French)
IL Y A RISQUE D'EXPLOSION SI LA BATTERIE EST REMPLACÉE PAR UNE BATTERIE DE TYPE INCORRECT. METTRE AU REBUT LES BATTERIES USAGÉES CONFORMÉMENT AUX INSTRUCTIONS.

VORSICHT: (German)
Explosionsgefahr bei unsachgemaßem Austausch der Batterie. Entsorgung gebrauchter Batterien nach Anleitung.

ADVERTENCIA: (Spanish)
Las baterías pueden explotar si no se manipulan de forma apropiada. No desmonte ni tire las baterías al fuego. Siga las normativas locales al desechar las baterías agotadas.

警告: (Simplified Chinese)
本电池如果更换不正确会有爆炸的危险，请依制造商说明处理用过之电池。

警告: (Traditional Chinese)
本電池如果更換不正確會有爆炸的危險，請依製造商說明處理用過之電池。

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1 Overview

Product Overview

This user manual describes how to set up and use the JetStor storage system.

SAS 724HS 10G (4U 24bays) – Single Controller Model
SAS 724HSD 10G (4U 24bays) – Dual Redundant Controller Model

The storage array provides a flexible, intelligent, storage area network (SAN) solution for virtualized server environments and the glowing demand for data storage. JetStor storage systems can provide non-stop service with a high degree of fault tolerance by using JetStor RAID technology and advanced array management features.

Model Comparison

JetStor storage system models.

Front-end interfaces:

- **SAS 724HS 10G:** 2 x 10GbE iSCSI ports + 2 x GbE iSCSI ports per controller.
- **SAS 724HSD 10G:** 2 x 10GbE iSCSI ports + 2 x GbE iSCSI ports per dual redundant controller.

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Chassis height and HDD bays:

- **SAS 724HS 10G / SAS 724HSD 10G:** 4U 24 bays with 3.5” HDD trays.

Host Interface	4U24
2 x 10GbE iSCSI + 2 x GbE iSCSI	SAS 724HS 10G SAS 724HSD 10G

The dual controller specific functions such as dual-active, cache mirroring, flexible RG ownership management, management port seamless take-over, no system down time, and etc are not available in Single controller series.

Package Contents

The package contains the following items:

- JetStor storage system (x1).
- HDD trays (x24)
- Power cords (x3)
- RS-232 cables (x2), one is for console (black color, phone jack to DB9 female), and the other is for UPS (gray color, phone jack to DB9 male).
- CD (x1).
- Rail kit (x1 set).
- Keys, screws for drives and rail kit (x1 packet).

Hardware

This section provides basic information about the hardware components.

SAS 724HS 10G (4U 24bays) – Single Controller Model
SAS 724HSD 10G (4U 24bays) – Dual Redundant Controller Model

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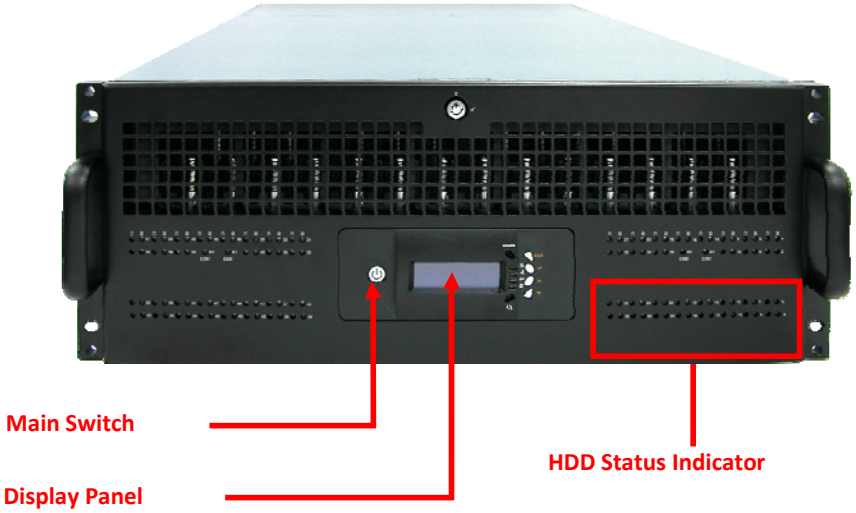
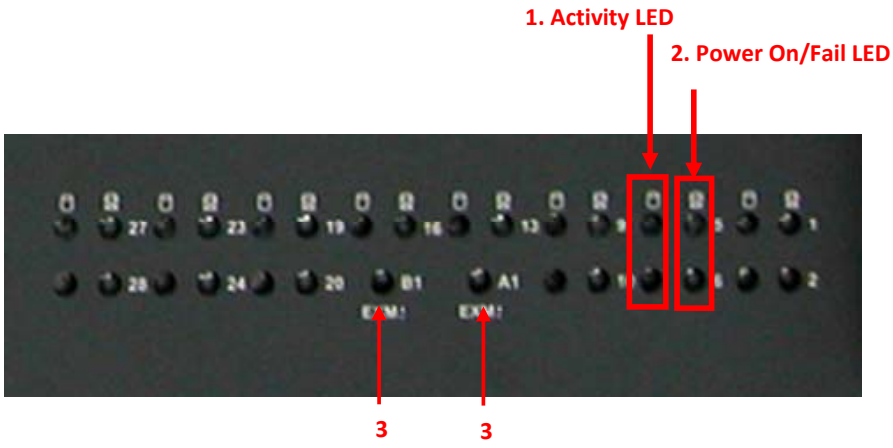
Front View



CAUTION:
When powering off the subsystem, press the Main Switch for 4 seconds and allow at least 3 minutes (during which each disk slot starting from slot #1 until slot #60 will be powered down) for the subsystem to shut down properly. Then turn off the switches of the 2 Power Supply Fan Modules.



This table shows the items located on the LCD Control Module.

Number	Description
1	Activity LED: • Blinking blue: Indicates the drive is busy or being accessed.
2	Power On / Fail LED: • Green: Indicates the drive in this slot is good. • Red: Indicates the drive in this slot is faulty. • Blinking Red: Indicates the drive in this slot is rebuilding.

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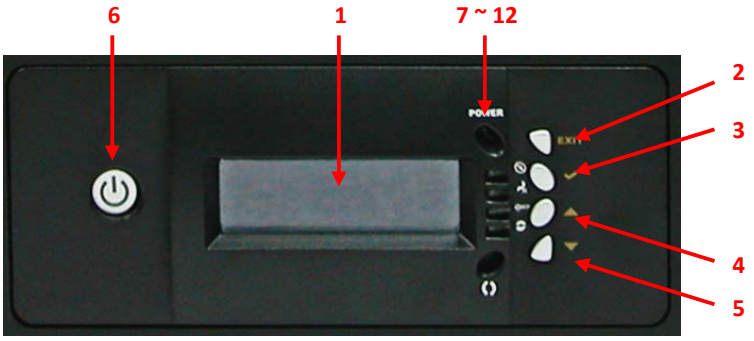
	• Off: Indicates there is no drive in this slot.
3	Expander module Fault LED: • Red: Indicates the Expander module is faulty. • Off: Indicates the Expander module is normal.

There are four buttons to control LCM (LCD Control Module), including:

▲ (up), ▼ (down), V (Select), and EXIT (Escape).



This table shows the items located on the LCD Control Module.

Number	Description
1	LCD display.
2	EXIT (Escape) button.
3	V (Select) button.
4	Up button.
5	Down button.
6	Power button.
7	Power LED: • Green: Power ON. • Off: Power OFF.
8	Power Fail LED: • Red: If one of the redundant power supply unit fails, this LED will turn to RED and alarm will sound. • Off: System OK.
9	Fan Fail LED: • Red: If a fan fails, this LED will turn red and an alarm will sound. • Off: Fan OK.
10	Over Temperature LED: • Red: If temperature irregularities in the system occur, this LED will turn RED and alarm will sound. • Off: Temperature OK.
11	Voltage Warning LED: • Red: If the output DC voltage is above or below the allowed range, an alarm will sound warning of a voltage abnormality and this LED will turn red. • Off: Voltage OK.
12	Activity LED:

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	• Blinking blue: When the disk array is busy or being accessed. • Off: Idle.

Disk Drive Assembly

Remove a drive tray. Then install a HDD.

- To install SAS drives: align the edge of the drive to the back end of tray; the backplane can directly connect to the drives.
- To install SATA drives with 3G/6G MUX boards: align the board edge to the back end of tray; the backplane can connect the drives through the boards.

SAS Drive

SATA Drive

The front of each disk tray has four components:

This table provides details about the front components of a disk tray.

Number	Description
1	Power LED: • Green: Drive is inserted and good. • Red: Drive fails. • Off: No drive in the tray.
2	Access LED: • Blue blinking: The drive is being accessed. • Off: The drive is not being accessed or no drive in the tray.
3	Tray removal handle.
4	Latch to release the tray.

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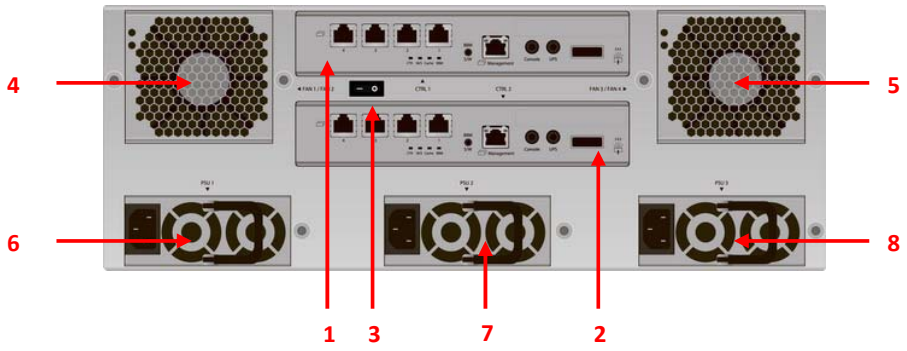
3TB / 6G MUX Board Limitation

	System	
	Single upgradable	Dual
	SAS 724HS 10G	SAS 724HSD 10G
<= 2TB SATA	No	6G MUX board
> 2TB SATA	No	6G MUX board
<= 2TB SAS	No	No
> 2TB SAS	No	No

HDD Type		6G MUX Board	3G MUX Board
SATA	3TB	2794 GB	2794 GB
	SATA 6Gb/s	SATA 6Gb/s	SATA 3Gb/s
	SATA 3Gb/s	SATA 6Gb/s	SATA 3Gb/s
	SATA 1.5Gb/s	SATA 6Gb/s	SATA 1.5Gb/s
		Without MUX Board	
SAS	3TB	2794 GB	
	SAS 6Gb/s	SAS 6Gb/s	
	SAS 3Gb/s	SAS 3Gb/s	

Rear View

Chassis:



This table describes the rear modules.

Number	Description
1	Controller 1 (CTRL 1).
2	Controller 2 (CTRL 2, only for dual-controller).
3	Power Switch • |: ON. • O: OFF.
4	Fan Module (FAN1 / FAN2).
5	Fan Module (FAN3 / FAN4).
6	Power Supply Unit (PSU1).
7	Power Supply Unit (PSU2).
8	Power Supply Unit (PSU3).

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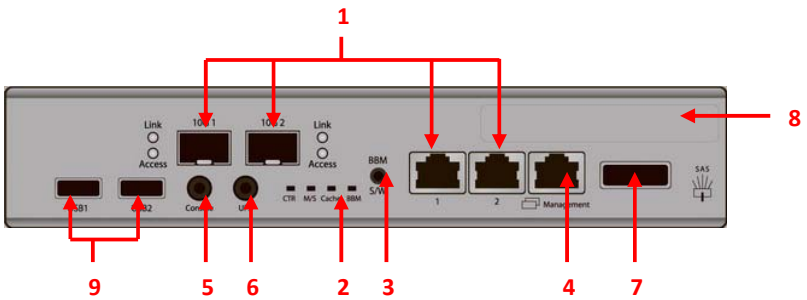
This table describes the rear components.

Number	Description
1	SAN ports (depending on model): • P600Q: 2 x 10GbE iSCSI ports + 2 x GbE iSCSI ports.
2	LED (from left to right) Controller health LED: • Green: Controller status normal. • Red: System booting or controller failure. Master slave LED (only for dual controllers): • Green: This is the Master controller. • Off: This is the Slave controller. Dirty cache LED: • Orange: Data on the cache waiting for flush to disks. • Off: No data on the cache. BBM LED (when status button pressed): • Green: BBM installed and powered. • Off: No BBM installed.
3	BBM status button (used to check the battery when the power is off.): • If the BBM LED shows Green, then the BBM still has power to keep data on the cache. • If the BBM LED stays Off, then the BBM power has run out and it cannot provide power for the cache anymore. It needs to be recharged or replaced.
4	Management port.
5	Console port.
6	RS 232 port for UPS.
7	SAS JBOD expansion port.
8	BBM slot.
9	USB • No function. Reserved for the future design purpose.
LED	10GbE Link LED: • Orange: Asserted when a 1G link is established and maintained. • Blue: Asserted when a 10G link is establish and maintained. 10GbE Access LED: • Yellow: Asserted when the link is established and packets are being transmitted along with any receive activity.

CAUTION: Be aware that when Controller Health LED is in RED, please DO NOT unplug the controller from the system or turn off the power suddenly. This may cause unrecoverable damage, which will not be covered by warranty.

(2 x 10GbE iSCSI + 2 x GbE iSCSI) controller:



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RAID Concepts

RAID is the abbreviation of Redundant Array of Independent Disks. The basic idea of RAID is to combine multiple drives together to form one large logical drive. This RAID drive obtains performance, capacity and reliability than a single drive. The operating system detects the RAID drive as a single storage device.

RAID Levels

There are various RAID levels with different degrees of data protection, data availability, and performance. A description of supported RAID levels follow:

Type	Description	Min. No. of Drives
RAID 0	Disk striping.	1
RAID 1	Disk mirroring over two disks.	2
N-way mirror	Extension to RAID 1 level. It has N copies of the disk.	N
RAID 3	Striping with parity on the dedicated disk.	3
RAID 5	Striping with interspersed parity over the member disks.	3
RAID 6	2-dimensional parity protection over the member disks.	4
RAID 0+1	Mirroring of the member RAID 0 volumes.	4
RAID 10	Striping over the member RAID 1 volumes.	4
RAID 30	Striping over the member RAID 3 volumes.	6
RAID 50	Striping over the member RAID 5 volumes.	6
RAID 60	Striping over the member RAID 6 volumes.	8
JBOD	The abbreviation of *Just a Bunch Of Disks*. Independently address a drive.	1

Volume Relationship

The following graphic is the volume structure which JetStor has designed. It describes the relationship of RAID components.

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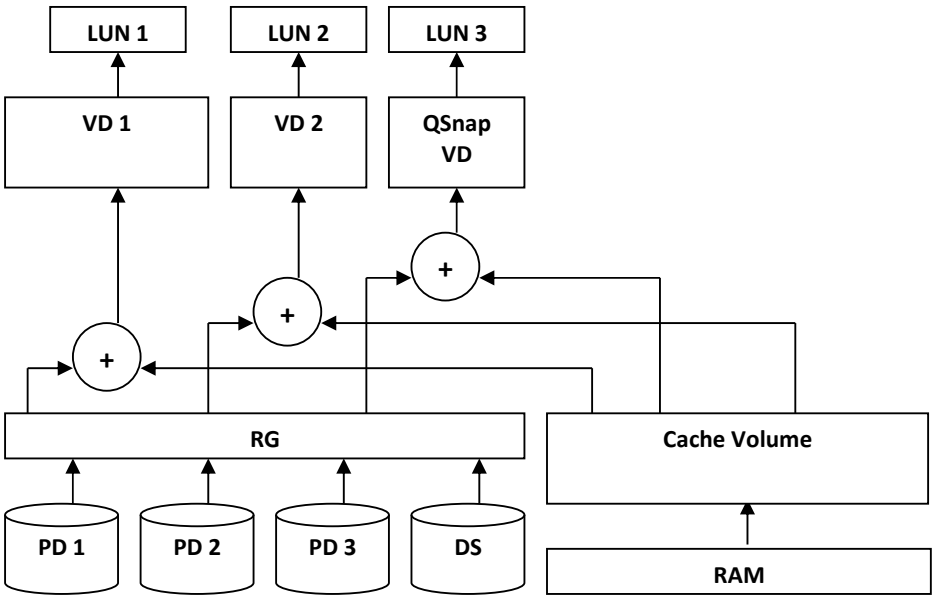
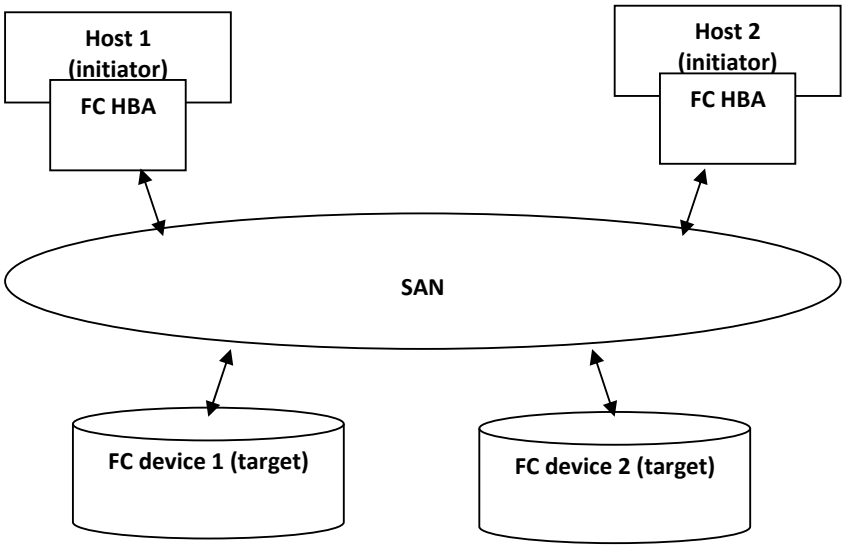


One RG (RAID group) consists of a set of VDs (Virtual Disk) and owns one RAID level attribute. Each RG can be divided into several VDs. The VDs in one RG share the same RAID level, but may have different volume capacity. All VDs share the CV (Cache Volume) to execute the data transaction. LUN (Logical Unit Number) is a unique identifier, in which users can access through SCSI commands.

Fibre Channel Concepts

Fibre channel started use primarily in the supercomputer field, but has become the standard connection type for storage area networks (SAN) in enterprise storage.



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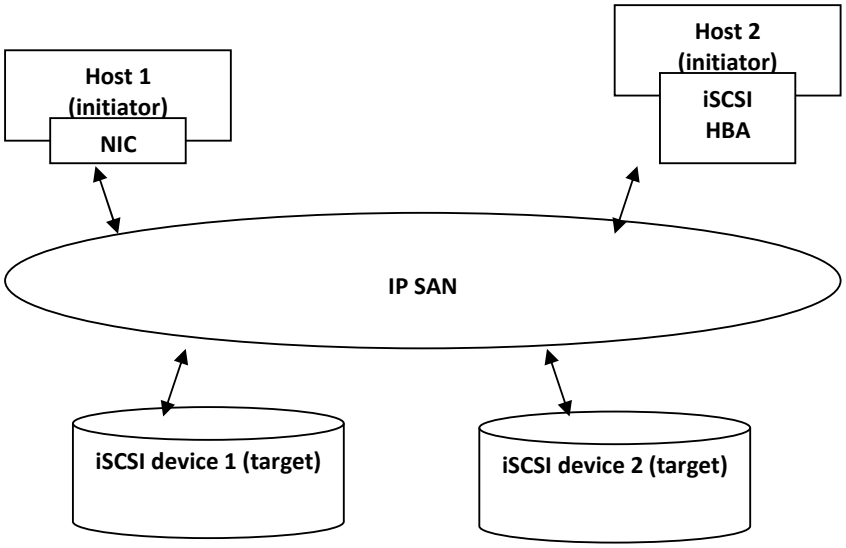
The target is the storage device itself or an appliance which controls and serves volumes or virtual volumes. The target is the device which performs SCSI commands or bridges to an attached storage device.

iSCSI Concepts

iSCSI (Internet SCSI) is a protocol which encapsulates SCSI (Small Computer System Interface) commands and data in TCP/IP packets for linking storage devices with servers over common IP infrastructures. iSCSI provides high performance SANs over standard IP networks like LAN, WAN or the Internet.

IP SANs are true SANs (Storage Area Networks) which allow several servers to attach to an infinite number of storage volumes by using iSCSI over TCP/IP networks. IP SANs can scale the storage capacity with any type and brand of storage system. In addition, it can be used by any type of network (Ethernet, Fast Ethernet, Gigabit Ethernet, and 10 Gigabit Ethernet) and combination of operating systems (Microsoft Windows, Linux, Solaris, Mac, etc.) within the SAN network. IP-SANs also include mechanisms for security, data replication, multi-path and high availability.



Storage protocol, such as iSCSI, has “two ends” in the connection. These ends are initiator and target. In iSCSI, we call them iSCSI initiator and iSCSI target. The iSCSI initiator requests or initiates any iSCSI communication. It requests all SCSI operations like read or write. An initiator is usually located on the host side (either an iSCSI HBA or iSCSI SW initiator).

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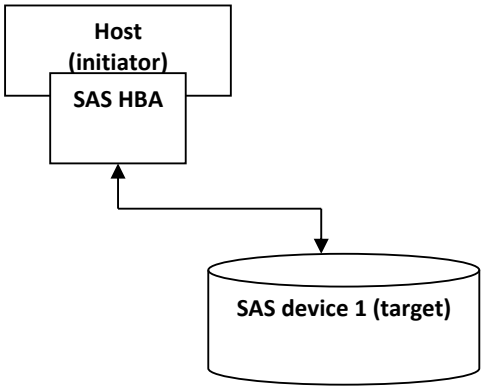
The target is the storage device itself or an appliance which controls and serves volumes or virtual volumes. The target is the device which performs SCSI command or bridge to an attached storage device.

SAS Concepts

Serial-attached SCSI offers advantages over older parallel technologies. The cables are thinner, and the connectors are less bulky. Serial data transfer allows the use of longer cables than parallel data transfer.

The target is the storage device itself or an appliance which controls and serves volumes or virtual volumes. The target is the device which performs SCSI command or bridge to an attached storage device.



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2 Installation

Installation Overview

Before starting, prepare the following items:

- A management computer with a Gigabit Ethernet NIC (recommend) on the same network as the JetStor storage system.
- Connection cables:
  - CAT 5e, or CAT 6 (recommend) network cables for the management port.
  - CAT 6 network cables.
- Prepare a storage system configuration plan by the network administrator. The plan should include network information for the management port and iSCSI data ports. If using static IP addresses, please prepare a list of the static IP addresses, the subnet mask, and the default gateway.
- Switches:
  - Gigabit switches (optional) for connecting management port.
  - Gigabit switches (recommended). Or Gigabit switches with VLAN / LCAP / Trunking (optional).
  - 10 Gigabit switches with VLAN / LCAP / Trunking (optional).
- CHAP security information, including CHAP username and secret (optional).
- For dual-controller systems, it is recommended that the host logon to the target twice (both Controller 1 and Controller 2), and then the MPIO should setup automatically.
- For an iSCSI dual-controller system, install an iSNS server on the same storage area network (recommended).

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Drive Slot Numbering

Slot 1	Slot 7	Slot 13	Slot 19
Slot 2	Slot 8	Slot 14	Slot 20
Slot 3	Slot 9	Slot 15	Slot 21
Slot 4	Slot 10	Slot 16	Slot 22
Slot 5	Slot 11	Slot 17	Slot 23
Slot 6	Slot 12	Slot 18	Slot 24

TIP:
Install at least one drive in Slot 1 to 4 (marked gray slots). System event logs are saved in these drives. Otherwise, event logs no longer exist after a reboot.

System Installation and Deployment

Using the following instructions to install and deploy the storage system.

- Install the BBM (Battery Backup Module) in their appropriate controllers if needed.

  - BBM supports hot pluggable. Regardless of the system is turned on or off.
  - Remove the cover of BBM.
  - Insert the BBM.
  - Tighten the BBM and use screws to lock the both sides.

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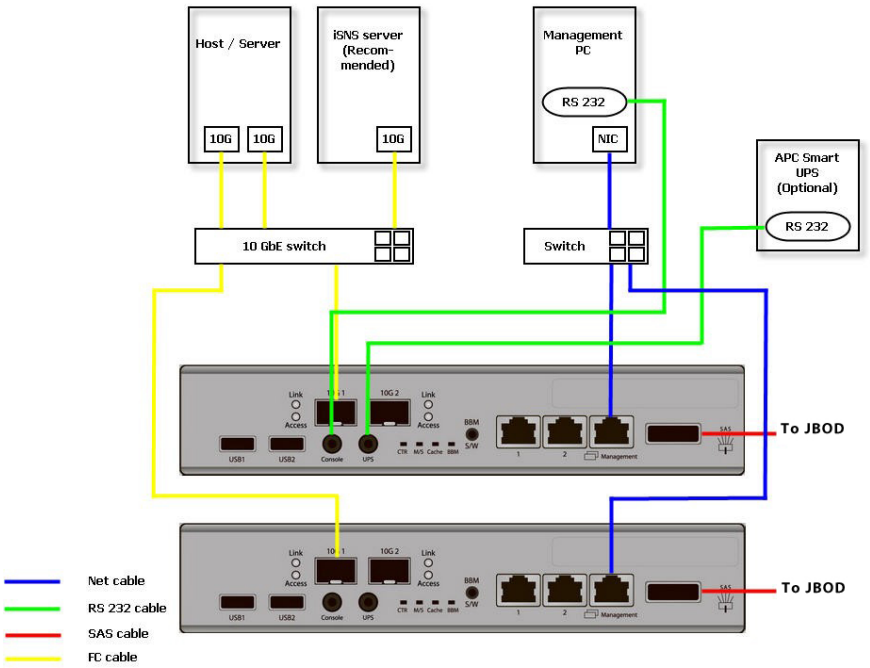
- At the rear, check that the Master Controller is in its slot (CTRL 1).
- If desired, install the optional Slave Controller in its slot (CTRL 2, only for dual-controller).

CAUTION:
When running on dual controller mode, please make sure both controllers have the same DIMM on each corresponding memory slot. Failing to do so will result in controller malfunction, which will not be covered by warranty.

- Install the Rail Kit onto the unit and insert it into the rack.

CAUTION:
The system is very heavy. It's recommend that a mechanical lifter or at least two persons be used to raise and align the system to prevent injury during installation. Use care when inserting or removing a system into or out of a rack to prevent the accidental tipping or the rack causing damage or personal injury.

- Install the Disk Drives.
- Connect the management port cable and data port cables on the network plan, the topology examples are on the following.



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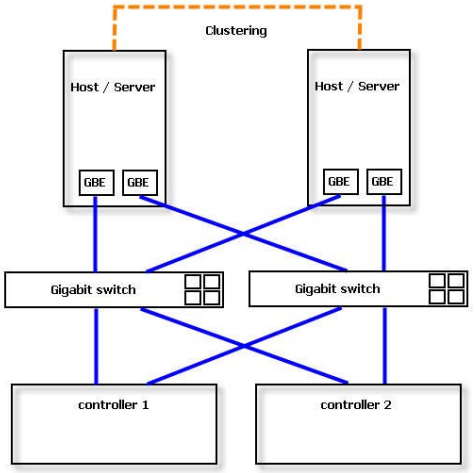
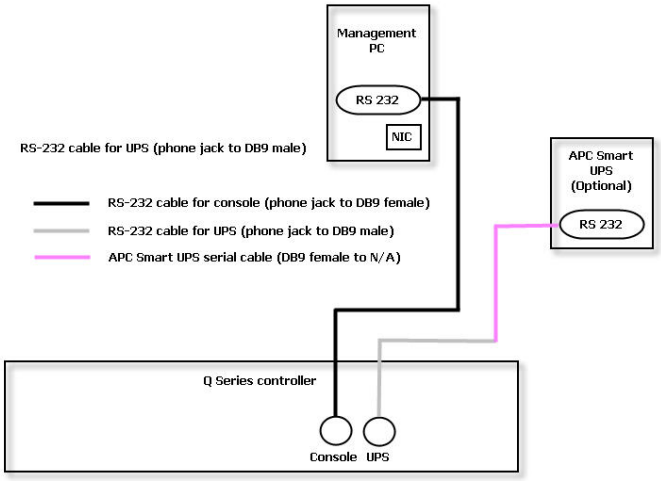
Dual controller topology:

For a better data service availability, all the connections among hosts, switches, and the dual controllers are recommended as redundant as below.



Console and UPS topology:

Connect the console cable and UPS as the following.



- Using RS-232 cable for console (back color, phone jack to DB9 female) to connect from controller to management PC directly.
- Using RS-232 cable for UPS (gray color, phone jack to DB9 male) to connect from controller to APC Smart UPS serial cable (DB9 female side), and then connect the serial cable to APC Smart UPS.

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CAUTION:
It may not work when connecting the RS-232 cable for UPS (gray color, phone jack to DB9 male) to APC Smart UPS directly.

- Attach the power cords and power on the system, and then power on the hosts and the iSNS server (optional for iSCSI environment).
- Start the configuration.

Power ON / OFF

Power on the System

The power switch is located at the rear of the panel. To turn on the system, you may press power switch to "|". After you turn the power ON, the system performs a booting process which takes a few minutes.

CAUTION:
Be aware that when Controller Health LED is in RED, please DO NOT plug out the controller from the system or turn off the power suddenly. This may cause unrecoverable damage, which will not be covered by warranty.

Power off the System

If it becomes necessary to power down the system, it is recommended using a normal, controlled shutdown form through either the LCM or Web UI to ensure all data is flushed from the cache first.

1. Shutdown using LCM:

   At the LCM:

   - Power off the system using a normal shutdown.
     - Press **ENT** button.
     - Press ▼ (down) twice to show **Reboot/Shutdown**, and press **ENT** button.
     - Press ▼ (down) once to show **Shutdown**, and press **ENT** button.
     - Press ▲ (up) once to highlight **Yes**, and press **ENT** button.
   - System shutdown begins. When the **System Shutdown** message is displayed, turn the power switch to OFF "O".

2. Shutdown using Web UI:

   Using the Web UI:

   - Select **System Maintenance -> Reboot and Shutdown**.

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- Click the **Shutdown** icon.
- System shutdown begins. When the **System Shutdown** message is displayed, turn the power switch to OFF “O”.

3. Shutdown using JetCentral Client:

   Login JetCentral Client:

   - Select **Maintenance -> Reboot and Shutdown**.
   - Click the **Shutdown** icon.
   - System shutdown begins. When the **System Shutdown** message is displayed, turn the power switch to OFF “O”.

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3 Quick Setup

Management Interfaces

There are several management methods to manage the storage system, described on the following.

Serial Console

Use console cable (NULL modem cable) to connect from console port of the storage system to RS 232 port of the management PC. The console settings are on the following:

- Baud rate: 115200, 8 data bit, no parity, 1 stop bit, and no flow control.
- Terminal Type: vt100

The initial defaults for administrator login are:

- Management IP Address: 192.168.1.234
- User Name: admin
- Password: 1234

Secure Shell Remote Access

SSH (secure shell) software is required for remote login. The SSH client software is available at the following web site:

- SSH Tectia Client: http://www.ssh.com/
- PuTTY: http://www.chiark.greenend.org.uk/

The default management IP address is 192.168.1.234/255.255.255.0, please configure your computer IP address at the same subnet of the system (e.g.: 192.168.1.1/255.255.255.0). The remote control settings are on the following:

- Host IP: <*IP Address*> (e.g.: 192.168.1.234)
- **User Name: admin**
- **Password: 00000000**

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TIP:
JetStor system supports SSH for remote access only. When using SSH, the IP address and password are required for login.

LCM

After booting up the system, the following screen shows management port IP and model name.

```
192.168.1.234
JetStor 724HSD 10G ←
```

To access the LCM options, use the **ENT** (Enter) button, **ESC** (Escape) button, ▲ (up) and ▼ (down) to scroll through the functions.

This table describes the function of each item.

Function	Description
System Info.	Display system information including firmware version and amount of RAM.
Alarm Mute	Mutes an alarm after an error occurs.
Reset/Shutdown	Reset or shutdown the system.
Quick Install	Provide quick steps to create a volume.
Volume Wizard	Provide smart steps to create a volume.
View IP Setting	Display current IP address, subnet mask, and gateway.
Change IP config	Set IP address, subnet mask, and gateway. There are 2 options: DHCP (Get IP address from DHCP server) or static IP.
Enc. Management	Shows the enclosure data for physical disk temperatures, fan status, and power supply status.
Reset to Default	Reset the system to default settings. The default resets include: • Management IP Address: 192.168.1.234 • **User Name: admin** • **Password: 00000000**

WARNING or ERROR events displayed on the LCM are automatically filtered by the LCM default filter. The filter setting can be changed in the Web UI under **System Configuration -> Log and Alert Settings**.

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This table displays the LCM menu hierarchy.

Main	L1	L2	L3	L4	L5
<IP Addr> JetStor <*Model*> ▲▼	System Info.	Firmware Version <n.n.n>			
		RAM Size <*nnnn*> MB			
	Alarm Mute	▲Yes No▼			
	Reset/ Shutdown	Reset	▲Yes No▼		
		Shutdown	▲Yes No▼		
	Quick Install (only available if not already set)	<RAID 0 RAID 1 RAID 3 RAID 5 RAID 6 RAID 0+1> *nnn* GB	Apply The Config	▲Yes No▼	
	Volume Wizard (only available if not already set)	Local <RAID 0 RAID 1 RAID 3 RAID 5 RAID 6 RAID 0+1>	Use default algorithm	Volume Size <*nnn*> GB	Apply The Config ▲Yes No▼
		JBOD <*n*> ▲▼ <RAID 0 RAID 1 RAID 3 RAID 5 RAID 6 RAID 0+1>	New *n* disk ▲▼ <*nnn*> GB	Adjust Volume Size	Apply The Config ▲Yes No▼
	View IP Setting	IP Config <Static IP / DHCP / BOOTP>			
		IP Address <192.168.001.234 >			
		IP Subnet Mask <255.255.255.0>			
		IP Gateway <xxx.xxx.xxx.xxx>			
	Change IP Config	DHCP	▲Yes No▼		
		BOOTP	▲Yes No▼		
		Static IP	IP Address	Adjust IP address	
			IP Subnet Mask	Adjust Submask IP	
			IP Gateway	Adjust Gateway IP	
			Apply IP Setting	▲Yes No▼	
	Enc. Management	Phy. Disk Temp.	Local Slot <*n*>:		

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		<*nn*> (C)
	Cooling	Local FAN<*n*>: <*nnnnn*> RPM
	Power Supply	Local PSU<*n*>: <*status*>
Reset to Default	▲Yes No▼	

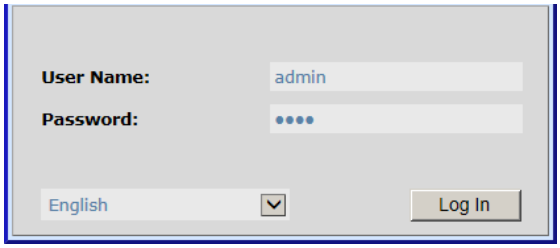
CAUTION:
To prevent data loss, when powering down the storage system, it is recommended to execute **Reset/Shutdown -> Shutdown -> Yes** to flush the data from the cache to the physical disks.

Web UI

JetStor storage system supports graphic user interface operation. It supports most common web browsers. Be sure to connect the LAN cable to the management port of the system.

The default management IP address is 192.168.1.234/255.255.255.0, please configure your computer IP address at the same subnet of the system (e.g.: 192.168.1.1/255.255.255.0). And then enter the IP address into your browser to display the authentication screen.

- http://<*IP Address*> (e.g.: http://192.168.1.234)



To access the Web UI, you have to enter a user name and password. The initial defaults for administrator login are:

- **User Name: admin**
- **Password: 00000000**

When the password has been verified, the home page is displayed.

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Choose the functions from the Menu Bar on the left side of the window to make any configuration changes.

TIP:
The **Host Port Configuration** menu bar option is only visible when the controller has multiple interfaces. The **iSCSI Configuration** menu bar option is only visible when the controller has iSCSI ports.

There are up to seven indicators and three icons at the top-right corner. The last indicator (Dual controller) is only visible when two controllers are installed.

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This table describes the indicators and icons.

Icon	Description
	RAID indicator: • Green: All RAID groups are functioning. • Red: A RAID group is degraded or has failed.
	Temperature indicator: • Green: Temperature is normal. • Red: Temperature is too high.
	Voltage indicator: • Green: Voltage values are normal. • Red: Voltage values are out of range.
	UPS indicator: • Green: UPS is functioning or no UPS is connected. • Red: UPS connection has failed.
	Fan indicator: • Green: Fan is working well. • Red: Fan failed.
	Power indicator: • Green: Power supplies are connected and working well. • Red: A power supply has failed or is no longer connected.
	Dual controller indicator: • Green: Dual controllers are active and working well. • Orange: One of the dual controllers has failed.
	Return to home page.
	Logout of the management web UI.
	Mute alarm beeper.

TIP:
If the status indicators in Internet Explorer (IE) are displayed in gray, but not in blinking red, please enable **Tools -> Internet Options -> Advanced -> Play animations in webpages** options in IE. The default value is enabled, but some applications disable it.

How to Use the Guided Configurations

To help users get started quickly, two guided configuration tools are available in the Web UI and LCM. **Quick Installation** guides you an easy way to create a volume. **Volume Creation Wizard** provides a smarter policy to help users to create a volume. If you are an advanced user, you can skip these steps.

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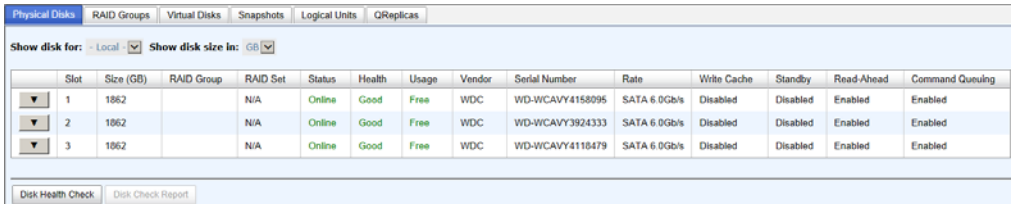
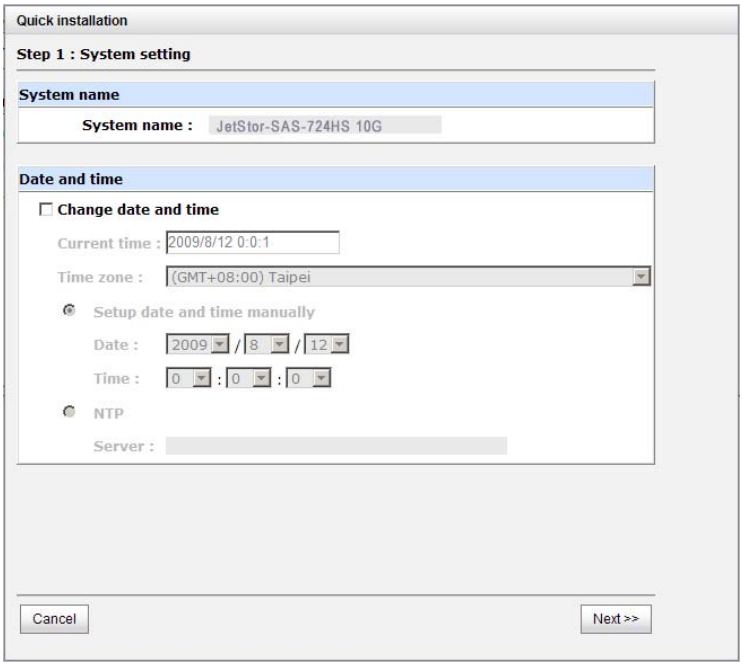
Quick Installation Tool

This tool guides you through the process of setting up basic array information, configuring network settings, and the creation of a volume on the storage system. Please make sure that it has some free hard drives installed in the system. SAS drivers are recommended.



1. Click **Quick Installation** from the menu bar.
2. Enter a **System Name** and set up the **Date and Time**. Click **Next** button to proceed.



3. Confirm or change the management port IP address and DNS server. If the default HTTP, HTTPS, and SSH port numbers are not allowed on your network, they can be changed here as well.

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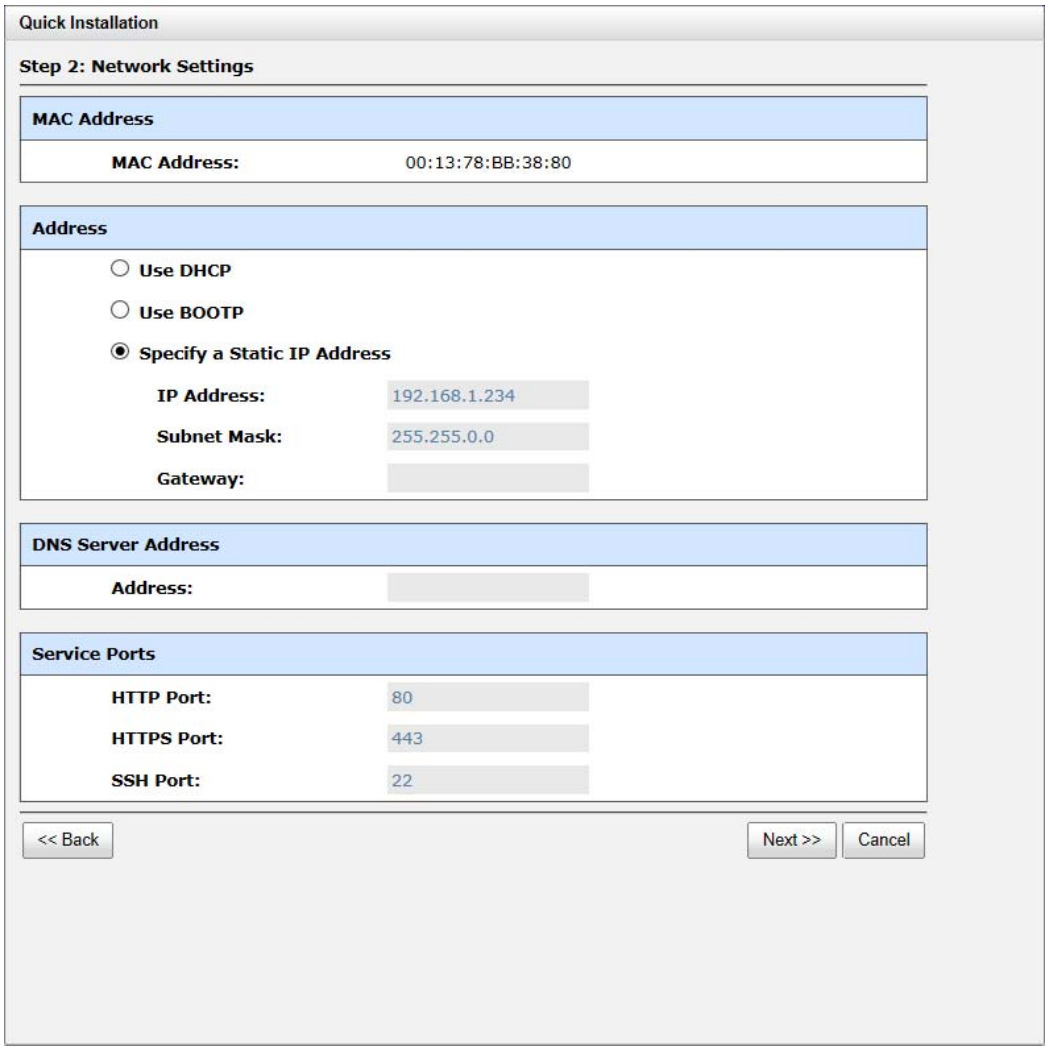

4. For iSCSI Configurations, use this step to set up the data port iSCSI IP address, and then click **Next** button.

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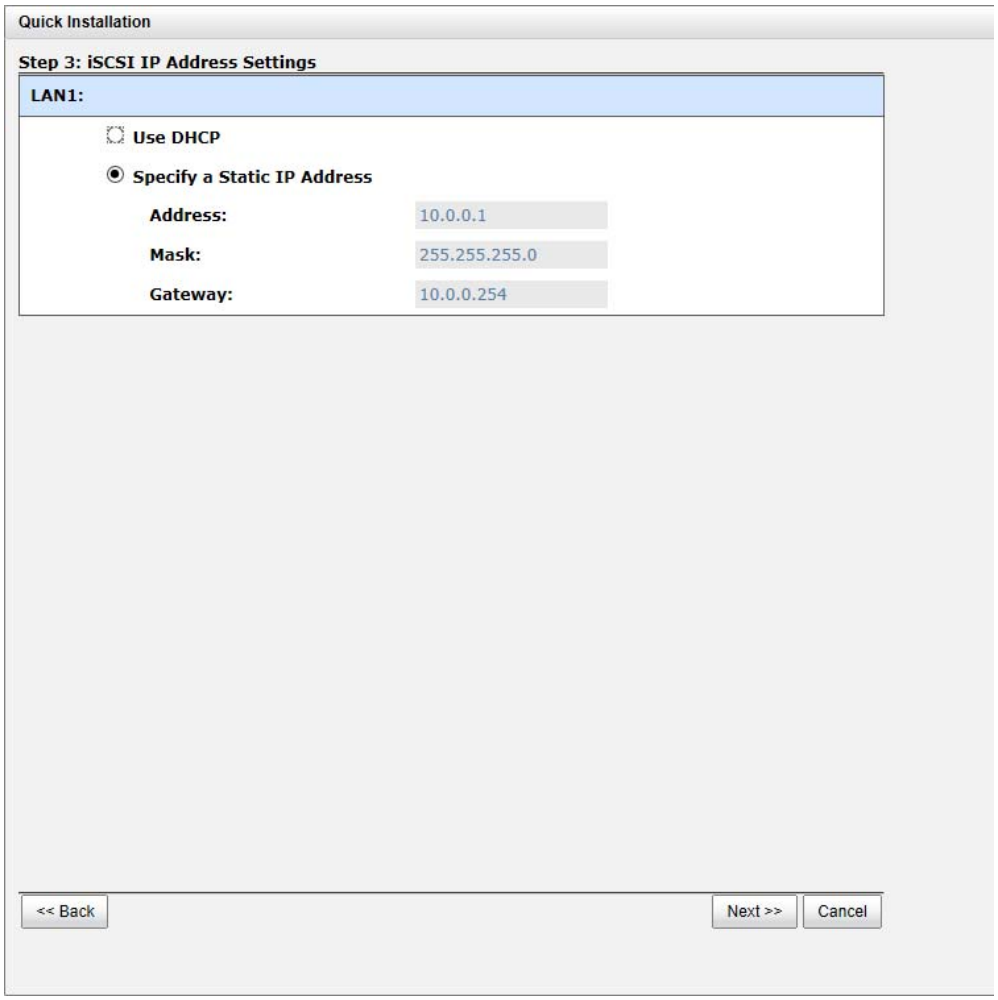

5. Choose a **RAID Level**. The number in the brackets is the maximum capacity at the RAID level. This step utilizes all drives in the storage system as well as any JBOD expansion arrays present. This option allows the selection of the RAID type and the number of drives in each array.

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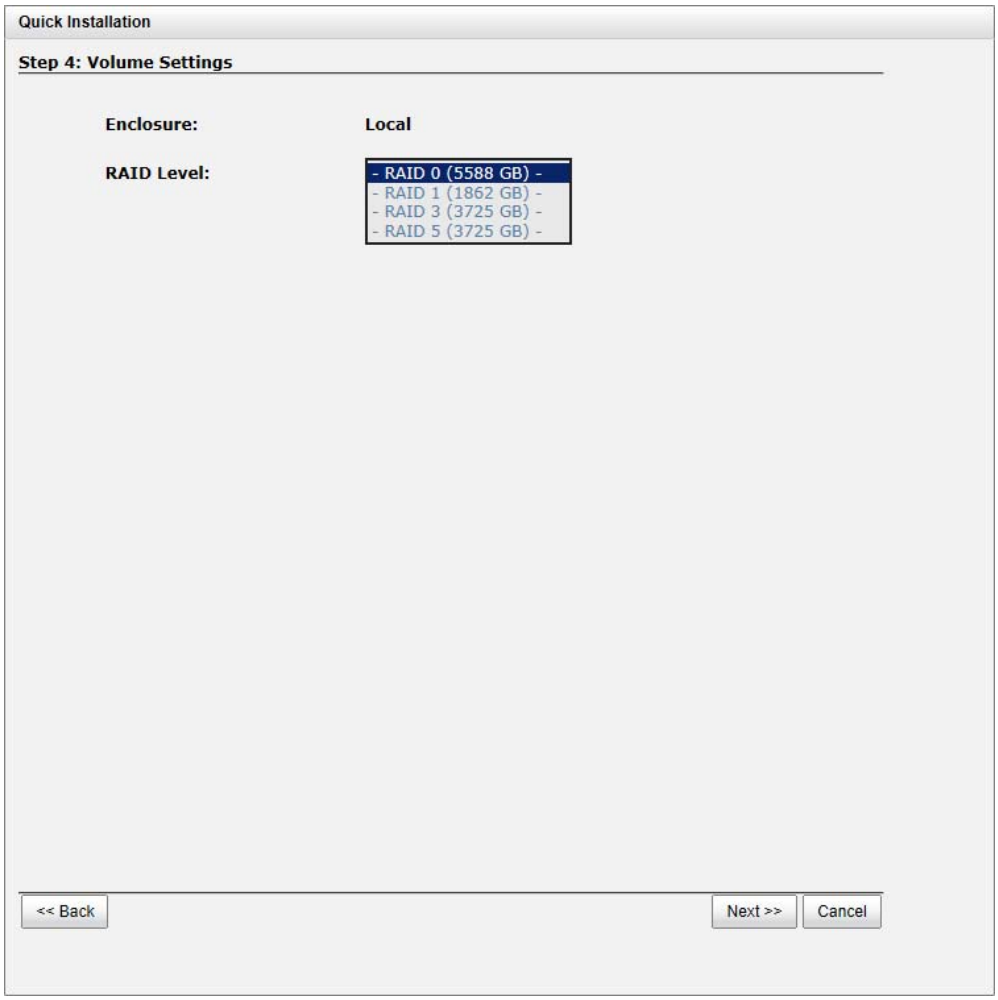

6. Verify all items, and then click **Finish** button to complete the quick installation.

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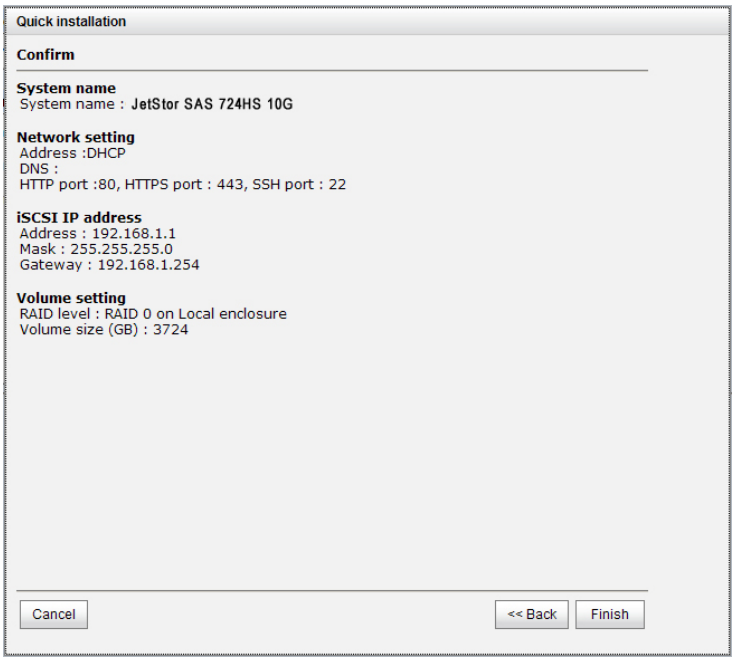

The iSCSI information is only displayed when iSCSI controllers are used. Use **Back** button to return to a previous page to change any setting.

Volume Creation Wizard

The **Volume Creation Wizard** provides a smarter policy to determine all possibilities and volume sizes in the different RAID levels that can be created using the existing free drives. It provides:

- Largest capacity for each RAID level from which to choose.
- The fewest number of drives for each RAID level / volume size.

This way, after choosing RAID level, you may find that some drives are still available (free status). This phenomenon is the result of using smart design. Take an example, user chooses the RAID 5 level and the system has 12*200GB + 4*80GB free drives inserted. Generally, if using all 16 drives for a RAID 5 group, the maximum size of volume is (16-1)*80GB = 1200GB. This wizard provides a smarter check and searches the most efficient way of using free drives. It uses 200GB drives only to provide (12-1)*200GB = 2200GB capacity, the volume size is larger and less drives.

1. Click **Volume Creation Wizard** from the menu bar.
2. Choose a **RAID Level**. The number in the brackets is the maximum capacity at the RAID level.

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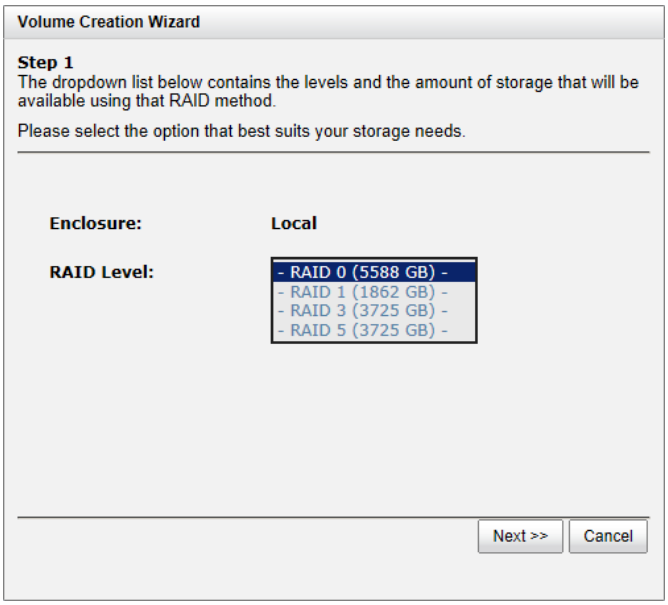
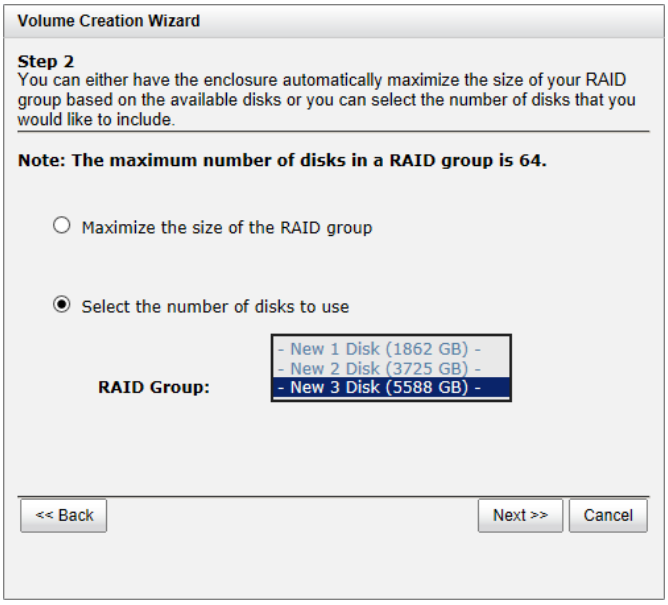


3. Select the default option **Maximize the size of the RAID group** or manual option **Select the number of disks to use**. From the drop-down list, select either the RAID Group capacity combination desired. Click **Next** button to proceed.



4. Enter the **Volume Size (GB)** desired that is less than or equal to the default available size shown. Then click **Next** button.

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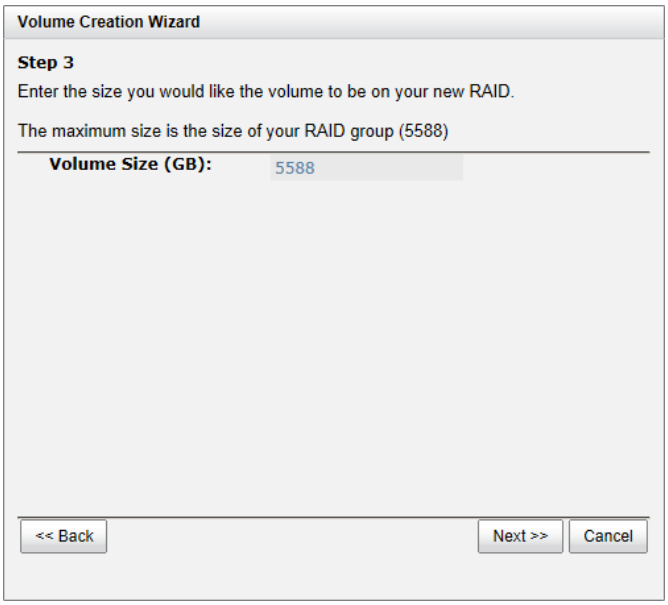
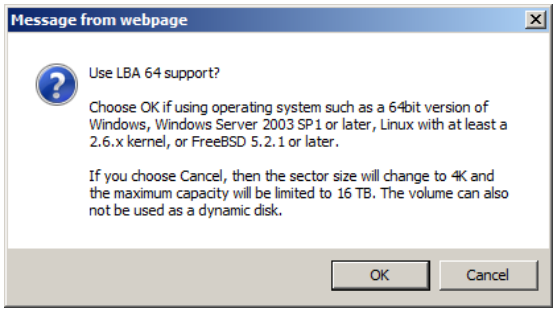


5. Use LBA 64 support? It depends on the operation system.



6. Finally, verify the selections and click **Finish** button if they are correct.

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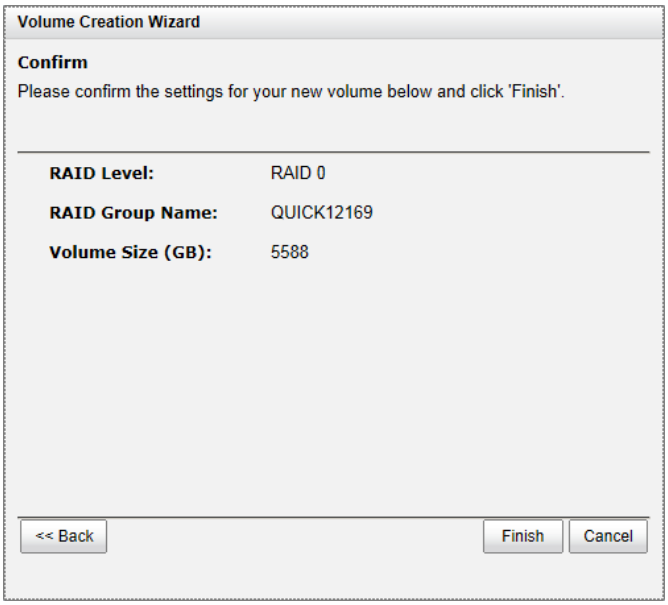

The volume is created and named by the system automatically. It is available to use now.

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4 Basic Configuration

Interface Hierarchy

This table describes the hierarchy of the web GUI.

Menu Bar	L1	L2, Button or Menu
System Configuration	System Settings	System Name / Date and Time / System Indication
	Network Settings	MAC Address / IP Address / DNS Server Address / Service Ports
	Login Settings	Login Options / Admin Password / User Password
	Email Notification Settings	Email Settings / Send Test Mail
	Log and Alert Settings	SNMP Trap Settings / Windows Messenger / Syslog Server Settings / Admin Interface and Front Display Alerts / Device Buzzer
iSCSI Configuration (This option is only visible when the controller has iSCSI ports.) Host Configuration (This option is only visible when the controller has multiple interfaces.)	Network Setup	Show information for: < Controller 1 | Controller 2 > **Options:** [iSCSI Bonding Settings | Delete iSCSI Bonding] / Set VLAN ID / iSCSI IP Address Settings / Make Default Gateway / [Enable | Disable] Jumbo Frames / Ping Host / Reset Port
	Entity and iSNS Settings	Entity Name / iSNS IP Address
	iSCSI Node	Show information for: < Controller 1 | Controller 2 > **Options:** Authentication Method / Change Portal / Rename Alias / Users
	Active Sessions	Show information for: < Controller 1 | Controller 2 > Connection Details / Disconnect
	CHAP Accounts	Create User **Options:** Modify User Information / Delete User
	Fibre Channel (This option is only visible when the controller has FC ports.)	Show information for: < Controller 1 | Controller 2 > Clear All Counters **Options:** Change Link speed / Change Connection Mode / Node Configuration / Clear Counters
Volume Configuration	Physical Disks	Show disk for: < -Local- | -JBODn- > Show disk size in: < (GB) | (MB) > Disk Health Check / Disk Check Report **Options:** Set Free Disk / Set Global Spare / Set Local Spare / Set Dedicated Spare / Upgrade / Disk Scrub / Read Error Cleared / Turn [on | off] the Indication LED / More information
	RAID Groups	Show RAID size in: < (GB) | (MB) >

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		Create **Options:** Migrate RAID Level / Move RAID Level / [Activate | Deactivate] / Verify Parity / Delete / Change Preferred Controller / Change RAID Options / Add RAID Set / Add Policy / More information **RAID Set options:** Remove / Move RAID Level / List Disks RAID Group Policy options: Delete / Modify
	Virtual Disks	Create / Cloning Options **Options:** Extend / Set SSD Caching / Verify Parity / Delete / Set Properties / Space Reclamation / Attach LUN / Detach LUNs / List LUNs / Set Clone / Set Snapshot Space / Cleanup Snapshots / Take a Snapshot / Scheduled Snapshots / List Snapshots / More information
	Snapshots	Set Snapshot Space / Scheduled Snapshots / Take a Snapshot / Cleanup Snapshots **Options:** Set Quota / Rollback / Delete
	Logical Units	Attach LUN **Options:** Detach LUN
	QReplicas	Create / Rebuild / QReplica Options / Shaping Setting Configuration **Options:** Start / Stop / Set Task Shaping / Add Path / Delete Path / Schedule / Delete / Add Connection / Delete Connection **Task Path options:** Add Connection / Delete Connection / Delete
Enclosure Management	Hardware Monitor	Show information for: < -Local- | -JBODn- > Temperature (Internal)/(Case): < (C) / (F) > Controller 1 Monitors / Controller 2 Monitors / Backplane **Options:** Auto Shutdown
	UPS	UPS Type / Shutdown Battery Level (%) / Shutdown Delay (Seconds) / Shutdown UPS / UPS Status / UPS Battery Level
	SES	[Enable | Disable]
	S.M.A.R.T.	Show information for: < -Local- | -JBODn- > Temperature (Internal)/(Case): < (C) | (F) >
System Maintenance	System information	Download System Information
	Event log	Event Log Level to Show: < Information | Warning | Error > Download / Mute Buzzer / Clear
	Upgrade	Controller Module Firmware Update / JBOD Firmware Update / Controller Mode / SSD Caching License
	Firmware Synchronization (This option is only visible when dual controllers are inserted.)	Apply
	Reset to Factory Default	Reset
	Configuration	Import or Export / Import File

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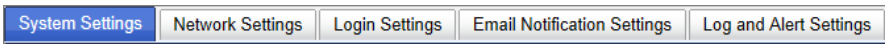
	Backup	
	Volume Restoration	**Options:** Restore
	Reboot and Shutdown	Reboot / Shutdown **Reboot options:** [Both Controller 1 and Controller 2 | Controller 1 | Controller 2]
Performance Monitor	Disk	Show disk for: < -Local- | -JBODn- >
	iSCSI	Controller 1 / Controller 2
	Fibre Channel (This option is only visible when the controller has FC ports.)	Controller 1 / Controller 2
Quick Installation		Step 1 / Step 2 / Step 3 / Step 4 / Confirm
Volume Creation Wizard		Step 1 / Step 2 / Step 3 / Confirm

System Configuration

The **System Configuration** menu option is for accessing the **System Settings**, **Network Settings**, **Login Settings**, **Email Notification Settings,** and **Log and Alert Settings** option tabs.



System Settings

The **System Settings** tab is used to setup the system name and date. The default system name is composed of the model name and the serial number of this system.

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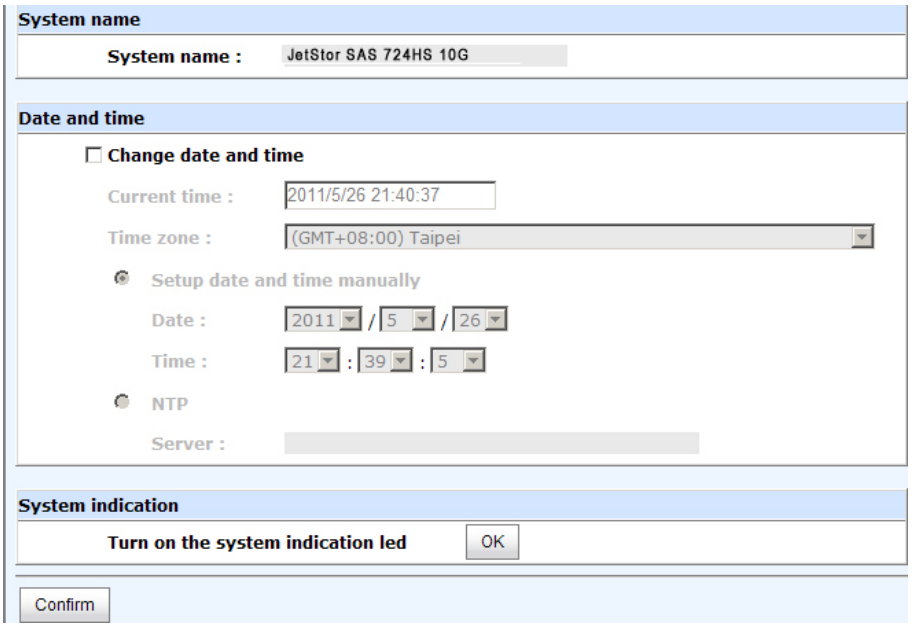

The options are available on this tab:

- **System Name:** Change the **System Name**, highlight the old name and type in a new one.
- **Date and Time:** Change the current date, time and time zone settings, check **Change Date and Time**. The changes can be done manually or synchronized from an NTP (Network Time Protocol) server.
- **System Identification: Flash the status light on the front display** for locating this system in the racks, click **OK** button. To **stop flashing the status light on the front display**, click **OK** button again.

When it is done, click **Apply** button.

Network Settings

The **Network Settings** tab is used to view the MAC address and change basic network settings.

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The options are available on this tab:

- **Enable dual management ports:** This is for dual controller models. Check it to enable dual management ports.
- **MAC Address:** Display the MAC address of the management port in the system.
- **IP Address:** The option can change IP address for remote administration usage. There are three options: **DHCP**, **BOOTP** and **Specify a Static IP Address**. **DNS Server Address:** If necessary, the IP address of DNS server can be entered or changed here.
- **Service Ports: If the def**ault port numbers of HTTP, HTTPS and SSH a**re** not allowed on the network, they can be changed here.

When it is done, click **Apply** button.

Login Settings

The **Login Settings** tab is used to control access to the storage system. For the security reason, set the auto logout option or set the limit access of one administrator at a time. The other options can change the Admin and User passwords.

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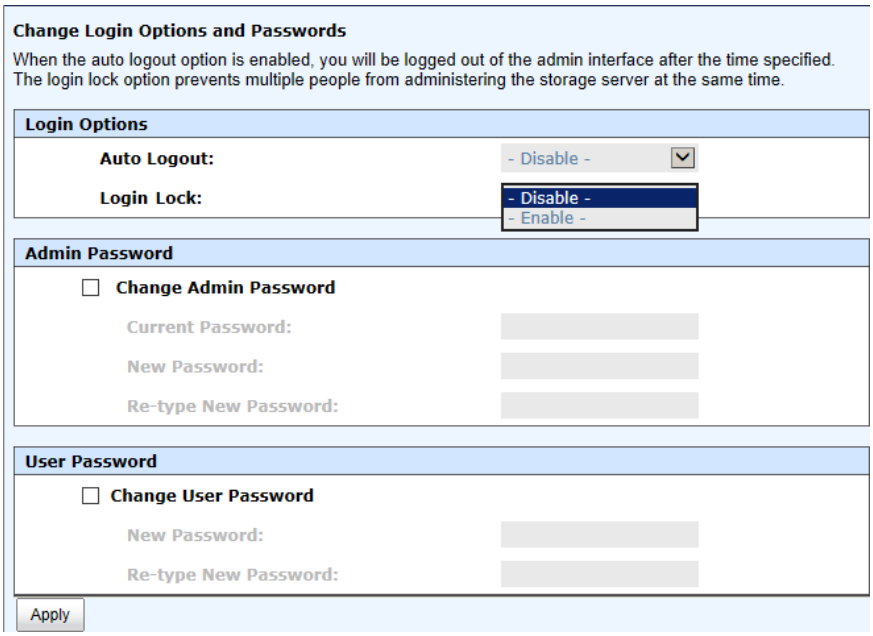

The options are available on this tab:

- **Auto Logout:** When the auto logout option is enabled, you will be logged out of the admin interface after the time specified. There are Disable (default), 5 minutes, 30 minutes and 1 hour options.
- **Login Lock:** When the login lock is enabled, the system allows only one user to login to the web UI at a time. There are Disable (default) and Enable options.
- **Change Admin Password:** Check it to change administrator password. The maximum length of password is 12 alphanumeric characters.
- **Change User Password:** Check it to change user password. The maximum length of password is 12 alphanumeric characters.

When it is done, click **Apply** button.

Email Notification Settings

The **Email Notification Settings** tab is used to enter up to three email addresses for receiving the event notifications. Fill in the necessary fields and click **Send Test Email** button to test whether it is available. Some email servers will check the mail-from address and need the SMTP relay settings for authentication.

TIP:
Please make sure the DNS server IP is well-setup in **System Configuration -> Network Settings**. So the event notification emails can be sent successfully.

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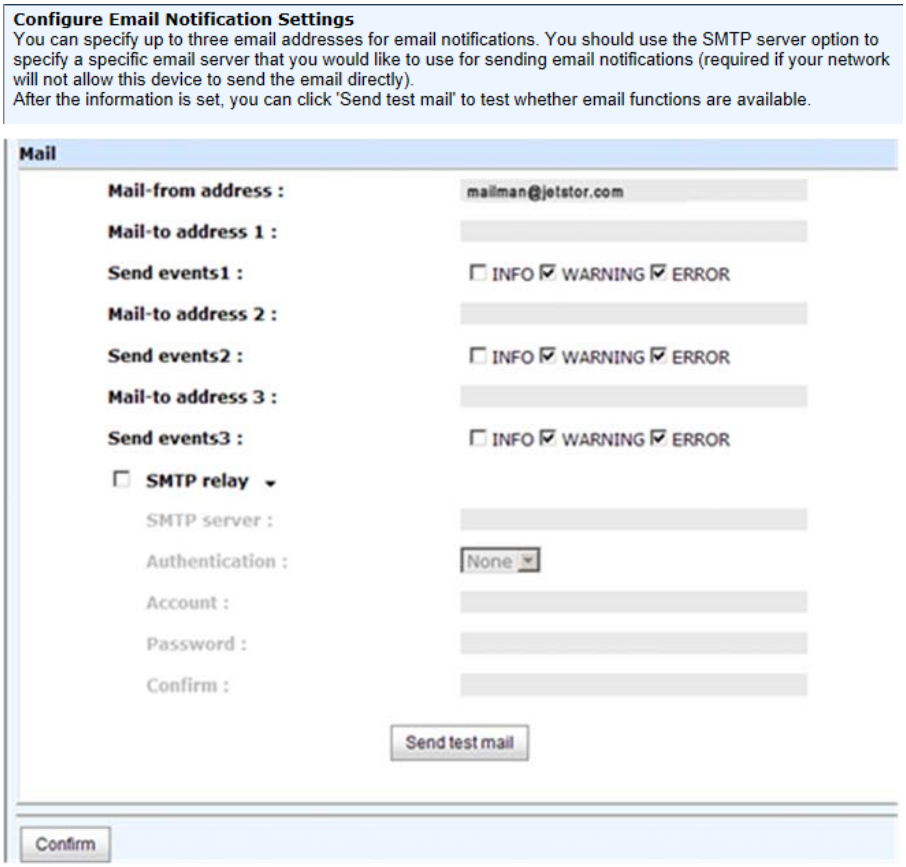
You can also select which levels of event logs which you would like to receive. The default setting only includes **Warning** and **Error** event logs.



When it is done, click **Apply** button.

Log and Alert Settings

The **Log and Alert Settings** tab is used to setup SNMP traps (for alerting via SNMP), pop-up messages via Windows messenger (not MSN or Skype), alerts via the syslog protocol, the pop-up alerts and alerts on the front display. The device buzzer is also managed here.

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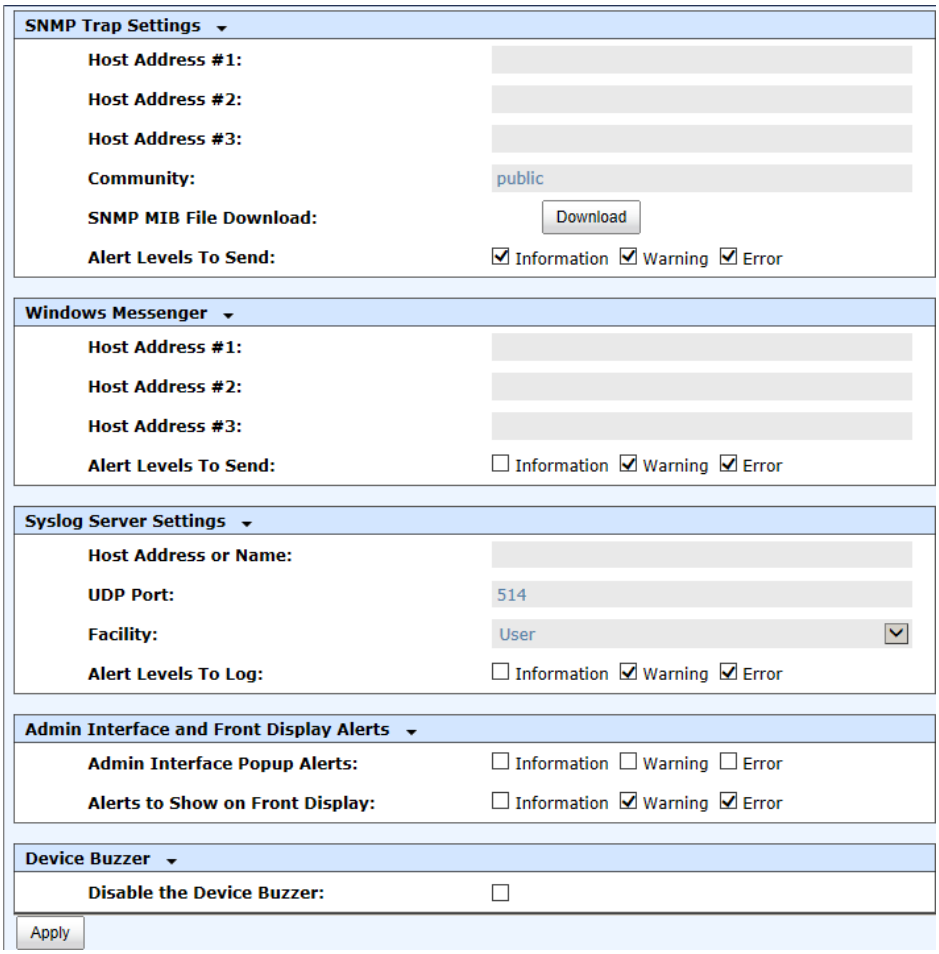

The options are available on this tab:

- **SNMP Trap Settings:** It allows up to three SNMP trap addresses. The default community setting is public. You can check the alert levels which you would like to receive. The default setting only includes **Warning** and **Error** event logs. If necessary, click **Download** to get the MIB file for importing to the SNMP client tool.

  There are many SNMP tools available on the internet.

  - SNMPc: http://www.snmpc.com/
  - Net-SNMP: http://net-snmp.sourceforge.net/

- **Windows Messenger:** You must enable the Messenger service in Windows (**Start -> Control Panel -> Administrative Tools -> Services -> Messenger**). It allows up to three host addresses. The same, you can check the alert levels which you would like to receive.

- **System Server Settings:** Fill in the host address and the facility for syslog service. The default UDP port is 514. You can also check the alert levels here.

  There are some syslog server tools available on the internet for Windows.

  - WinSyslog: http://www.winsyslog.com/
  - Kiwi Syslog Daemon: http://www.kiwisyslog.com/

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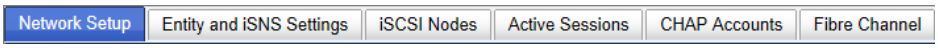
Most UNIX systems built in syslog daemon.

- **Admin Interface and Front Display Alerts:** You can check the alert levels which you would like to have pop-up message in the Web UI and show on front display. The default setting for admin interface is none while the default setting for shown on the front display includes **Warning** and **Error** event logs.
- **Device Buzzer:** Check it to disable the device buzzer. Uncheck it to activate the device buzzer.

When it is done, click **Apply** button.

Host Port / iSCSI Configuration

The **Host port / iSCSI Configuration** menu option is for accessing the **Network Setup**, **Entity and iSNS Settings**, **iSCSI Nodes**, **Active Sessions**, **CHAP Account** and **Fibre Channel** (This option is only visible when the controller has Fibre Channel ports) option tabs.

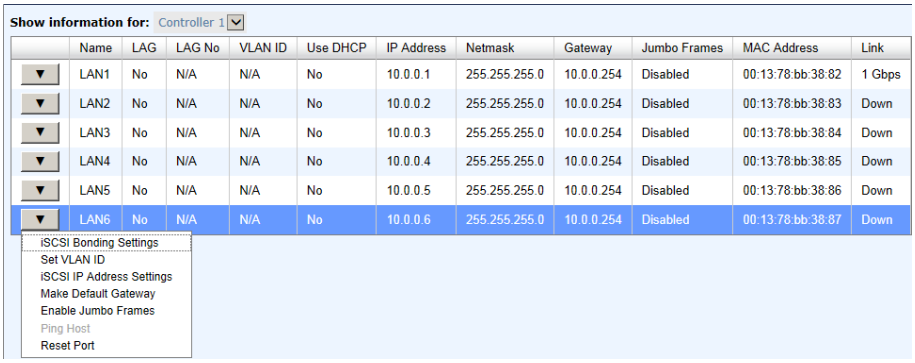


Network Setup

The **Network Setup** tab is used to change IP addresses of iSCSI data ports.

- 2 x 10GbE iSCSI ports + 2 x GbE iSCSI port per controller.

These network ports must be assigned IP addresses then they can be used. For better performance or fault tolerance reason, they can be bonding as Trunking or LACP. These bonding network ports share a single IP address. The following example shows (6 x GbE iSCSI ports).



This figure shows six iSCSI data ports. These data ports are set up with a static IP address. For the other controllers, that can be set up the same way.

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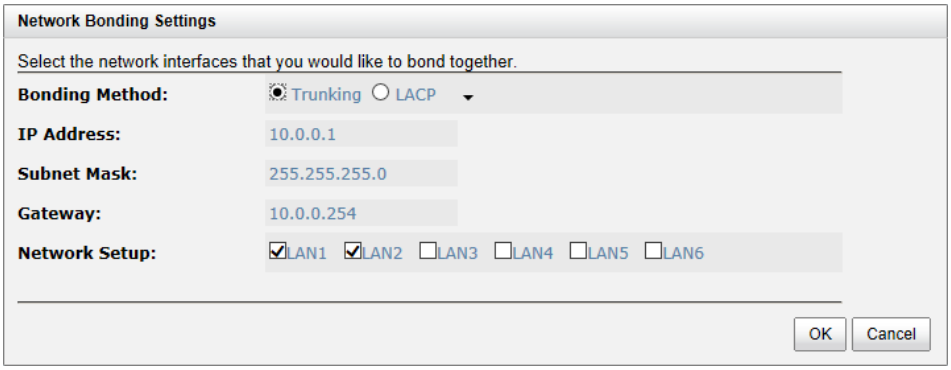
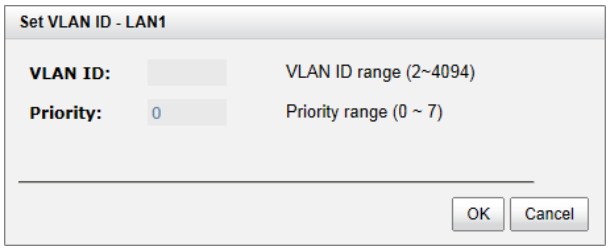
The options are available on this tab:

- ▼ -> **iSCSI Bonding Settings:** The default mode of each iSCSI data port is individually connected without any bonding. Trunking and LACP (Link Aggregation Control Protocol) settings can be setup here. At least two iSCSI data ports must be checked for iSCSI bonding.



  - **Trunking:** Configures multiple iSCSI ports to be grouped together into one in order to increase the connection speed beyond the limit of a single iSCSI port.
  - **LACP:** The Link Aggregation Control Protocol is part of IEEE specification 802.3ad that allows bonding several physical ports together to form a single logical channel. LACP allows a network switch to negotiate an automatic bundle by sending LACP packets to the peer. The advantages of LACP are that it increases bandwidth usage and it automatically performs a failover when the link status fails on a port.
- ▼ -> **Set VLAN ID:** VLAN is a logical grouping mechanism implemented on switch device. VLANs are collections of switching ports that comprise a single broadcast domain. It allows network traffic to flow more efficiently within these logical subgroups. Please consult your network switch user manual for VLAN setting instructions. Most of the work is done at the switch part. All you need to do is to make sure that your VLAN ID of iSCSI port matches that of switch port. If your network environment supports VLAN, you can use this function to change the configurations. Fill in VLAN ID and Priority settings to enable VLAN.



  - **VLAN ID:** VLAN ID is a 12-bit number. Its range is from 2 to 4094, while 0, 1, and 4095 are reserved for special purposes.

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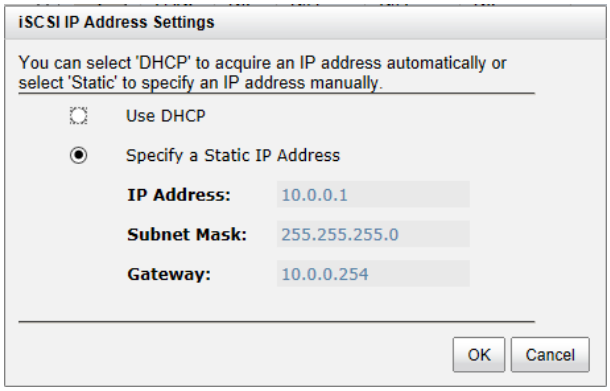
- **Priority:** The PCP (Priority Code Point) is a 3-bit number and reserved for QoS. The definition complies with IEEE 802.1p protocol, ranging from 0 to 7, with 0 as the default value. In normal cases, you don't need to set this value. Using the default will do just fine.

TIP:
If iSCSI ports are assigned with VLAN ID before creating aggregation takes place, aggregation will remove VLAN ID. You need to repeat the steps to set VLAN ID for the aggregation group.

- ▼ -> **iSCSI IP Address Settings:** It can assign an iSCSI IP address of the iSCSI data port. There are two options: **Use DHCP** to acquire an IP address automatically or **Specify a Static IP Address** to set the IP address manually.



- ▼ -> **Make Default Gateway:** Set the gateway of the IP address as default gateway. There can be only one default gateway. To remove the default gateway, click ▼ -> **Remove Default Gateway**.
- ▼ -> **Enable jumbo frames:** It can enable the MTU (Maximum Transmission Unit) size. The maximum jumbo frame size is **3900** bytes. To disable jumbo frames, click ▼ -> **Disable Jumbo Frames**.

CAUTION:
VLAN ID, jumbo frames for both the switching hub and HBA on host must be enabled. Otherwise, the LAN connection cannot work properly.

- ▼ -> **Ping host:** It can verify the port connection from a target to the corresponding host data port. Input the host's IP address and click **Start** button. The system will display the ping result. Or click **Stop** button to stop the test.

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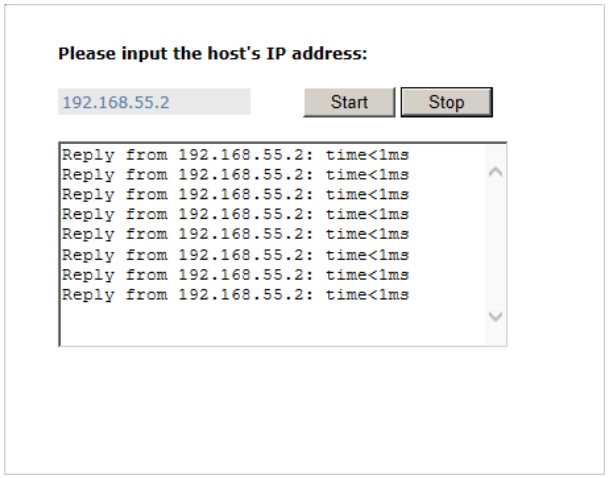
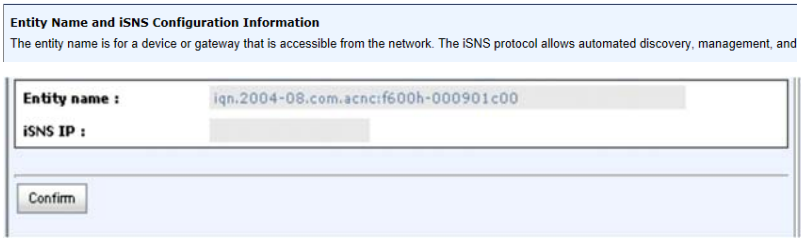


- ▼ -> **Reset Port:** If the behavior of the port is abnormal, try to reset port to make it normal.

Entity and iSNS Settings

The **Entity and iSNS Settings** tab is used to view the entity name of the system, and setup iSNS IP for the iSNS (Internet Storage Name Service) protocol. It allows automated discovery, management and configuration of iSCSI devices on a TCP/IP network. To use iSNS, an iSNS server needs to be added to the SAN. When this is done, the iSNS server IP address must be added to the storage system for iSCSI initiator service to send queries to it.



To make changes, enter the **Entity Name** and the **iSNS IP Address**, and then click **Apply** button.

iSCSI Nodes

The **iSCSI Nodes** tab is used to view the target name for iSCSI initiator.

- Up to 128 multiple nodes per controller.

The options are available on this tab:

- ▼ -> **Authentication Method:** CHAP (Challenge Handshake Authentication Protocol) is a strong authentication method used in point-to-point for user login. It's a type of

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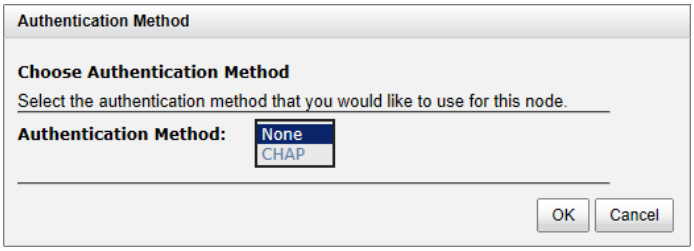
authentication in which the authentication server sends the client a key to be used for encrypting the username and password. CHAP enables the username and password to transmit in an encrypted form for protection.

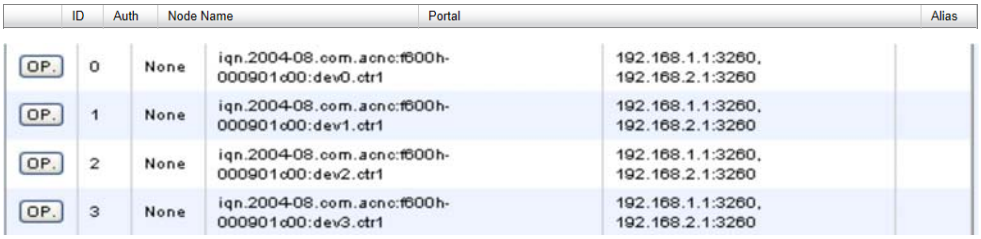
TIP:
A CHAP account must be added before you can use this authentication method. Please refer to **CHAP Accounts** session to create an account if none exists.

To use CHAP authentication, please follow the procedures.

- Select one of nodes from one controller.
- Chick ▼ -> **Authentication Method**.
- Select **CHAP** from the drop-down list.



- Click **OK** button.



- Chick ▼ -> **User**.
- Select CHAP user(s) which will be used. It can be more than one, but it must be at least one CHAP to enable on the node.

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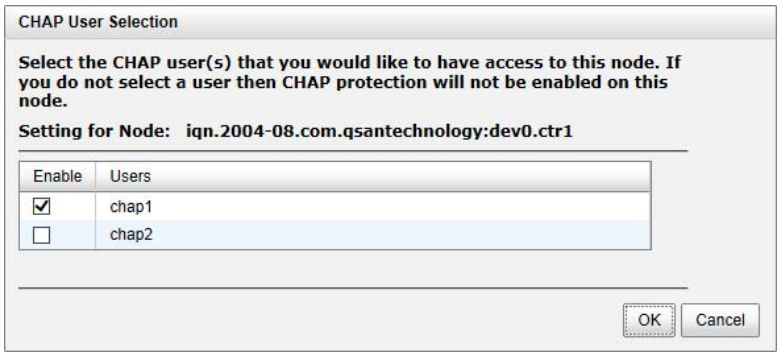
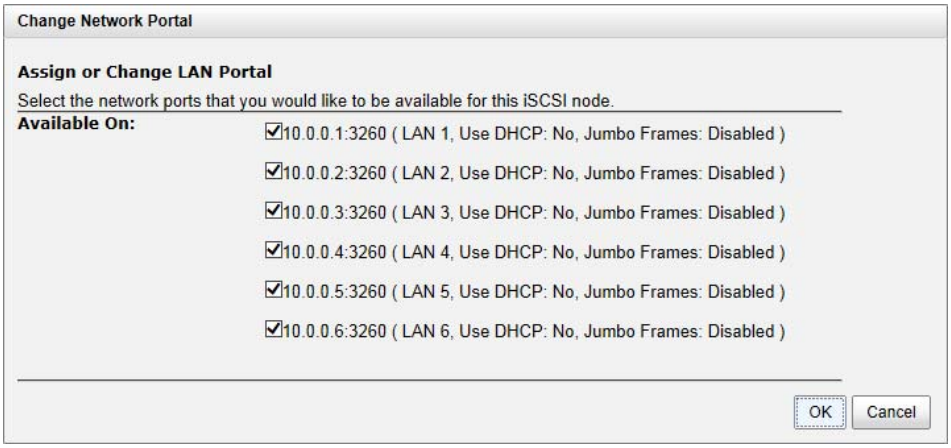


- Click **OK** button.

To disable CHAP authentication, please follow the procedures.

- Select the node which wants to disable CHAP.
- Chick ▼ -> **Authentication Method**.
- Change it to **None** from the drop-down list.
- Click **OK** button.

- ▼ -> **Change Portal:** Use this iSCSI node option to change the network ports available.
  - Select one of nodes from one controller.
  - Chick ▼ -> **Change Portal**.
  - Select the network ports that you would like to be available for this iSCSI node.



  - Click **OK** button.

- ▼ -> **Rename Alias:** Use this option to add or change iSCSI alias.
  - Select one of nodes from one controller.
  - Chick ▼ -> **Rename Alias**.
  - Enter the Alias Name. Leave it empty to remove the alias.
  - Click **OK** button.

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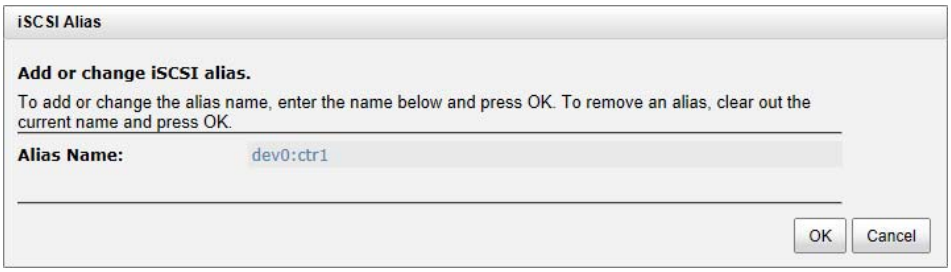
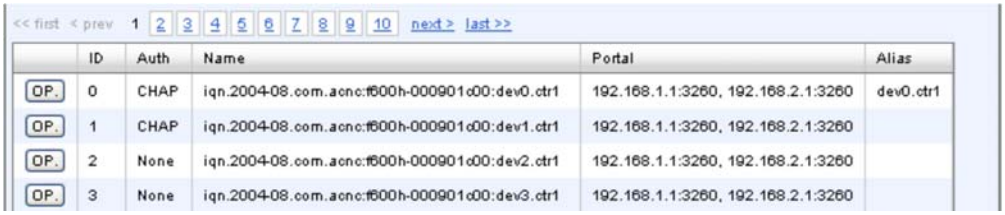


After creating an alias, it is displayed at the end of the portal information.



TIP:
After setting CHAP, the host initiator should be set with the same CHAP account. Otherwise, the host cannot connect to the volume.

Active Sessions

The **Active Session** tab is used to display all currently active iSCSI sessions and their connection information.

- Up to 1024 sessions per controller.

This table shows the column descriptions. Most of the options are standard parameters used in the negotiation between the initiator and target when an iSCSI connection is created.

Column Name	Description
TSIH	TSIH (Target Session Identifying Handle) is used for this active session.
Initiator Name	It displays the host computer name.
Target Name	It displays the controller name.
InitialR2T	InitialR2T (Initial Ready to Transfer) is used to turn off either the use of a unidirectional R2T command or the output part of a bidirectional command. The default value is Yes.
Immed. data	Immed. data (Immediate Data) sets the support for immediate data

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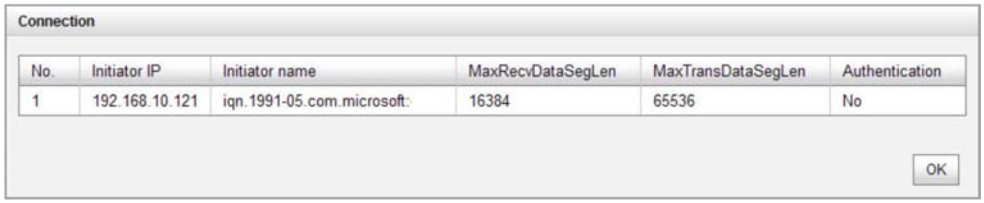
	between the initiator and the target. Both must be set to the same setting. The default value is Yes.
MaxDataOutR2T	MaxDataOutR2T (Maximum Data Outstanding Ready to Transfer) determines the maximum number of outstanding ready to transfer per task. The default value is 1.
MaxDataBurstLen	MaxDataBurstLen (Maximum Data Burst Length) determines the maximum SCSI data payload. The default value is 256kb.
DataSeginOrder	DataSeginOrder (Data Sequence in Order) determines if the PDU (Protocol Data Units) are transferred in continuously non-decreasing sequence offsets. The default value is Yes.
DataPDU InOrder	DataPDU InOrder (Data PDU in Order) determines if the data PDUs within sequences are to be in order and overlays forbidden. The default value is Yes.

The options are available on this tab:

- ▼ -> **Connection Details:** It can list all connection(s) of the selected session.



- ▼ -> **Disconnect:** Disconnect the selected session, click **OK** button to confirm.

CHAP Accounts

The **CHAP Account** tab is used to manage the CHAP accounts on the system.

The options are available on this tab:

- **Create User:** Create a CHAP user.

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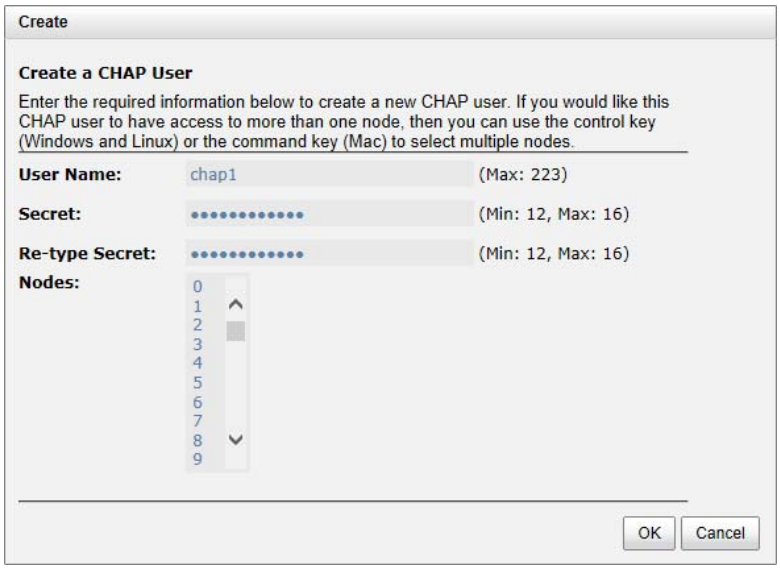
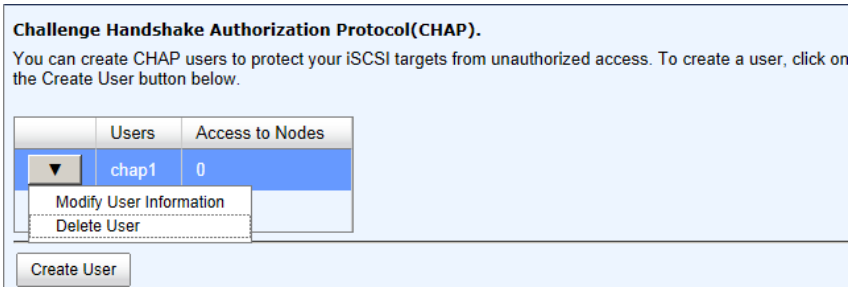


- Enter the required information for **User Name**, **Secret**, and **Re-type Secret**.
- If you would like this CHAP user to have access, select one or multiple nodes. If selecting none, you can add it later by **iSCSI Configuration** -> **iSCSI Nodes** -> **Users**.
- Click **OK** button.



The options are available after creating a CHAP account:

- ▼ -> **Modify User Information:** Modify the selected CHAP user information.
- ▼ -> **Delete User:** Delete the selected CHAP user.

Fibre Channel

The **Fibre Channel** tab is used view the fibre channel information, and change the link speed of FC. It displays the Port ID, Connection Mode, Data Rate, WWNN (World Wide Node Name), WWPN (World Wide Port Name), error count, and the link status.

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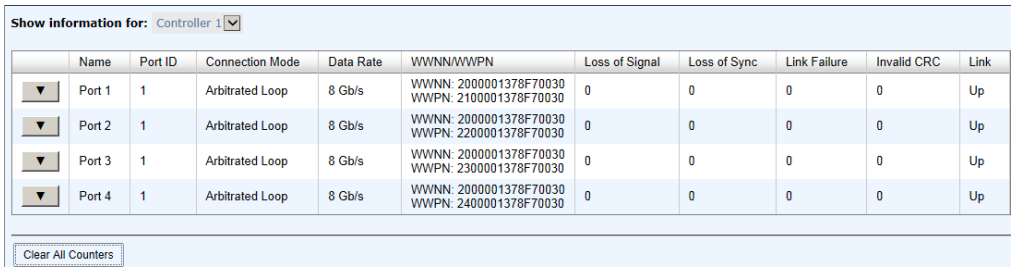
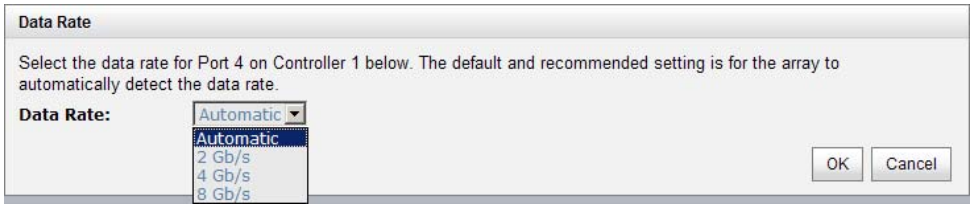
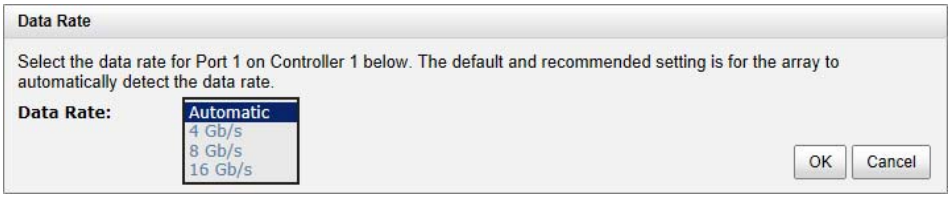


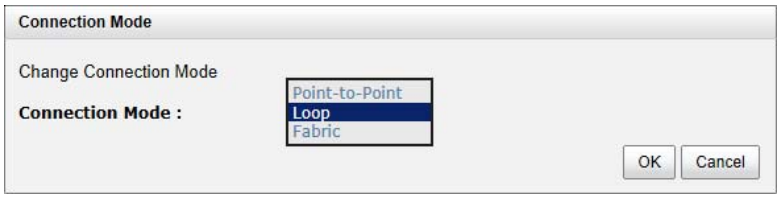
The options are available on this tab:

- **Clear All Counters:** Clear all counters of all fibre channels.
- ▼ -> **Change Link Speed:** The default and recommended setting is to automatically detect the data rate.





- ▼ -> **Change Connection Mode:** There are **Loop / Point-to-Point / Fabric** options.



  - **Point-to-Point (FC-P2P):** Two devices are connected directly to each other. This is the simplest topology, with limited connectivity.
  - **Loop (Arbitrated Loop)(FC-AL):** In this design, all devices are in a loop or ring, similar to token ring networking. Adding or removing a device from the loop causes all activity on the loop to be interrupted. The failure of one device causes a break in the ring. Fibre Channel hubs exist to connect multiple devices together and may bypass failed ports. A loop may also be made by cabling each port to the next in a ring.

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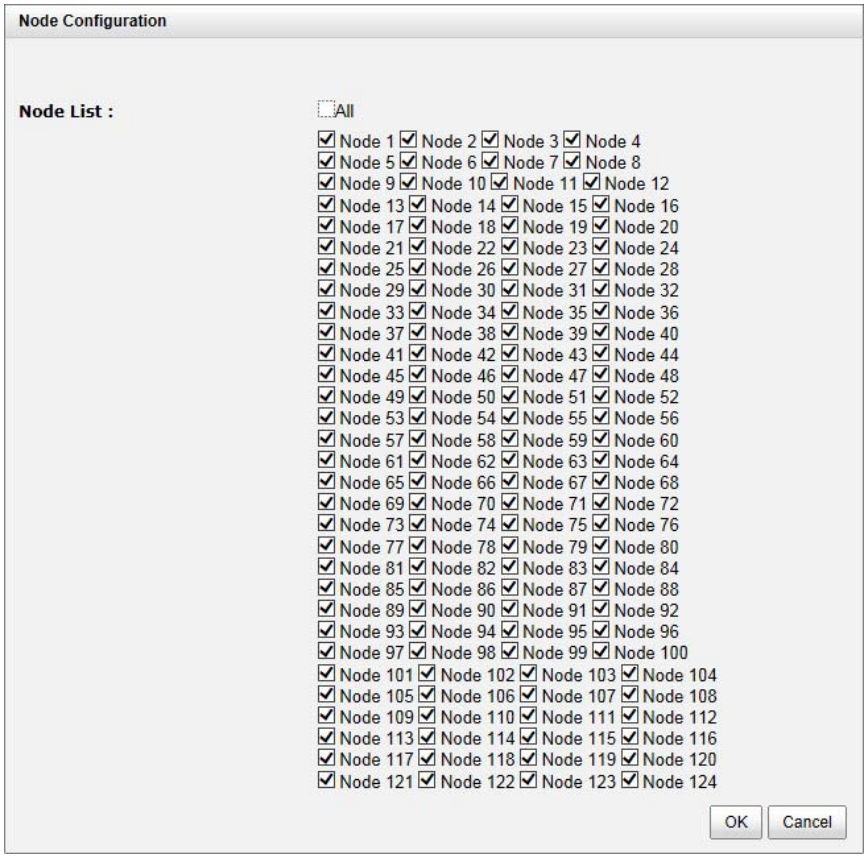
- **Fabric (Switched Fabric)(FC-SW):** All devices or loops of devices are connected to Fibre Channel switches, similar conceptually to modern Ethernet implementations. Advantages of this topology over FC-P2P or FC-AL include.

Attribute	Point-to-Point	Arbitrated Loop	Switched Fabric
Max ports	2	127	~16777216 (2^24)
Address size	N/A	8-bit ALPA	24-bit port ID
Side effect of port failure	Link fails	Loop fails (until port bypassed)	N/A
Mixing different link rates	No	No	Yes
Frame delivery	In order	In order	Not guaranteed
Access to medium	Dedicated	Arbitrated	Dedicated

(* Reference from http://en.wikipedia.org/wiki/Fibre_Channel)

- ▼ -> **Node Configuration:** Set the selected fibre channel for multi-nodes configuration. Check the nodes which can be accessed by the host.



- ▼ -> **Clear Counters:** Clear the counters of the selected fibre channel.

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CAUTION:
The connection mode Point-to-Point does not support multi-node.

Volume Configuration

The **Volume configuration** menu option is for accessing the **Physical Disks**, **RAID Groups**, **Virtual Disks**, **Snapshots**, **Logical Units**, and **QReplicas** option tabs.

Physical Disks

The **Physical Disks** tab provides the status of the hard drives in the system. The two drop-down lists at the top enable you to switch between the local system and any expansion JBOD systems attached. The other is to change the drive size units (MB or GB).

This table shows the column descriptions.

Column Name	Description
Slot	The position of a hard drive. The button next to the number of slot shows the functions which can be executed.
Size (GB) or (MB)	Capacity of hard drive. The unit can be displayed in GB or MB.
RAID Group	RAID group name.
RAID Set	The number of RAID Set: • N/A: The RAID group is traditional provisioning. • Number: The RAID group is the number of RAID set of thin provisioning.
Virtual Disk	Virtual disk name for SSD caching.
Status	The status of the hard drive: • Online: The hard drive is online. • Rebuilding: The hard drive is being rebuilt. • Transitioning: The hard drive is being migrated or is replaced by another disk when rebuilding occurs. • Scrubbing: The hard drive is being scrubbed.
Health	The health of the hard drive: • Good: The hard drive is good. • Failed: The hard drive is failed.

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	• Error Alert: S.M.A.R.T. error alerts. • Read Errors: The hard drive has unrecoverable read errors.
Usage	The usage of the hard drive: • RAID: This hard drive has been set to a RAID group. • Free: This hard drive is free for use. • Dedicated Spare: This hard drive has been set as dedicated spare of a RAID group. • Local Spare: This hard drive has been set as local spare of the enclosure. • Global Spare: This hard drive has been set as global spare of whole system.
Vendor	Hard drive vendor.
Serial Number	Hard drive serial number.
Rate	Hard drive rate: • SAS 6.0Gb/s. • SAS 3.0Gb/s. • SATA 6.0Gb/s. • SATA 3.0Gb/s. • SATA 1.5Gb/s. • SAS SSD 6.0Gb/s. • SATA SSD 6.0Gb/s.
Write Cache	Hard drive write cache is enabled or disabled. The default value is Enabled.
Standby	HDD auto spindown to save power. The default value is Disabled.
Read-Ahead	This feature makes data be loaded to disk's buffer in advance for further use. The default value is Enabled.
Command Queuing	Newer SATA and most SCSI disks can queue multiple commands and handle one by one. The default value is Enabled.

The options are available on this tab:

- **Disk Health Check:** Check the health of the selected disks. It cannot check the disks which are in used.

- **Disk Check Report:** Download the disk check report. It's available after executing **Disk Health Check**.
- ▼ -> **Set Free Disk:** Make the selected hard drive be free for use.
- ▼ -> **Set Global Spare:** Set the selected hard drive to global spare of all RIAD groups.
- ▼ -> **Set Local Spare:** Set the selected hard drive to local spare of the RIAD groups which located in the same enclosure.
- ▼ -> **Set Dedicated Spare:** Set a hard drive to dedicated spare of the selected RAID group.
- ▼ -> **Upgrade:** Upgrade the firmware of the hard drive.
- ▼ -> **Disk Scrub:** Scrub the hard drive. It's not available when the hard drive is in used.

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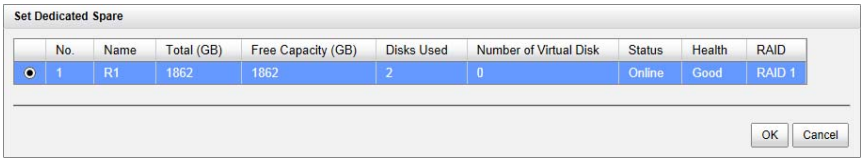
- ▼ -> **Read Error Cleared:** Clean the read error of the hard drive.
- ▼ -> **Turn on/off the indication LED:** Turn on the indication LED of the hard drive. Click again to turn off.
- ▼ -> **More information:** Display hard drive detail information.

Take an example to set the physical disk to dedicated spare disk.

1. Check ▼ -> **Set Dedicated Spare** at one physical disk.



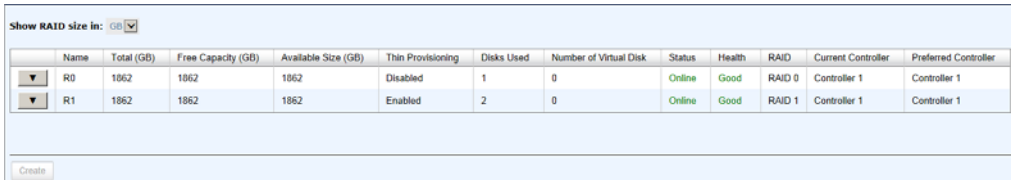
2. If there is any RAID group which is in protected RAID level and can be set with dedicate spare disk, select one RAID group, and then click **OK** button.

TIP:
- The maximum number of physical drives in a system is 256.

RAID Groups

The **RAID Groups** tab provides to create, modify, delete, or view the status of the RAID groups. Use the drop-down list at the top to change the drive size units (MB or GB).

Select the traditional RAID group, it displays on the following.



This table shows the column descriptions.

Column Name	Description
Name	RAID group name.
Total (GB) or (MB)	Total capacity of the RAID group. The unit can be displayed in GB or MB.
Free Capacity (GB) or (MB)	Free capacity of the RAID group. The unit can be displayed in GB or MB.
Available Size	Available capacity of the RAID group. The unit can be displayed in GB or

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(GB) or (MB)	MB.
Thin Provisioning	The status of Thin provisioning: • Disabled. • Enabled.
Disks Uses	The number of physical disks in the RAID group.
Number of Virtual Disk	The number of virtual disks in the RAID group.
Status	The status of the RAID group: • Online: the RAID group is online. • Offline: the RAID group is offline. • Rebuilding: the RAID group is being rebuilt. • Migrating: the RAID group is being migrated. • Scrubbing: the RAID group is being scrubbed.
Health	The health of the RAID group: • Good: the RAID group is good. • Failed: the RAID group fails. • Degraded: the RAID group is not healthy and not completed. The reason could be lack of disk(s) or have failed disk.
RAID	The RAID level of the RAID group.
Current Controller (This option is only visible when dual controllers are installed.)	The controller of the RAID group. The default is controller 1.
Preferred Controller (This option is only visible when dual controllers are installed.)	The preferred controller of the RAID group. The default is controller 1.

The options are available on this tab:

- **Create:** Create a RAID group.

The options are available after creating a RAID group:

- ▼ -> **Migrate RAID Level:** Change the RAID level of a RAID group. Please refer to next chapter for details.
- ▼ -> **Move RAID Level:** Move the member disks of RAID group to totally different physical disks.
- ▼ -> **Activate/Deactivate:** Activate or deactivate the RAID group after disk roaming. Activate can be executed when the RAID group status is offline. Conversely, Deactivate can be executed when the status is online. These are for online disk roaming purpose.
- ▼ -> **Verify Parity:** Regenerate parity for the RAID group. It supports the RAID level 3 / 5 / 6 / 30 / 50 / 60.
- ▼ -> **Delete:** Delete the RAID group.
- ▼ -> **Change Preferred Controller:** Set the RAID group ownership to the other controller.

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- ▼ -> **Change RAID Options:** Change the RAID property options.
  - Write Cache:
    - ✓ Enabled: When the write cache is enabled, data transfer operations are written to fast cache memory instead of being written directly to disk. This may improve performance but may take the data lost risk when losing power if there is no BBM protection.
    - ✓ Disabled: Disable disk write cache. (Default)
  - Standby:
    - ✓ Disabled: Disable auto spin down. (Default)
    - ✓ 30 sec / 1 min / 5 min / 30 min: The hard drives will be spun down for power saving when the disk is idle for the period of time specified.
  - Read-Ahead:
    - ✓ Enabled: The system will discern what data will be needed next based on what was just retrieved from disk and then preload this data into the disks buffer. This feature will improve performance when the data being retrieved is sequential. (Default)
    - ✓ Disabled: Disable disk read ahead.
  - Command Queuing:
    - ✓ Enabled: Sends multiple commands at once to a disk to improve performance. (Default)
    - ✓ Disabled: Disable disk command queuing.
- ▼ -> **Add RAID Set**: Add RAID sets for the thin provisioning RAID group.
- ▼ -> **Add Policy:** Add policy for the thin provisioning RAID group..
- ▼ -> **More information**: Display RAID group detail information.

Select the thin provisioning RAID group, it displays on the following. There are two more tables to describe the properties of the thin provisioning RAID group, RAID Set and RAID Group Policy.

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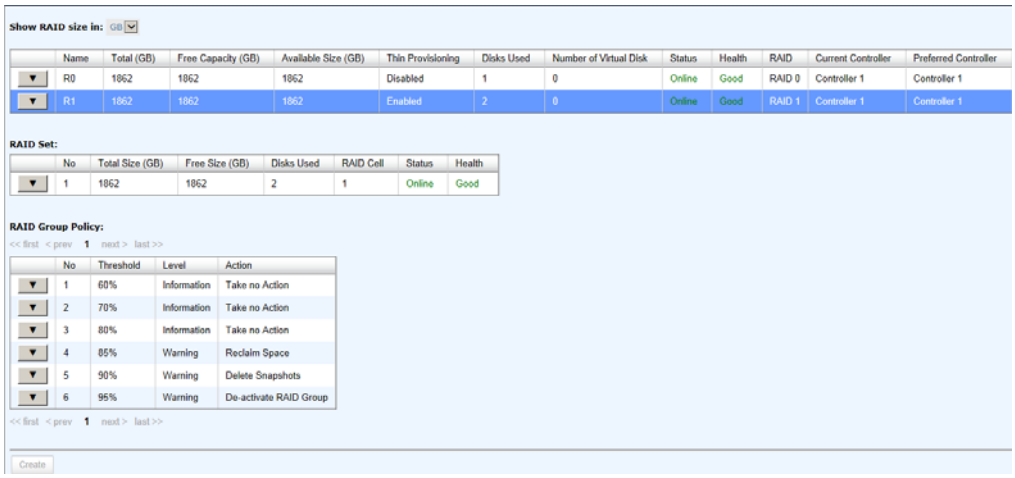

This table shows the column descriptions of **RAID Set**.

Column Name	Description
No	The number of the RAID set.
Total Size(GB)	Total capacity of the RAID set.
Free Size (GB)	Free capacity of the RAID set.
Disks Used	The number of physical disks in the RAID set.
RAID Cell	The number of RAID cell in the RAID set.
Status	The status of the RAID set: • Online: the RAID set is online. • Offline: the RAID set is offline. • Rebuilding: the RAID set is being rebuilt. • Migrate: the RAID set is being migrated. • Scrubbing: the RAID set is being scrubbed.
Health	The health of the RAID set: • Good: the RAID set is good. • Failed: the RAID set fails. • Degraded: the RAID set is not healthy and not completed. The reason could be lack of disk(s) or have failed disk.

The options are available on this tab:

- ▼ -> **Remove:** Remove the selected RAID set.
- ▼ -> **Move RAID Level:** Move the member disks of RAID set to other physical disks.
- ▼ -> **List Disks:** List the member of physical disks.

This table shows the column descriptions of **RAID Group Policy**.

Column Name	Description
No	The number of the RAID group policy.
Threshold	The threshold of the thin provision RAID group.
Level	Define the event log level when the thin provision RAID group usage reaches the threshold.

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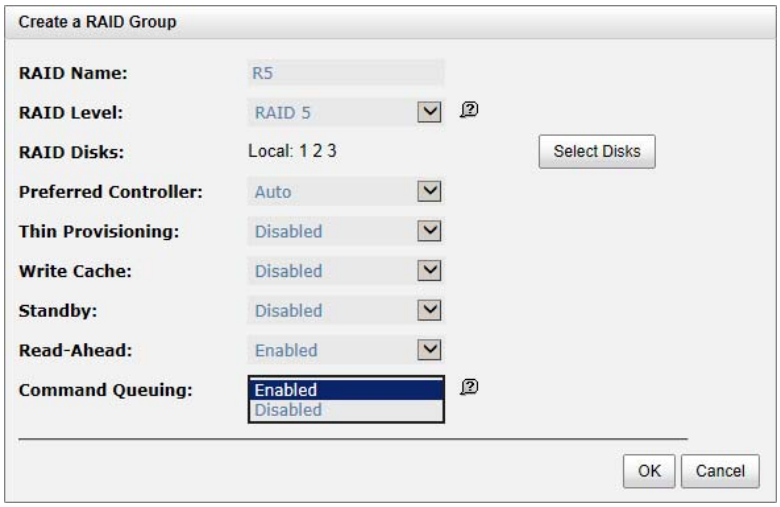
Action	Take action of the system when the thin provision RAID group usage reaches the threshold. • Take no Action. • Reclaim Space. • Delete Snapshots. • De-activate RAID Group.

The options are available on this tab:

- ▼ -> **Delete:** Delete the selected policy.
- ▼ -> **Modify:** Modify the level and the action of the policy.

Take an example of creating a RAID group.

1. Click the **Create** button.



2. Enter a **RAID Name** for the RAID group.
3. Select a **RAID Level** from the drop-down list.
4. Click the **Select Disks** button to select disks from either local or expansion JBOD systems, and click **OK** to complete the selection. The selected disks are displayed at **RAID Disks**.
5. Optionally, configure the following:
   - **Preferred Controller:** This option is only visible when dual controllers are installed. The default value is Auto.
   - **Thin Provisioning:** This option is only visible when thin provisioning feature is enabled. The default value is Disabled.
   - **Write Cache:** It's to enable or disable the write cache option of hard drives. The default value is Disabled.

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- **Standby:** It's to enable or disable the auto spin down function of hard drives, when this option is enabled and hard drives have no I/O access after certain period of time, they will spin down automatically. The default value is Disabled.
- **Read-Ahead:** It's to enable or disable the read ahead function. The default value is Enabled.
- **Command Queuing:** It's to enable or disable the hard drives' command queue function. The default value is Enabled.

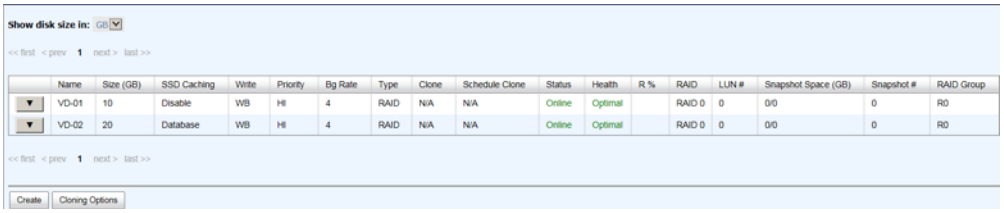
6. At the confirmation dialog, click **OK** button to create the RAID group.

TIP:

- The maximum number of physical drives in a RAID group is 64.

Virtual Disks

The **Virtual Disks** tab provides to create, modify, delete, or view the status of the virtual disk. Use the drop-down list at the top to change the drive size units (MB or GB).



This table shows the column descriptions.

Column Name	Description
Name	Virtual disk name.
Size (GB) or (MB)	Total capacity of the virtual disk. The unit can be displayed in GB or MB.
SSD Caching	The SSD caching policy: • Disable: Disable SSD caching. • Database: Enable SSD caching and set it as database policy. • File System: Enable SSD caching and set it as file system policy. • Web Service: Enable SSD caching and set it as web service policy. • Custom: Enable SSD caching and set it as customization policy.
Write	The right of virtual disk: • WT: Write Through. • WB: Write Back. • RO: Read Only.
Priority	The priority of virtual disk: • HI: High priority. • MD: Middle priority. • LO: Low priority.
Bg Rate	Background task priority:

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	• 4 / 3 / 2 / 1 / 0: Default value is 4. The higher number the background priority of a VD is, the more background I/O will be scheduled to execute.
Type	The type of the virtual disk: • RAID: the virtual disk is normal. • BACKUP: the virtual disk is for backup usage.
Clone	The clone target name of the virtual disk.
Schedule Clone	The clone schedule of the virtual disk.
Status	The status of the virtual disk: • Online: The virtual disk is online. • Offline: The virtual disk is offline. • Initiating: The virtual disk is being initialized. • Rebuilding: The virtual disk is being rebuilt. • Migrating: The virtual disk is being migrated. • Rollback: The virtual disk is being rolled back. • Parity checking: The virtual disk is being parity check.
Health	The health of virtual disk: • Optimal: the virtual disk is working well and there is no failed disk in the RG. • Degraded: At least one disk from the RG of the Virtual disk is failed or plugged out. • Failed: the RAID group disk of the VD has single or multiple failed disks than its RAID level can recover from data loss. • Partially optimal: the virtual disk has experienced recoverable read errors. After passing parity check, the health will become Optimal.
R %	Ratio (%) of initializing or rebuilding.
RAID	RAID level.
LUN #	Number of LUN(s) that virtual disk is attached.
Snapshot space (GB) or (MB)	The virtual disk size that is used for snapshot. The number means Used snapshot space / Total snapshot space. The unit can be displayed in GB or MB.
Snapshot #	Number of snapshot(s) that have been taken.
RAID Group	The RAID group name of the virtual disk.

The options are available on this tab:

- **Create:** Create a virtual disk.
- **Cloning Options:** Set the clone options. Detail is described in chapter 5.

The options are available after creating a virtual disk:

- ▼ **-> Extend:** Extend the virtual disk capacity.
- ▼ **-> Set SSD Caching:** Set SSD caching for the virtual disk. Detail is described in chapter 5.
- ▼ **-> Verify Parity:** Execute parity check for the virtual disk. It supports RAID 3 / 5 / 6 / 30 / 50 / 60. The options are:
  - Verify and repair data inconsistencies.
  - Only verify for data inconsistencies. Stop verifying when 1 10 20 30 40 50 60 70 80 90 100 inconsistencies have been found.
- ▼ **-> Delete:** Delete the virtual disk.

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- ▼ **-> Set Properties:** Change the virtual disk name, cache mode, priority, bg rate, read-ahead, AV-media mode, and type.
  - Cache Mode:
    - ✓ Write-through Cache: A caching technique in which the completion of a write request is not signaled until data is safely stored in non-volatile media. Each data is synchronized in both data cache and accessed physical disks.
    - ✓ Write-back Cache: A caching technique in which the completion of a write request is signaled as soon as the data is in cache and actual writing to non-volatile media occurs at a later time. It speeds up system write performance but needs to bear the risk where data may be in consistent between data cache and the physical disks in one short time interval. (Default)
    - ✓ Read-Only: Set the volume to be read-only, any write request is forbidden.
  - Priority:
    - ✓ High Priority. (Default)
    - ✓ Medium Priority.
    - ✓ Low Priority.
  - Bg Rate:
    - ✓ 4 / 3 / 2 / 1 / 0: Default value is 4. The higher number the background priority of a virtual disk has, the more background I/O will be scheduled to execute.
  - Read-Ahead:
    - ✓ Enabled: The system will discern what data will be needed next based on what was just retrieved form disk and then preload this data into the disks buffer. This feature will improve performance when the data being retrieved is sequential. (Default)
    - ✓ Disabled: Disable disk read ahead.
  - AV-Media Mode:
    - ✓ Enabled: Enable AV-media mode for optimizing video editing.
    - ✓ Disabled: Disable AV-media mode. (Default)
  - Type:
    - ✓ RAID: The virtual disk is normal. (Default)
    - ✓ Backup Target: The virtual disk is used for clone or QReplica usage.
- ▼ **-> Space Reclamation:** Reclaim space for the virtual disk.
- ▼ **-> Attach LUN:** Attach a logical unit number to the virtual disk.
- ▼ **-> Detach LUNs:** Detach a logical unit number from the virtual disk.
- ▼ **-> List LUNs:** List all of the attached logical unit numbers.
- ▼ **-> Set Clone:** Set the target virtual disk for clone.
- ▼ **-> Clear Clone:** Clear the clone.

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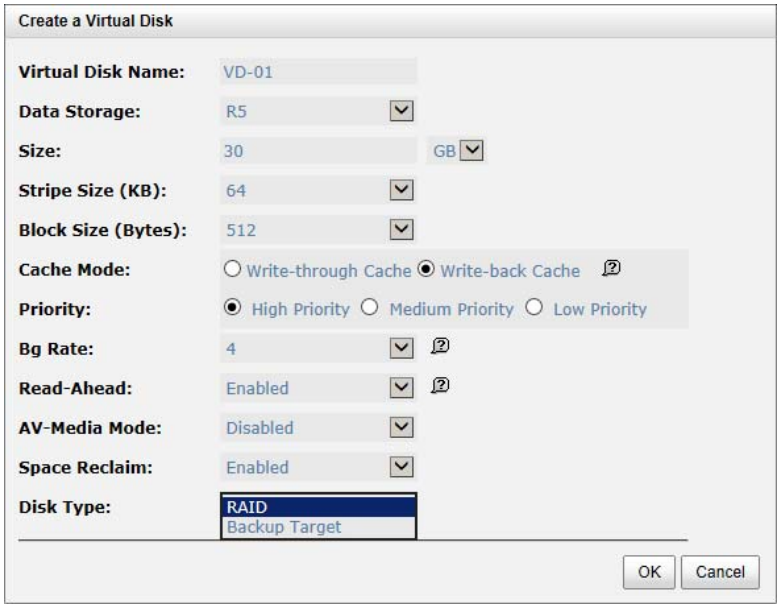
- ▼ **-> Start Clone:** Start the clone.
- ▼ **-> Stop Clone:** Stop the clone.
- ▼ **-> Change QReplica Options:** Change the clone to QReplica relationship.
- ▼ **-> Schedule Clone:** Set the clone function by schedule.
- ▼ **-> Set Snapshot Space:** Set snapshot space for preparing to take snapshots.
- ▼ **-> Cleanup Snapshots:** Clean all snapshots of the virtual disk and release the snapshot space.
- ▼ **-> Take a Snapshot:** Take a snapshot on the virtual disk.
- ▼ **-> Schedule Snapshots:** Set the snapshots by schedule.
- ▼ **-> List Snapshots:** List all snapshots of the virtual disk.
- ▼ **-> More Information:** Show the detail information of the virtual disk.

Take an example of creating a virtual disk.

1. Click **Create** button.



2. Enter a **Virtual Disk Name** for the virtual disk.
3. Select a **Data Storage** from the drop-down list.
4. Enter required **Size**.
5. Optionally, configure the following:
   - **Stripe Size (KB):** The options are 4KB, 8KB, 16KB, 32KB, 64KB. The default value is 64KB.
   - **Block Size (Bytes):** The options are 512 to 65536. The default value is 512 bytes.
   - **Cache Mode:** The options are Write-through Cache and Write-back Cache. The default value is Write-back Cache.

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- **Priority:** The options are High, Medium and Low Priority. The default value is High priority.
- **Bg Rate:** Background task priority. The higher number the background priority of a virtual disk has, the more background I/O will be scheduled to execute. The options are 0 to 4. The default value is 4.
- **Read-Ahead:** The system will discern what data will be needed next based on what was just retrieved form disk and then preload this data into the disks buffer. This feature will improve performance when the data being retrieved is sequential. The default value is Enabled.
- **AV-Media Mode:** Optimize for video editing. The default value is Disabled.
- **Erase:** This option is available when the RAID group is not thin provisioning. This option will wipe out old data in virtual disk to prevent that OS recognizes the old partition. The options are Do Not Erase, erase First 1GB or Full Disk. The default value is Do Not Erase.
- **Space Reclaim:** This option is available when the RAID group is thin provisioning. There are Enabled or Disabled. The default value is Enabled.
- **Fast Rebuild:** This option is available when the RAID group is not RAID 0. There are Enabled or Disabled. The default value is Disabled.
- **Disk Type:** Select type for normal or backup usage. The options are RAID (for general usage) and Backup Target (for Clone or QReplica). The default value is RAID.

6. Click **OK** button to create the virtual disk.

TIP:

- The maximum number of virtual disks in a RAID group is 96. The maximum host number per virtual disk is 16. The maximum host number per controller is 128. The maximum virtual disk number in a system is 4096. The max virtual disk number for snapshot is 64.

CAUTION:
If shutdown or reboot the system when creating a virtual disk, the erase process will stop.

Snapshots

The **Snapshots** tab provides to create, modify, delete, or view the status of snapshot. The two drop-down lists at the top enable you to switch the virtual disks. The other is to change the drive size units (MB or GB).

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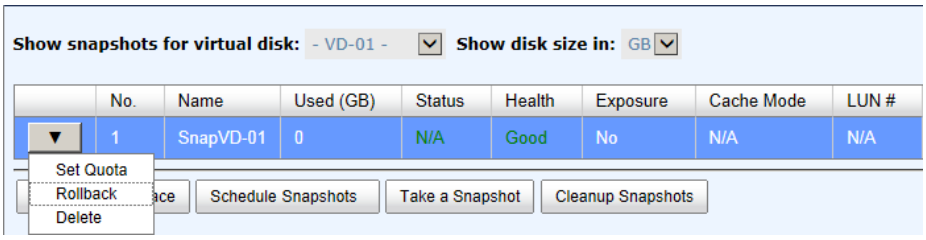

This table shows the column descriptions.

Column Name	Description
No.	Number.
Name	Snapshot name.
Used (GB) or (MB)	The amount of the snapshot space that has been used. The unit can be displayed in GB or MB.
Status	The status of the snapshot: • N/A: The snapshot is normal. • Replicated: The snapshot is for clone or QReplica usage. • Abort: The snapshot is over space and abort.
Health	The health of the snapshot: • Good: The snapshot is good. • Failed: The snapshot fails.
Exposure	The snapshot is exposed or not.
Cache Mode	The cache mode of the snapshot: • N/A: Unknown when the snapshot is unexposed. • Read-write: The snapshot can be read / write. • Read-only: The snapshot is read only.
LUN #	Number of LUN(s) that snapshot is attached.
Time Created	The created time of the snapshot.

The options are available on this tab:

- **Set Snapshot Space:** Set snapshot space for preparing to take snapshots.
- **Schedule Snapshots:** Set the snapshots by schedule.
- **Take a Snapshot:** Take a snapshot on the virtual disk.
- **Cleanup Snapshots:** Clean all snapshots of the virtual disk and release the snapshot space.

The options are available after taking a snapshot:

- ▼ **-> Set Quota:** Set the snapshot quota.
- ▼ **-> Rollback:** Rollback the snapshot.
- ▼ **-> Delete:** Delete the snapshot.

The options are available after setting the quota of the snapshot:

- ▼ **-> Unexpose:** Unexpose the snapshot VD.
- ▼ **-> Attach LUN:** Attach a logical unit number to the snapshot.
- ▼ **-> Detach LUNs:** Detach a logical unit number from the virtual disk.

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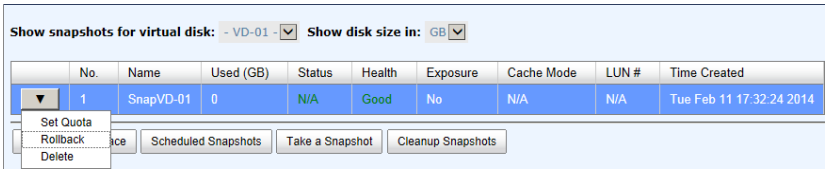
- ▼ **-> List LUNs:** List all of the attached logical unit numbers.

Take an example of taking a snapshot.

1. Before taking a snapshot, it must reserve some storage space for saving variant data. Click **Set Snapshot Space** button.

2. Select a **Virtual Disk** from the drop-down list.
3. Enter a **Size** which is reserved for the snapshot space.
4. Click **OK** button. The snapshot space is created.
5. Click **Take a Snapshot** button.
6. Use the drop-down list to select a **Virtual Disk**.
7. Enter a **Snapshot Name**.
8. Click **OK** button. The snapshot is taken.



9. Set quota to expose the snapshot. Click ▼ **-> Set Quota** option.

10. Enter a size which is reserved for the snapshot. If the size is zero, the exposed snapshot will be read only. Otherwise, the exposed snapshot can be read / written, and the size will be the maximum capacity for writing.
11. Attach LUN to the snapshot.

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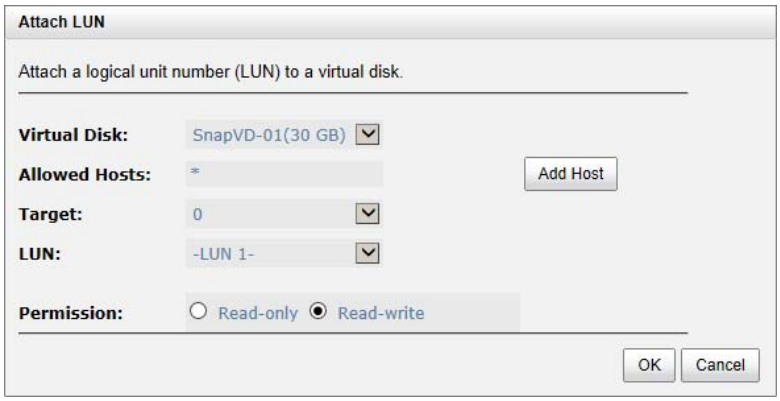
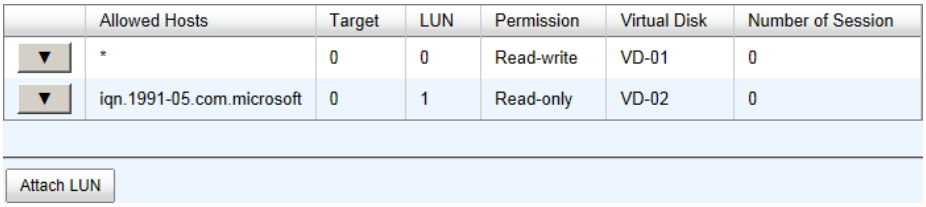


12. Done. The snapshot can be used.

TIP:
- The maximum snapshot number per virtual disk is 64.

Logical Units

The **Logical Units** tab provides to attach, detach or view the status of logical unit numbers for each virtual disk.



This table shows the column descriptions.

Column Name	Description
Allowed Hosts	The FC node name / iSCSI node name for access control or a wildcard (*) for access by all hosts.
Target	The number of the target.
LUN	The number of the LUN assigned.
Permission	The permission level: • Read-write. • Read-only.
Virtual Disk	The name of the virtual disk assigned to this LUN.
Number of Session (This option is only visible when the controller has iSCSI ports.)	The number of the active connection linked to the logical unit.

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The options are available on this tab:

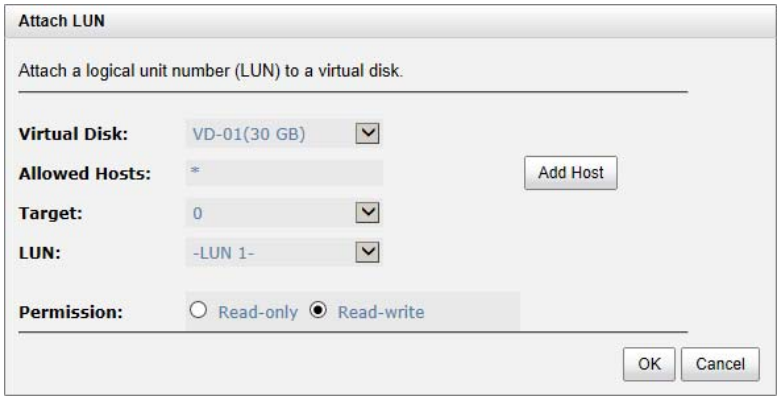
- **Attach LUN:** Attach a logical unit number to the virtual disk.

The options are available after attaching LUN:

- ▼ **-> Detach LUNs:** Detach a logical unit number from the virtual disk.

Take an example of attaching a LUN.

1. Click the **Attach LUN** button.



2. Select the **Protocol**. (FC models only)
3. Select a **Virtual Disk** from the drop-down list.
4. Enter the **Allowed Hosts** with semicolons (;) or click **Add Host** button to add one by one. Fill-in wildcard (*) for access by all hosts.
5. Select a **Target** number from the drop-down list.
6. Select a **LUN** from the drop-down list.
7. Check the **Permission** level.
8. Click **OK** button.

The matching rules of access control are followed from created time of the LUNs. The earlier created LUN is prior to the matching rules. For example: there are two LUN rules for the same VD, one is *****, **LUN 0**; and the other is **iqn.host1**, **LUN 1**. The host **iqn.host2** can login successfully because it matches the rule 1.

Wildcard ***** and **?** are allowed in this field. ***** can replace any word. **?** can replace only one character. For example:

- **iqn.host?** -> **iqn.host1** and **iqn.host2** are accepted.
- **iqn.host*** -> **iqn.host1** and **iqn.host12345** are accepted.

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This field cannot accept comma, so **iqn.host1, iqn.host2** stands a long string, not two iqns.

TIP:

- The maximum LUN number is 4096.

QReplicas

The **QReplicas** tab provides to create, rebuild, delete, or manage the replication tasks.

This table shows the **Task** column descriptions.

Column Name	Description
No.	Number.
Source Virtual Disk	The source name of the virtual disk.
Status	The status of the task: • Online: The task is normal and idle. • Initiating: The source virtual disk is initiating. • Offline: The source virtual disk is offline. • Queued: The task is queued. When multiple tasks are replicating, one task is running, the others are queued. • Replicating: The task is running. • Missing: The target virtual disk does not exist. • N/A: It's unavailable to get the status of the source virtual disk when the system is busy.
%	Ratio of the replication task.
Shaping	Apply the number of the shaping group.
Speed (MB)	Replication speed.
Target Virtual Disk	The target name of the virtual disk.
Size (GB) or (MB)	Total capacity of the target virtual disk.
Schedule	The status of the schedule: • N/A: No schedule for the replication task. • Icon: The schedule of the replication task is set.
Time Created	The created time of the task.
Vendor	The vendor of the target.
Model	The model of the target.
WWN	The WWN of the target virtual disk.

This table shows the **Task Path** column descriptions.

Column Name	Description
No.	Number.
Source NIC	The NIC port of the source side for the replication task.
Target IP	The IP address of the target side.
Target Name	The iSCSI node name of the target side.
LUN	The number of the LUN assigned.
Status	The status of the connection: • Connecting: The replication task pair is connecting.

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	• Connected: The replication task pair is connected. • Disconnected: The replication task pair is disconnected. • Recovering: The replication task pair is reconnecting when it's disconnected.

The options are available on this tab:

- **Create:** Create a replication task.
- **Rebuild:** Rebuild the replication task which is changed from a cloning job.
- **QReplica Options:** Set replication options.
- **Shaping Setting Configuration:** Set task shaping configurations.

The options are available after creating a replication task in the **Task** table:

- ▼ **-> Start:** Start the replication task.
- ▼ **-> Stop:** Stop the replication task.
- ▼ **-> Set Task Shaping:** Set task shaping group.
- ▼ **-> Add Path:** Add multi path for the replication task.
- ▼ **-> Schedule:** Set the replication task by schedule.
- ▼ **-> Delete:** Delete the replication task.

The options are available after creating a replication task in the **Task Path** table:

- ▼ **-> Add Connection:** Add a connection of the replication task.
- ▼ **-> Delete Connection:** Delete the connection for the replication task.
- ▼ **-> Delete:** Delete multi path of the replication task.

More detail is described in chapter 5.

Enclosure Management

The **Enclosure Management** menu option is for accessing the **Hardware Monitor**, **UPS**, **SES**, and **S.M.A.R.T.** option tabs.

For the enclosure management, there are many sensors for different purposes, such as temperature sensors, voltage sensors, hard disk status, fan sensors, power sensors, and LED status. Due to the different hardware characteristics among these sensors, they have different polling intervals. Below are the details of the polling time intervals:

- Temperature sensors: 1 minute.

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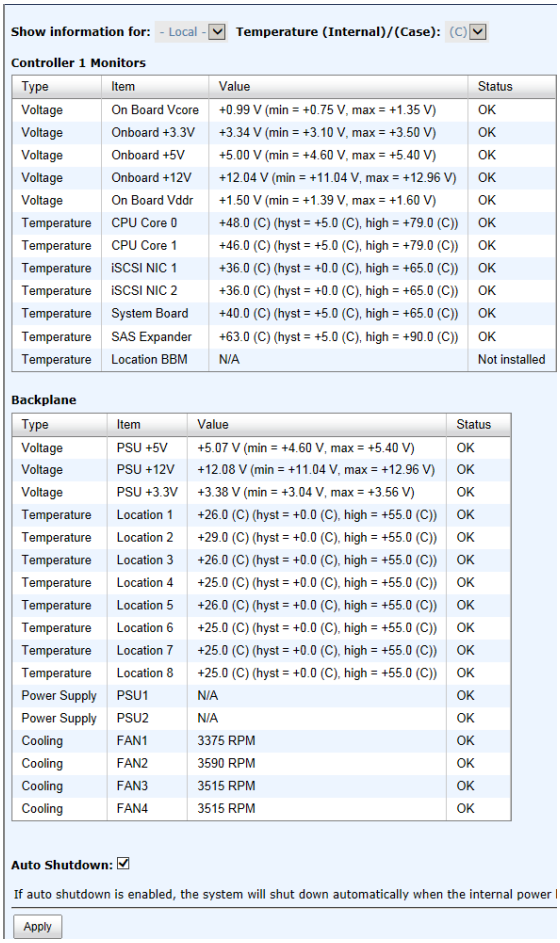
- Voltage sensors: 1 minute.
- Hard disk sensors: 10 minutes.
- Fan sensors: 10 seconds . When there are 3 errors consecutively, system sends ERROR event log.
- Power sensors: 10 seconds, when there are 3 errors consecutively, system sends ERROR event log.
- LED status: 10 seconds.

Hardware Monitor

The **Hardware Monitor** tab displays the information of current voltages and temperatures, also provides an Auto shutdown option.



Show information for: - Local - **Temperature (Internal)/(Case):** (C)

Controller 1 Monitors

Type	Item	Value	Status
Voltage	On Board Vcore	+0.99 V (min = +0.75 V, max = +1.35 V)	OK
Voltage	Onboard +3.3V	+3.34 V (min = +3.10 V, max = +3.50 V)	OK
Voltage	Onboard +5V	+5.00 V (min = +4.60 V, max = +5.40 V)	OK
Voltage	Onboard +12V	+12.04 V (min = +11.04 V, max = +12.96 V)	OK
Voltage	On Board Vddr	+1.50 V (min = +1.39 V, max = +1.60 V)	OK
Temperature	CPU Core 0	+48.0 (C) (hyst = +5.0 (C), high = +79.0 (C))	OK
Temperature	CPU Core 1	+46.0 (C) (hyst = +5.0 (C), high = +79.0 (C))	OK
Temperature	iSCSI NIC 1	+36.0 (C) (hyst = +0.0 (C), high = +65.0 (C))	OK
Temperature	iSCSI NIC 2	+36.0 (C) (hyst = +0.0 (C), high = +65.0 (C))	OK
Temperature	System Board	+40.0 (C) (hyst = +5.0 (C), high = +65.0 (C))	OK
Temperature	SAS Expander	+63.0 (C) (hyst = +5.0 (C), high = +90.0 (C))	OK
Temperature	Location BBM	N/A	Not installed

Backplane

Type	Item	Value	Status
Voltage	PSU +5V	+5.07 V (min = +4.60 V, max = +5.40 V)	OK
Voltage	PSU +12V	+12.08 V (min = +11.04 V, max = +12.96 V)	OK
Voltage	PSU +3.3V	+3.38 V (min = +3.04 V, max = +3.56 V)	OK
Temperature	Location 1	+26.0 (C) (hyst = +0.0 (C), high = +55.0 (C))	OK
Temperature	Location 2	+29.0 (C) (hyst = +0.0 (C), high = +55.0 (C))	OK
Temperature	Location 3	+26.0 (C) (hyst = +0.0 (C), high = +55.0 (C))	OK
Temperature	Location 4	+25.0 (C) (hyst = +0.0 (C), high = +55.0 (C))	OK
Temperature	Location 5	+26.0 (C) (hyst = +0.0 (C), high = +55.0 (C))	OK
Temperature	Location 6	+25.0 (C) (hyst = +0.0 (C), high = +55.0 (C))	OK
Temperature	Location 7	+25.0 (C) (hyst = +0.0 (C), high = +55.0 (C))	OK
Temperature	Location 8	+25.0 (C) (hyst = +0.0 (C), high = +55.0 (C))	OK
Power Supply	PSU1	N/A	OK
Power Supply	PSU2	N/A	OK
Cooling	FAN1	3375 RPM	OK
Cooling	FAN2	3590 RPM	OK
Cooling	FAN3	3515 RPM	OK
Cooling	FAN4	3515 RPM	OK

Auto Shutdown: ☑

If auto shutdown is enabled, the system will shut down automatically when the internal power

Apply

If **Auto Shutdown** is checked, the system will shut down automatically when the voltage or temperature is out of the normal range. For better data protection, it is recommended to check **Auto Shutdown**.

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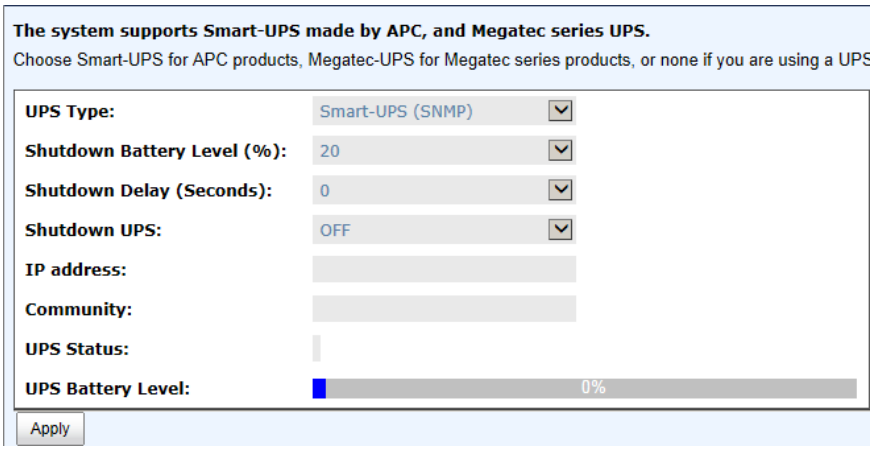
For better protection and avoiding single short period of high temperature that could trigger an automatic shutdown, the system uses to gauge if a shutdown is needed. This is done using several sensors placed on key systems that the system checks every 30 seconds for present temperatures.

- The core processor temperature limit is 80℃.
- The interface temperature limit is 65℃.
- The SAS Controller and SAS Expandor temperature limits are 65℃.

When one of these sensors reports a temperature above the threshold for three contifuous minutes, the system shuts down automatically.

UPS

The **UPS** tab is used to set up a UPS (Uninterruptible Power Supply).



Currently, the system only supports and communicates with Smart-UPS series by APC (American Power Conversion Corp, http://www.apc.com/) and Megatec UPS.

TIP:
Connection with other vendors of UPS can work well, but they have no such communication features with the system.

Now we support the traditional UPS via serial port and network UPS via SNMP. If using the UPS with serial port, connect the system to UPS via the included cable for communication. (The cable plugs into the serial cable that comes with the UPS.) Then set up the shutdown values for when the power goes out.

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This table shows the available options and their descriptions.

Options	Description
UPS Type	Select UPS Type: • None: No UPS or other vendors. • Smart-UPS (Serial port): APC Smart-UPS with serial port. • Smart-UPS (SNMP): APC Smart-UPS with network function. • Megatec-UPS: Megatec UPS.
Shutdown Battery Level (%)	When the battery level goes down and lower than the configured threshold, the system will auto shutdown. This function will be disabled if the configured threshold is set to 0.
Shutdown Delay (Seconds)	When there is the power outage happening, if the power cannot be recovered within the configured time, such as 30 seconds, the system will auto shutdown at the moment. This function will be disabled if the configured seconds is set to 0.
Shutdown UPS	The status of shutdown UPS: • ON: The system will send the command to shut down the connected UPS if one of the above functions is triggered when the power outage is happening. • OFF: Disable this function.
IP Address (This option is only visible when the UPS type is Smart-UPS (SNMP).)	The IP address of the network UPS.
Community (This option is only visible when the UPS type is Smart-UPS (SNMP).)	The SNMP community of the network UPS.
Status	The status of UPS: • Detecting… • Running • Unable to detect UPS • Communication lost • UPS reboot in progress • UPS shutdown in progress • Batteries failed. Please change them NOW!
Battery level (%)	Current power percentage of battery level.

The system will shut down either **Shutdown Battery level (%)** or **Shutdown Delay (Seconds)** reaches the condition. User should set these values carefully.

SES

The **SES** (SCSI Enclosure Services, one of the enclosure management standards) tab is used to enable or disable the management of SES.

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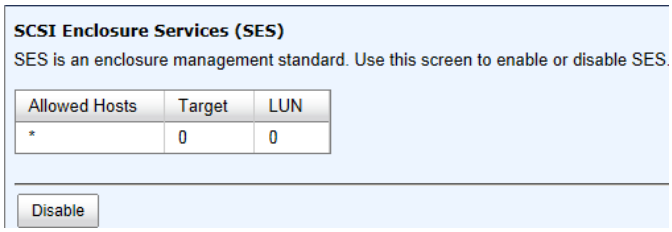


The options are available on this tab:

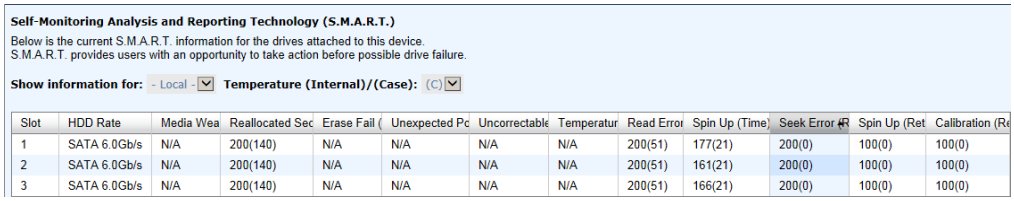
- **Enable:** Click the **Enable** button to enable SES.
- **Disable:** Click the **Disable** button to disable SES.

The SES client software is available at the following web site:

SANtools: http://www.santools.com/

S.M.A.R.T.

S.M.A.R.T. (Self-Monitoring Analysis and Reporting Technology) is a diagnostic tool for hard drives to deliver warning of drive failures in advance. It provides users a chance to take actions before a possible drive failure.



S.M.A.R.T. measures many attributes of the hard drive all the time and inspects the properties of hard drives which are close to be out of tolerance. The advanced notice of possible hard drive failure can allow users to back up hard drive or replace the hard drive. This is much better than hard drive crash when it is writing data or rebuilding a failed hard drive.

This tool displays S.M.A.R.T. information of hard drives. The number is the current value; the number in parenthesis is the threshold value. The threshold values from different hard drive vendors are different; please refer to hard drive vendors' specification for details.

S.M.A.R.T. only supports SATA drives. SAS drives do not have this function and will show N/A in the web page.

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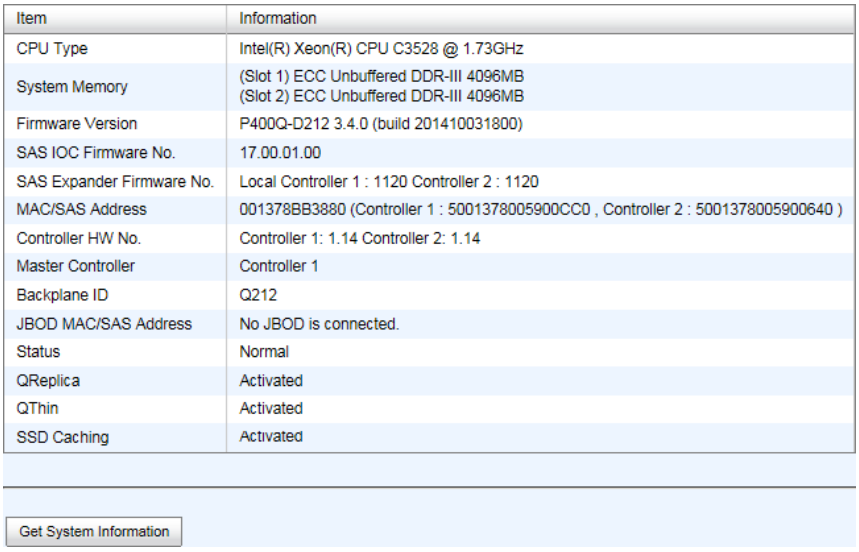
System Maintenance

The **System Maintenance** menu option is accessing the **System Information**, **Event Log**, **Upgrade**, **Firmware Synchronization** (This option is only visible when dual controllers is installed.), **Reset to Factory Defaults**, **Configuration Backup**, **Volume Restoration**, and **Reboot and Shutdown** option tabs.

System Information

The **System Information** provides to display system information. It includes CPU Type, installed System Memory, Firmware Version, SAS IOC Firmware No., SAS Expander Firmware No., MAC/SAS Address, Controller Hardware No., Master Controller, Backplane ID, JBOD MAC/SAS Address, Status, Error Message (This item is only visible when the system status is Degraded or Lockdown.), QReplica, QThin, and SSD Caching status.



This table shows the **Status** descriptions.

Status	Description
Normal	Dual controllers and JBODs are in normal stage.
Degraded	One controller or JBOD fails or has been plugged out.
Lockdown	The firmware of two controllers is different or the size of memory of two controllers is different.
Single	Single controller mode.

The options are available on this tab:

- **Download System Information:** Download the system information for debug.

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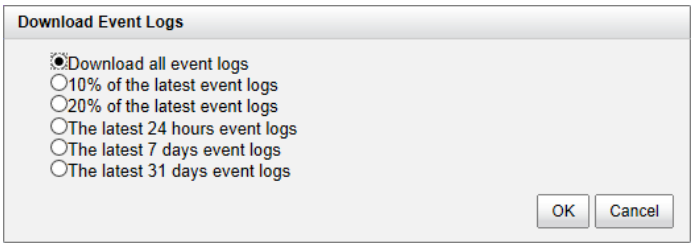
CAUTION:
If you try to increase the system memory and running in dual controller mode, please make sure both controllers have the same DIMM on each corresponding memory slot. Failing to do so will result in controller malfunction, which will not be covered by warranty.

Event log

The **Event Log** tab provides a log or event messages. Choose the buttons of INFO, WARNING, or ERROR levels to display those particular events.

The options are available on this tab:

- **Download:** Save the event log as a file. It will pop up a filter dialog as the following. The default it “Download all event logs”.



- **Mute Buzzer:** Stop alarm if the system alerts.
- **Clear:** Clear all event logs.

TIP:
Please plug-in any of the first four hard drives, then event logs can be saved and displayed in next system boot up. Otherwise, the event logs cannot be saved and will disappear.

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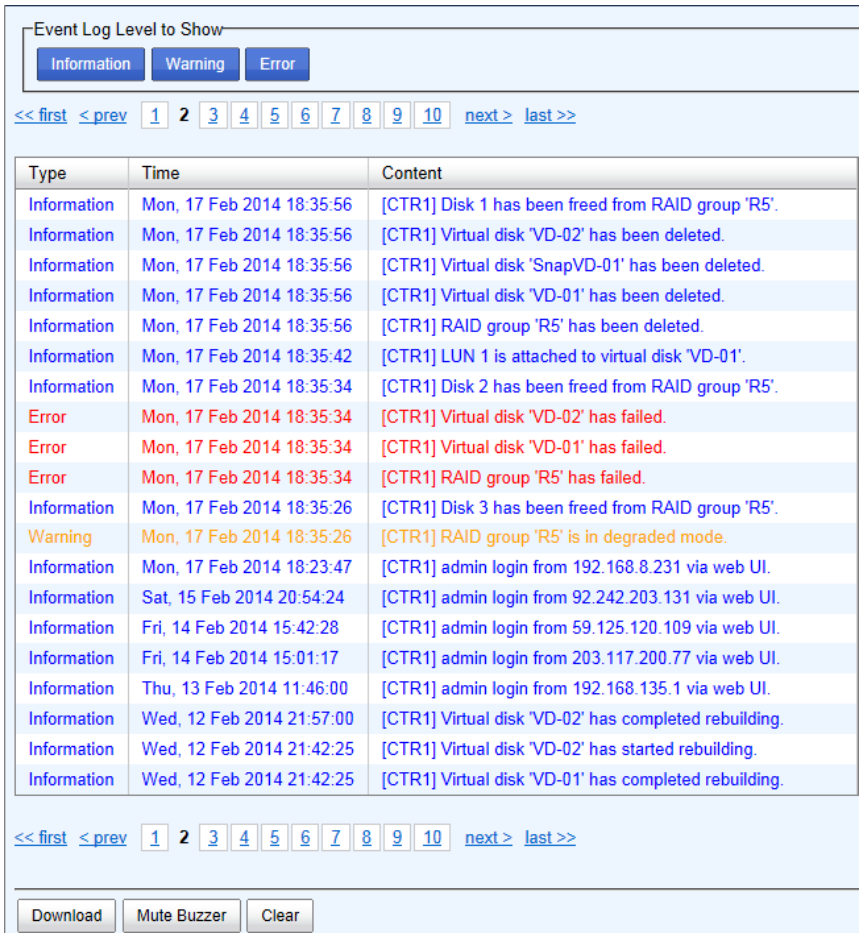

Type	Time	Content
Information	Mon, 17 Feb 2014 18:35:56	[CTR1] Disk 1 has been freed from RAID group 'R5'.
Information	Mon, 17 Feb 2014 18:35:56	[CTR1] Virtual disk 'VD-02' has been deleted.
Information	Mon, 17 Feb 2014 18:35:56	[CTR1] Virtual disk 'SnapVD-01' has been deleted.
Information	Mon, 17 Feb 2014 18:35:56	[CTR1] Virtual disk 'VD-01' has been deleted.
Information	Mon, 17 Feb 2014 18:35:56	[CTR1] RAID group 'R5' has been deleted.
Information	Mon, 17 Feb 2014 18:35:42	[CTR1] LUN 1 is attached to virtual disk 'VD-01'.
Information	Mon, 17 Feb 2014 18:35:34	[CTR1] Disk 2 has been freed from RAID group 'R5'.
Error	Mon, 17 Feb 2014 18:35:34	[CTR1] Virtual disk 'VD-02' has failed.
Error	Mon, 17 Feb 2014 18:35:34	[CTR1] Virtual disk 'VD-01' has failed.
Error	Mon, 17 Feb 2014 18:35:34	[CTR1] RAID group 'R5' has failed.
Information	Mon, 17 Feb 2014 18:35:26	[CTR1] Disk 3 has been freed from RAID group 'R5'.
Warning	Mon, 17 Feb 2014 18:35:26	[CTR1] RAID group 'R5' is in degraded mode.
Information	Mon, 17 Feb 2014 18:23:47	[CTR1] admin login from 192.168.8.231 via web UI.
Information	Sat, 15 Feb 2014 20:54:24	[CTR1] admin login from 92.242.203.131 via web UI.
Information	Fri, 14 Feb 2014 15:42:28	[CTR1] admin login from 59.125.120.109 via web UI.
Information	Fri, 14 Feb 2014 15:01:17	[CTR1] admin login from 203.117.200.77 via web UI.
Information	Thu, 13 Feb 2014 11:46:00	[CTR1] admin login from 192.168.135.1 via web UI.
Information	Wed, 12 Feb 2014 21:57:00	[CTR1] Virtual disk 'VD-02' has completed rebuilding.
Information	Wed, 12 Feb 2014 21:42:25	[CTR1] Virtual disk 'VD-02' has started rebuilding.
Information	Wed, 12 Feb 2014 21:42:25	[CTR1] Virtual disk 'VD-01' has completed rebuilding.

The event logs are displayed in reverse order which means the latest event log is on the first / top page. They are actually saved in the first four hard drives; each hard drive has one copy of event log. For one system, there are four copies of event logs to make sure users can check event log any time when there are failed disks.

Upgrade

The **Upgrade** tab is used to upgrade controller firmware, JBOD firmware, change operation mode, and active SSD caching license. Before upgrade, it recommends to use **Configuration Backup** tab to export all configurations to a file.

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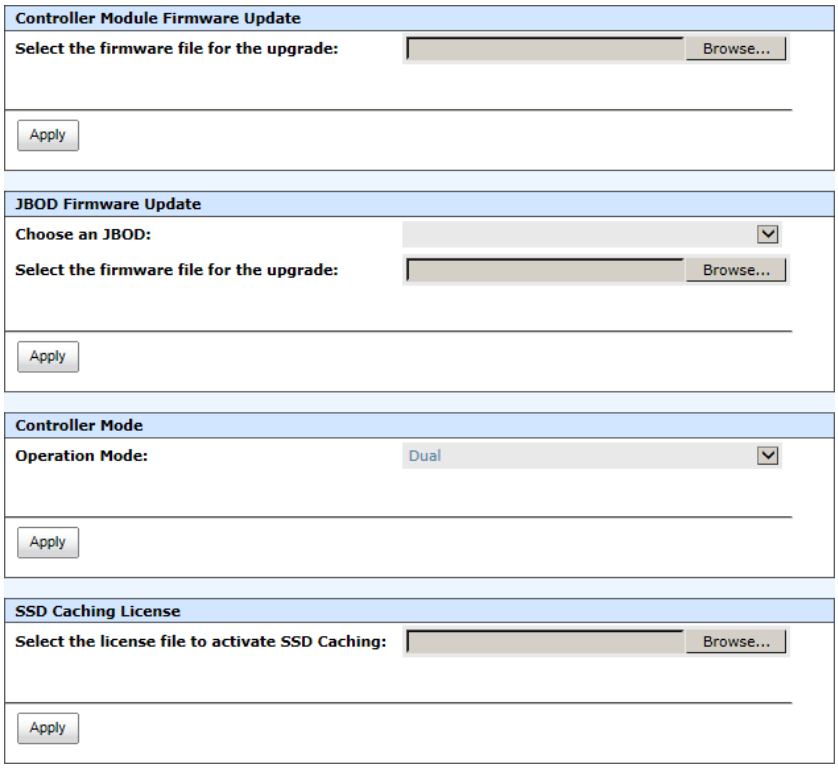

The options are available on this tab:

- **Controller Module Firmware Update:** Please prepare new controller firmware file named "xxxx.bin" in local hard drive, then click **Browse** to select the firmware file. Click **Apply** button, it will pop up a warning message, click **OK** button to start upgrading the firmware. When upgrading, there is a progress bar running. After finished upgrading, the system must reboot manually to make the new firmware take effect.
- **JBOD Firmware Update:** To upgrade JBOD firmware, choose a JBOD first, the other steps are the same as controller firmware update.
- **Controller Mode:** This option can be modified to dual or single here. If the system installed only one controller, switch this mode to **Single**, and then click **Apply** button.
- **SSD Caching License:** This option can activate SSD caching function. Select the license file, and then click **Apply** button. Each license key is unique and dedicated to a specific system. To obtain the license key, please contact sales for assistance.

Firmware Synchronization (Only available in Dual controller models)

The **Firmware Synchronization** tab is used on dual controller systems to synchronize the controller firmware versions when the firmware of the master controller and the slave controller are different. The firmware of slave controller is always changed to match the firmware of the master

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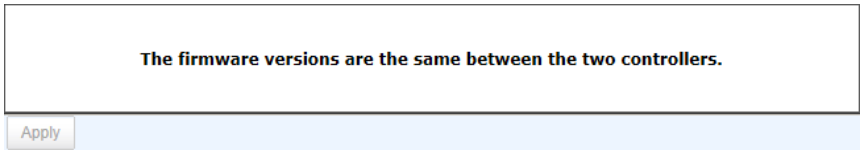
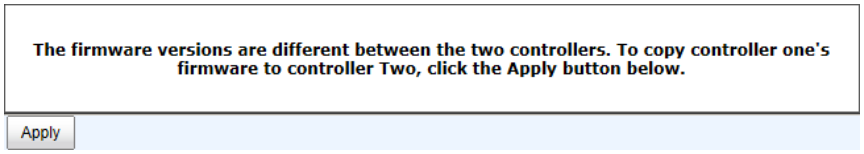
controller. It doesn't matter if the firmware version of slave controller is newer or older than that of the master. Normally, the firmware versions in both controllers are the same.



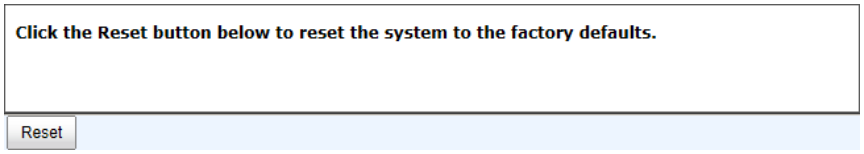
If the firmware versions between two controllers are different, it will display the following message. Click **Apply** button to synchronize.



TIP:
This tab is only visible when the dual controllers are installed. A single controller system does not have this option.

Reset to Factory Defaults

The **Reset to factory defaults** tab allows users to reset the system configurations back to the factory default settings.



The default values are:

- **Management IP Address: 192.168.1.234**
- **User Name: admin**
- **Password: 00000000**

Configuration Backup

The **Configuration Backup** is used to either save system configuration (export) or apply a saved configuration (import).

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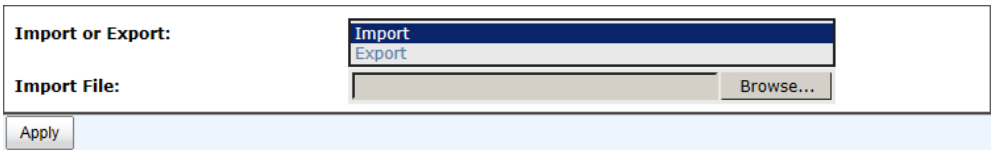


While the volume configuration settings are available for exporting, to prevent conflicts and overwriting existing data, they cannot be imported.

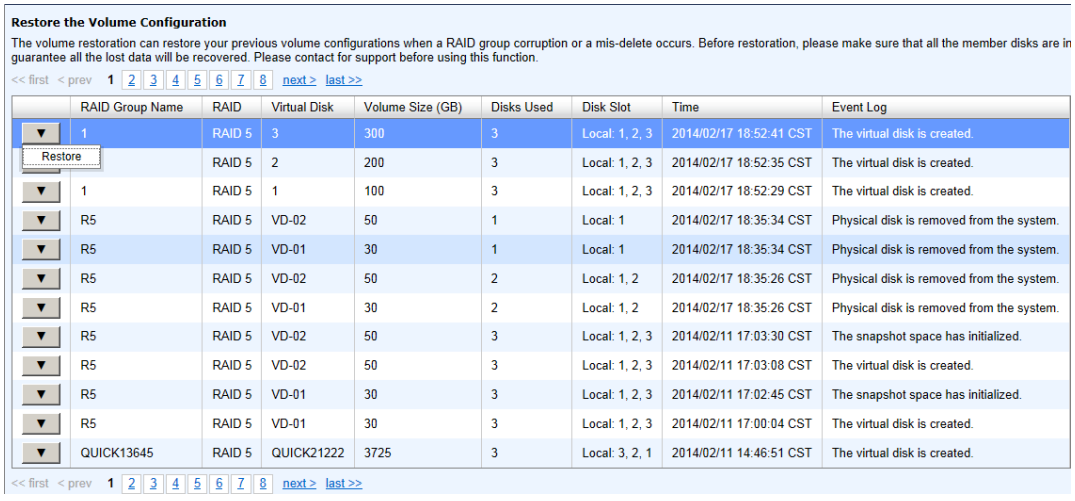
The options are available on this tab:

- **Import:** Import all system configurations excluding volume configuration.
- **Export:** Export all configurations to a file.

CAUTION:
Import option will import all system configurations excluding volume configuration and the current system configurations will be replaced.

Volume Restoration

The **Volume Restoration** can restore the volume configuration from the volume creation history. It is used for RAID group corrupt and tries to recreate the volume. When trying to do data recovery, the same volume configurations as original must be set and all member disks must be installed by the same sequence as original. Otherwise, data recovery will fail. The volume restoration does not guarantee that the lost data can be restored. Please get help from the expert before executing the function.



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This table shows the column descriptions.

Column Name	Description
RAID Group Name	The original RAID group name.
RAID	The original RAID level.
Virtual Disk	The original virtual disk name.
Volume Size (GB)	The original capacity of the virtual disk.
Disks Used	The original physical disk number of the RAID group.
Disk slot	The original physical disk locations.
Time	The last action time of the virtual disk.
Event Log	The last event of the virtual disk.

The options are available on this tab:

- **Restore:** Restore the virtual disk of the RAID group.

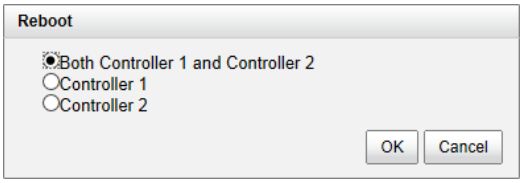
TIP:
When trying to do data recovery, the same volume configurations as original must be set and all member disks must be installed by the same sequence as original. Otherwise, data recovery will fail.

CAUTION:
The data recovery does not guarantee that the lost data can be restored 100%. It depends on the real operation and the degree of physical damages on disks. Users will take their own risk to do these procedures.

Reboot and Shutdown

The **Reboot and Shutdown** function is used to reboot or shutdown the system. Before powering off the system, it is highly recommended to execute **Shutdown** function to flush the data from cache onto the physical disks. The step is important for data protection.

The Reboot function has three options; reboot both controllers, controller 1 only or controller 2 only.



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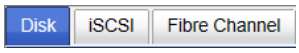
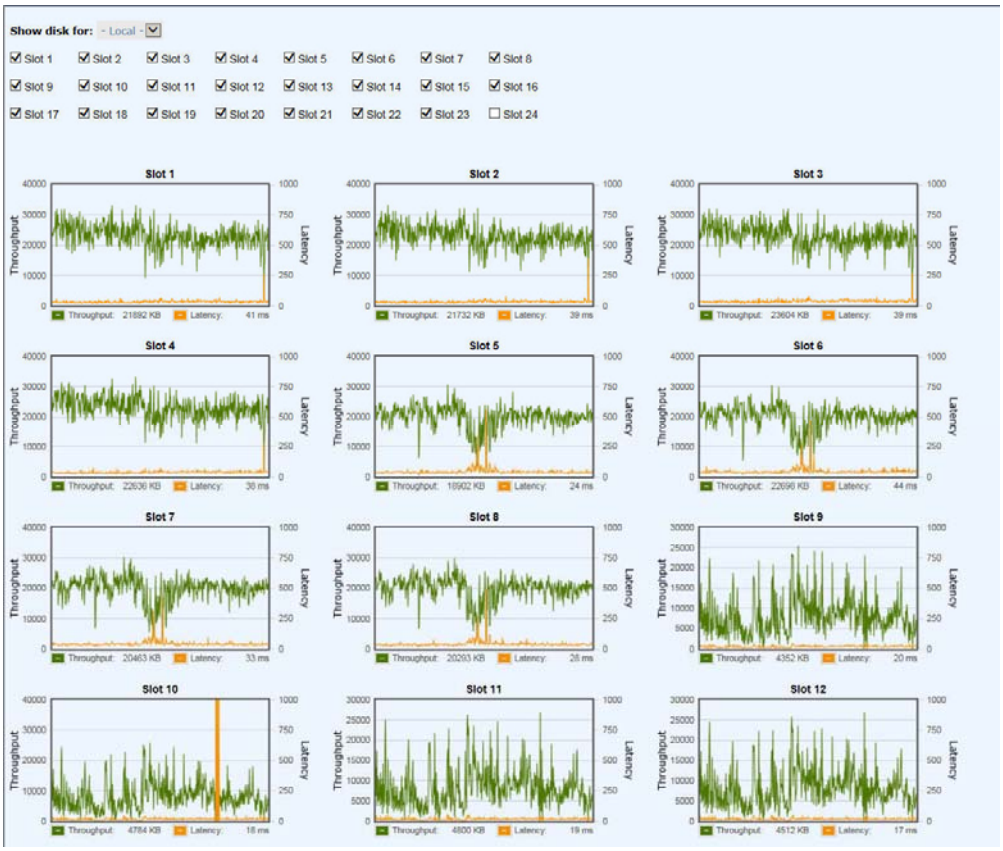
Performance Monitor

The **Performance Monitor** menu option is accessing the **Disk**, **iSCSI**, and **Fibre Channel** (This option is only visible when it is fibre channel model.) option tabs.



Disk

The **Disk** provides to display the throughput and latency of the physical disk. Check the slots which you want to monitor.



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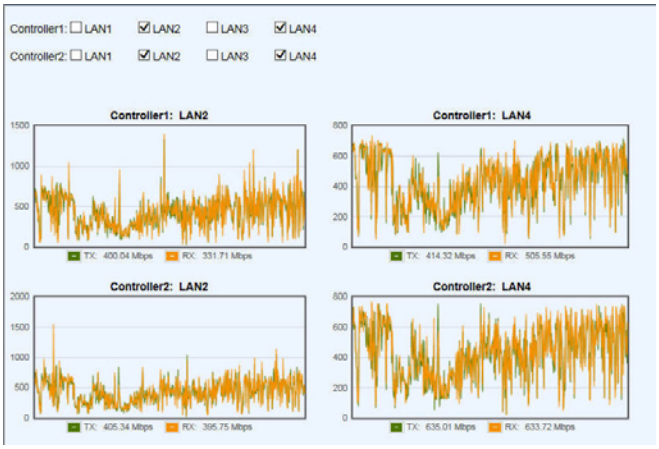
iSCSI

The **iSCSI** provides to display TX (Transmission) and RX (Reception) of the iSCSI ports. Check the interfaces which you want to monitor.



Fibre Channel

The **Fibre Channel** provides to display TX (Transmission) and RX (Reception) of the fibre channels. Check the interfaces which you want to monitor.

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5 Advanced Operations

Volume Rebuild

If one physical disk of the RAID group which is set as protected RAID level (e.g.: RAID 5, or RAID 6) fails or has been removed, then the status of RAID group will be changed to degraded mode. At the same time, the system will search the spare disk to execute volume rebuild the degraded RAID group into complete one.

There are three types of spare disks which can be set in **Physical Disks**:

- **Dedicated Spare**: The hard drive has been set as dedicated spare of a RAID group.
- **Local Spare**: The hard drive has been set as local spare of the enclosure.
- **Global Spare**: The hard drive has been set as global spare of whole system.

The detection sequence is the dedicated spare disk as the rebuild disk first, then local spare disk and global spare disk.

The following examples are scenarios for a RAID 6.

1. When there is no global spare disk or dedicated spare disk in the system, The RAID group will be in degraded mode and wait until there is one disk assigned as spare disk, or the failed disk is removed and replaced with new clean disk, and then the Auto-Rebuild starts.
2. When there are spare disks for the degraded array, system starts Auto-Rebuild immediately. In RAID 6, if there is another disk failure occurs during rebuilding, system will start the above Auto-Rebuild process as well. Auto-Rebuild feature only works at that the status of RAID group is **Online**. Thus, it will not conflict with the online roaming feature.
3. In degraded mode, the health of the RAID group is **Degraded**. When rebuilding, the status of RAID group and virtual disk will display **Rebuilding**, the column **R%** in virtual disk will display the ratio in percentage. After complete rebuilding, the status will become **Online**.

TIP:
The dedicated spare cannot be set if there is no RAID group or only RAID groups with RAID 0 or JBOD level.

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Sometimes, rebuild is called recover; they are the same meaning. This table describes the relationship between RAID levels and recovery.

Operation	Description
RAID 0	Disk striping. No protection for data. RAID group fails if any hard drive fails or unplugs.
RAID 1	Disk mirroring over 2 disks. RAID 1 allows one hard drive fails or unplugging. Need one new hard drive to insert to the system and rebuild to be completed.
N-way mirror	Extension to RAID 1 level. It has N copies of the disk. N-way mirror allows N-1 hard drives failure or unplugging.
RAID 3	Striping with parity on the dedicated disk. RAID 3 allows one hard drive failure or unplugging.
RAID 5	Striping with interspersed parity over the member disks. RAID 5 allows one hard drive failure or unplugging.
RAID 6	2-dimensional parity protection over the member disks. RAID 6 allows two hard drives failure or unplugging. If it needs to rebuild two hard drives at the same time, it will rebuild the first one, then the other in sequence.
RAID 0+1	Mirroring of RAID 0 volumes. RAID 0+1 allows two hard drive failures or unplugging, but at the same array.
RAID 10	Striping over the member of RAID 1 volumes. RAID 10 allows two hard drive failure or unplugging, but in different arrays.
RAID 30	Striping over the member of RAID 3 volumes. RAID 30 allows two hard drive failure or unplugging, but in different arrays.
RAID 50	Striping over the member of RAID 5 volumes. RAID 50 allows two hard drive failures or unplugging, but in different arrays.
RAID 60	Striping over the member of RAID 6 volumes. RAID 60 allows four hard drive failures or unplugging, every two in different arrays.
JBOD	The abbreviation of “Just a Bunch Of Disks”. No data protection. RG fails if any hard drive failures or unplugs.

Migrate and Move RAID Groups

Migrate RAID Level function changes the RAID group to different RAID level or adds the member disks of the RAID group for larger capacity. Usually, the RAID group migrates to higher RAID level for better protection. To do migration, the total size of RAID group must be larger than or equal to the original RAID group. The limitation is that it’s not allowed expanding the same RAID level with the same physical disks of the original RAID group. There is a similar function **Move RAID Level** which will move the member disks of the RAID group to totally different physical disks. In addition, thin provision RAID group cannot execute migrate or move, it uses **Add RAID Set** to enlarge capacity. Describe more detail in the Thin Provision section.

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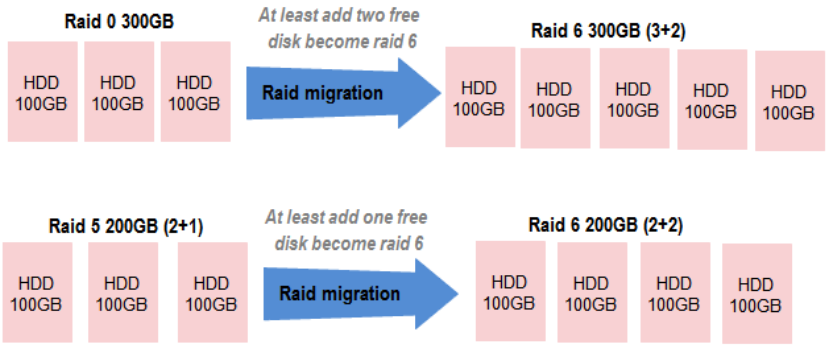

There are some limitations when a RAID group is being migrated or moved. System would reject these operations:

1. Add dedicated spare.
2. Remove a dedicated spare.
3. Create a new virtual disk.
4. Delete a virtual disk.
5. Extend a virtual disk.
6. Scrub a virtual disk.
7. Perform another migration operation.
8. Scrub entire RAID group.
9. Take a snapshot.
10. Delete a snapshot.
11. Expose a snapshot.
12. Rollback to a snapshot.

TIP:
Migrate function will migrate the member disks of RAID group to the same physical disks but it should increase the number of disks or it should be different RAID level. Move function will move the member disks of RAID group to totally different physical disks.

CAUTION:
RAID group migration or moving cannot be executed during rebuilding or virtual disk extension.

Take an example of migrate the RAID group.

1. Select **Volume Configuration -> RAID Groups**.
2. Select a RAID group, and then click ▼ **-> Migrate RAID Level**.
3. Select a **RAID Level** from the drop-down list.

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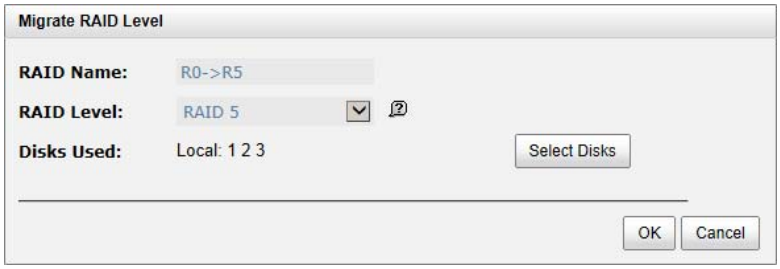
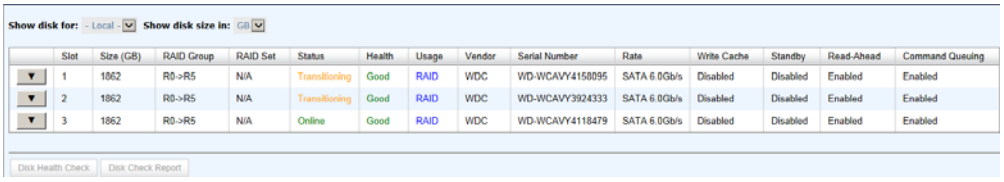
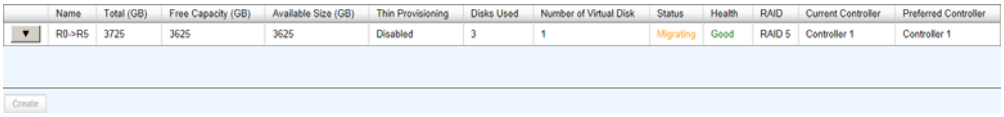
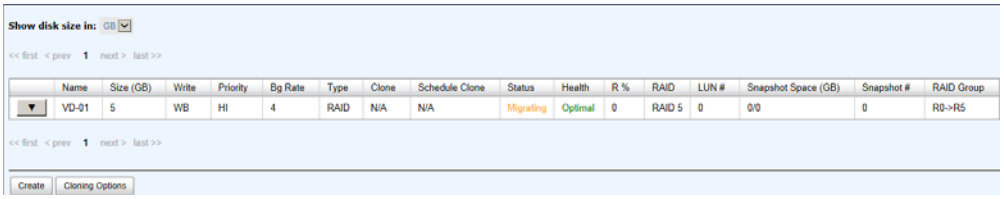
4. Click the **Select Disks** button to select disks from either local or expansion JBOD systems, and click **OK** to complete the selection. The selected disks are displayed at **Disks Used**.



5. At the confirmation dialog, click **OK** button to execute migration.
6. Migration starts. The status of **Physical Disks**, **RAID Groups** and **Virtual Disks** are changing. The complete percentage of migration is displayed in **R%**.







Move RAID Level usage is the same as **Migrate RAID Level** except it cannot change the RAID level.

Extend Virtual Disks

Extend function extend the size of the virtual disk if there is enough free space.

Take an example of extending the virtual disk.

1. Select **Volume Configuration -> Virtual Disks**.
2. Select a virtual disk, and then click ▼ **-> Extend**.

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3. Change the virtual disk size. The size must be larger than the current, and then click **OK** button to start extension.

4. Extension starts. If the virtual disk needs initialization, it will display the status **Initiating** and the complete percentage of initialization in **R%**.

TIP:
The extension size must be larger than the current size of the virtual disk.

CAUTION:
Extension cannot be executed during rebuilding or migration.

QThin

Nowadays thin provisioning is a hot topic people talk about in IT management and storage industry. To make contrast to thin provisioning, it naturally brings to our minds with the opposite term - fat provisioning, which is the traditional way IT administrators allocate storage space to each logical volume that is used by an application or a group of users. When it comes to the point to decide how much space a logical volume requires for three years or for the lifetime of an application, it's really hard to make the prediction correctly and precisely. To avoid the complexity of adding more space to the volumes frequently, IT administrators might as well allocate more storage space to each logical volume than it needs in the beginning. This is why it's called "fat" provisioning. Usually it turns out that a lot of free space is sitting around idle. This stranded capacity is wasted, which equals to waste of investment and inefficiency. Various studies indicate that as much as 75% of the storage capacity in small and medium enterprises or large data centers is allocated but unused. And this is where thin provisioning kicks in.

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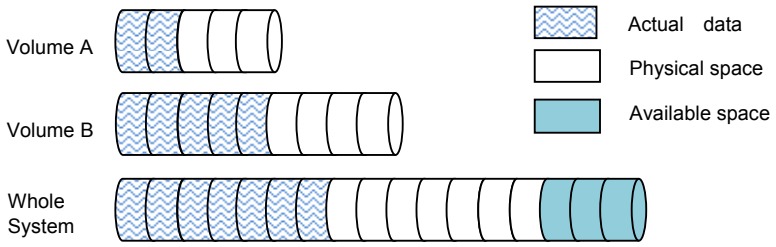
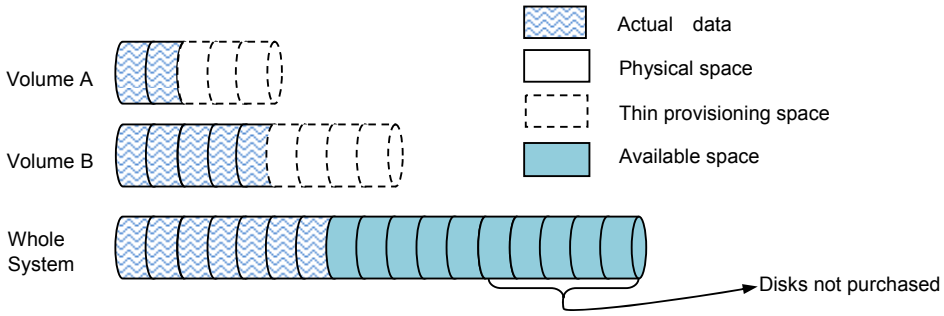


Traditional Fat Provisioning

Thin provisioning sometimes is known as just-in-time capacity or over allocation. As the term explains itself, it provides storage space by requests dynamically. Thin provisioning presents more storage space to the hosts or servers connecting to the storage system than is actually available on the storage system. Put it in another way, thin provisioning allocates storage space that may or may not exist. The whole idea is actually another way of virtualization. Virtualization is always about a logical pool of physical assets and provides better utilization over those assets. Here the virtualization mechanism behind thin provisioning is storage pool. The capacity of the storage pool is shared by all volumes. When write requests come in, the space will be drawn dynamically from this storage pool to meet the needs.



Thin Provisioning

The Benefits of QThin

The benefits of QThin are described on the following.

- Less disk purchase is needed initially when setting up a new storage system.
  You don't need to buy more capacity to meet your future data growth at present time. Usually hard drive price declines as time progresses. You can buy the same hard drives with cheaper price at a later time. Why not save money upfront while you can?
- No stranded storage capacity, better utilization efficiency and lower total cost of ownership.
  QThin can make full use of the stranded capacity that traditional provisioning can't. All free capacity can be made available to other hosts. A single storage system can serve more hosts and servers to achieve high consolidation ratio. QThin can help you achieve the same level of

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services with less hard drives purchased upfront, which can significantly reduce your total cost of ownership.

- Scalability: storage pool can grow on demand.

  When the storage pool (RAID group) has reached the threshold you set before. Up to 32 RAID sets can be added to the RAID group to increase the capacity on demand without interrupting I/O. Each RAID set can have up to 64 physical disks.

- Automatic space reclamation mechanism to recycle unused blocks.

  The technology used here is called zero reclamation. When a thin RAID group is created, the initialization process will try to fill out all the storage pool space with zero. This process will run in background with low priority in order not to impact the I/O performance. This is the reason why when there is no I/O traffic from the hosts, the hard drive LED will keep blinking as if there are I/O activities. The purpose of zero reclamation is that when the actual user data happens to have all zero in a basic allocation unit (granularity), the storage system will treat it as free space and recycle it. Until the next time there is data update to this reclaimed all zero basic unit, the storage system can swiftly return a basic unit from the free storage pool because it's already filled with zero.

- An eco-friendly green feature that helps to reduce energy consumption.

  Hard drive is the top power consumer in a storage system. Because you can use less hard drives to achieve the same amount of work, this translates directly to a huge reduction of power consumption and more green in your pocket.

Features Highlight

The following describes the comparison with Fat and Thin provisioning.

- Write on demand or allocate on demand.

  This is the most distinctive function in thin provisioning. You can see from the screenshots below. Figure 1 shows there are two RAID groups created. "Fat-RG" is using traditional provisioning without QThin enabled and its size is 1862GB. "Thin-RG" is QThin-enabled and its size is the same.

	Name	Total (GB)	Free Capacity (GB)	Available Size (GB)	Thin Provisioning
▼	Fat-RG	1862	1862	1862	Disabled
▼	Thin-RG	1862	1862	1862	Enabled

Figure 1: No virtual disk is created

Let's create a Virtual Disk on each RAID group with the same size of 1000GB respectively in Figure 2 and see what happens.

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	Name	Size (GB)	Write	Priority	Bg Rate	Type	Clone
▼	Fat-VD	1000	WB	HI	4	RAID	N/A
▼	Thin-VD	1000	WB	HI	4	RAID	N/A

Figure 2: Virtual disks are created

In Figure 3, the free space of "Fat-RG" immediately reduces to 862GB. 1000GB is taken away by the virtual disk. However, the free space of "Thin-RG" is still 1862GB even though the same size of virtual disk is created from the RAID group. Nothing is written to the virtual disk yet, so no space is allocated. The remaining 1862GB can be used to create other virtual disks. This is storage efficiency.

	Name	Total (GB)	Free Capacity (GB)	Available Size (GB)	Thin Provisioning
▼	Fat-RG	1862	862	862	Disabled
▼	Thin-RG	1862	1862	1862	Enabled

Figure 3: Write on demand

- Expand capacity on demand without downtime.

  Extra RAID set can be added to the thin RAID group to increase the size of free storage pool. A thin RAID group can have up to 32 RAID sets with each RAID set containing up to 64 physical hard drives. The maximum size of each RAID set is 64TB. Figure 4 shows that "Thin-RG" consists of two RAID sets.

Show RAID size in: GB

	Name	Total (GB)	Free Capacity (GB)	Available Size (GB)	Thin Provisioning	Disks Used
▼	Fat-RG	1862	862	862	Disabled	1
▼	Thin-RG	3724	3724	3724	Enabled	2

RAID Set:

	No	Total Size (GB)	Free Size (GB)	Disks Used	RAID Cell	Status	Health
▼	1	1862	1862	1	1	Online	Good
▼	2	1862	1862	1	1	Online	Good

Figure 4: Scalable RAID group size

- Allocation unit (granularity) is 1GB. This is a number that demands careful balance between efficiency and performance. The smaller it is, the better the efficiency and the worse the performance becomes, and vice versa.
- Thin provisioned snapshot space and it is writable.

  Snapshot space sits at the same RAID group of the volume that the snapshot is taken against. Therefore when you expose the snapshot into a virtual disk, it becomes a thin-provisioned

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virtual disk. It will only take up the just the right amount of space to store the data, not the full size of the virtual disk.

- Convert traditional virtual disk to QThin and vice versa.

  You can enjoy the benefits of QThin right now and right this moment. Move all your existing fat-provisioned virtual disks to thin-provisioned ones. Virtual disk clone function can be performed on both directions - fat-to-thin and thin-to-fat, depending on your application needs. Figure 5 shows cloning a fat virtual disk to a thin one.

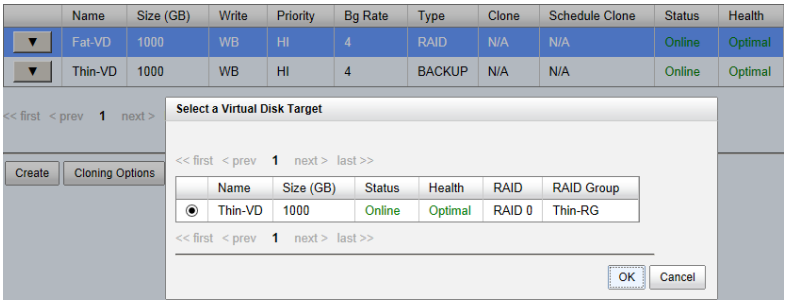

Figure 5: Clone between thin virtual disk and fat one

QThin Options

The following describes the thin provisioning options.

- Threshold settings and capacity policies.

  These are designed to simplify the management and better monitoring the storage usage. You can set as many as 16 policies for each RAID group. When space usage ratio grows over the threshold set in the policy, the action will be taken and event log will be generated.

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	Name	Total (GB)	Free Capacity (GB)	Available Size (GB)	Thin Provisioning	Disks Used
▼	Fat-RG	1862	360	360	Disabled	1
▼	Thin-RG	3724	3722	3724	Enabled	2

RAID Set:

	No	Total Size (GB)	Free Size (GB)	Disks Used	RAID Cell	Status	Health
▼	1	1862	1862	1	1	Online	Good
▼	2	1862	1860	1	1	Online	Good

RAID Group Policy:

<< first < prev 1 next > last >>

	No.	Threshold	Level	Action
▼	1	60%	Information	Take no Action
▼	2	70%	Information	Take no Action
▼	3	80%	Information	Take no Action
▼	4	85%	Warning	Reclaim Space
▼	5	90%	Warning	Delete Snapshots
▼	6	95%	Warning	De-activate RAID Group

Figure 6: Capacity policy settings

- Automatic space reclamation to recycle unused space and increase utilization rate.

  Automatic space reclamation will be automatically activated in RAID group initialization process or it can be set manually through capacity policy. You can set as many as 16 policies. When space usage ratio grows over the threshold set in the policy, space reclamation will be enabled automatically at the background with the lowest priority or when the I/O is low. The resource impact is reduced to minimum.

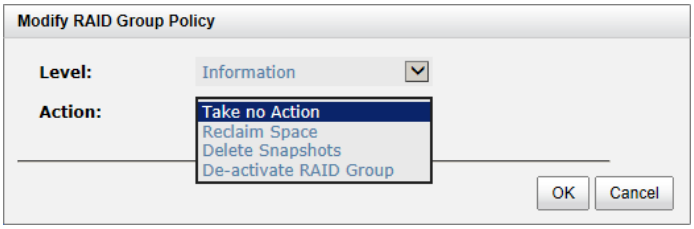

Figure 7: Space reclamation

Thin Provisioning Case

We suggest that you apply QThin to non-critical production applications first. Thin provisioning works well when the data written is thin-friendly, which means that the data written is not completely spread across the whole volume. Applications that spread metadata across the entire volume will obviate the advantages of thin provisioning. Some applications that expect the data to be contiguous at block level are not good candidates for thin provisioning as well.

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QThin works well with email system, web-based archive, or regular file archive system. When the number of supported volumes grows larger, the benefits of QThin will become more apparent.

Disk Roaming

Physical disks can be re-sequenced in the same system or move all physical disks in the same RAID group from system-1 to system-2. This is called disk roaming. System can execute disk roaming online. Please follow the procedures.

1. In **Volume Configuration -> RAID Group** tab, selects a RAID group. And then click ▼ **-> Deactivate**.
2. Click **OK** button to apply. The **Status** changes to **Offline**.
3. Move all physical disks of the RAID group to another system.
4. In **Volume Configuration -> RAID Group** tab, selects the RAID group. And then click ▼ **-> Activate**.
5. Click **OK** to apply. The **Status** changes to **Online**.

Disk roaming has some constraints as described in the followings:

1. Check the firmware version of two systems first. It is better that either systems have the same firmware version or the firmware version of the system-2 is newer.
2. All physical disks of the RAID group should be moved from system-1 to system-2 together. The configuration of both RAID group and virtual disk will be kept but LUN configuration will be cleared in order to avoid conflict with the current setting of the system-2.

JBOD Expansion

JetStor storage space can be expanded by adding JBOD expansion system.

Connecting JBOD

JetStor storage systems suport expansion systems with SAS connections. When connecting to an expansion system, it will be displayed at the **Show disk for:** drop-down list in **Volume Configuration -> Physical Disks** tab. For example: Local, JBOD 1 (**JETSTOR J300Q**), JBOD 2 (**JETSTOR J300Q**), …etc. Local means disks in local controller, JOBD 1 means disks in JBOD 1 controller, and so on.

In **Enclosure Management -> Hardware monitor** tab, select the enclosure at the **Show information for:** drop-down list, it can display the hardware status of SAS JBODs.

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In **Enclosure Management -> S.M.A.R.T.** tab, select the enclosure at the **Show information for:** drop-down list, it can display the SMART information of the disks in JBODs.

SAS JBOD expansion has some constraints as described in the followings:

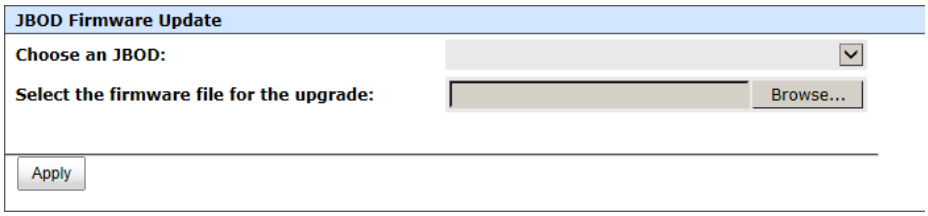
1. User could create RAID group among multiple chassis, max number of disks in a single RAID group is 32.
2. Local spare disk can support the RAID groups which located in the local chassis.
3. Global spare disk can support all RAID groups which located in the different chassis.
4. When support SATA drives for the redundant JBOD model, the 6G MUX board is required. The 3G MUX board does not apply to this model.
5. The following table is the maximum JBOD numbers and maximum HDD numbers with different chassis can be cascaded.

RAID Storage System	
JBOD no.	9
Max HDD no.	240

Upgrade Firmware

Before upgrade, it recommends to use **System maintenance -> Configuration Backup** tab to export all configurations to a file. To upgrade the firmware of JBOD, please follow the procedures.

1. In **System Maintenance -> Upgrade** tab, select a JBOD first, and then click **Browse** to select the firmware file.



2. Click **Apply** button, it will pop up a warning message, click **OK** button to start upgrading the JBOD firmware.
3. After finished upgrading, the JBOD system must reboot manually to make the new firmware took effect.

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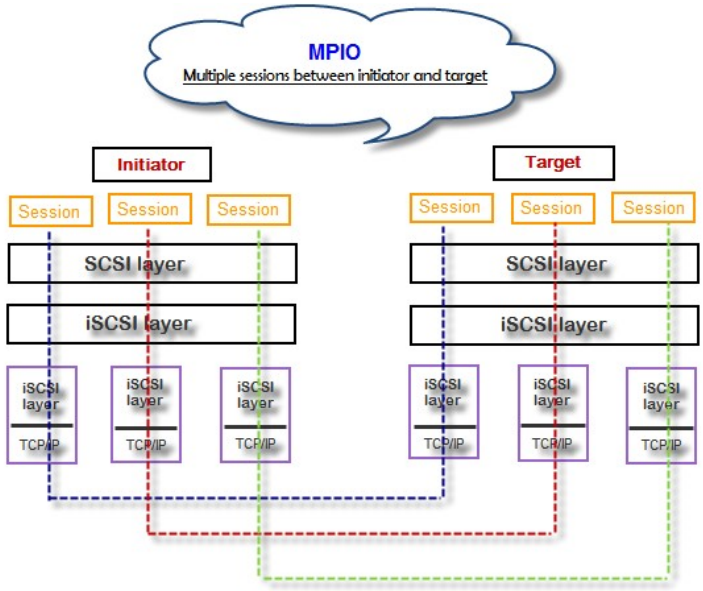
MPIO and MC/S

These features come from iSCSi initiator. They can be setup from iSCSI initiator to establish redundant paths for sending I/O from the initiator to the target.

MPIO

In Microsoft Windows server base system, Microsoft MPIO driver allows initiators to login multiple sessions to the same target and aggregate the duplicate devices into a single device. Each session to the target can be established using different NICs, network infrastructure and target ports. If one session fails, then another session can continue processing I/O without interruption to the application.



MC/S

MC/S (Multiple Connections per Session) is a feature of iSCSI protocol, which allows combining several connections inside a single session for performance and failover purposes. In this way, I/O can be sent on any TCP/IP connection to the target. If one connection fails, another connection can continue processing I/O without interruption to the application.

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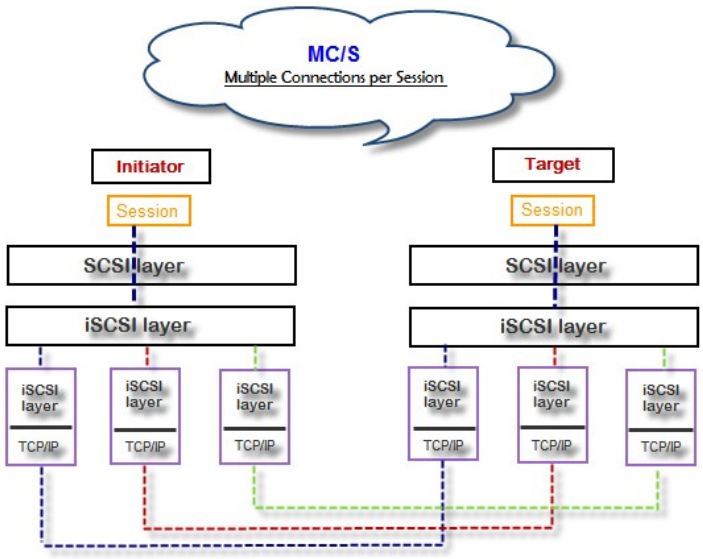

Difference

MC/S is implemented on iSCSI level, while MPIO is implemented on the higher level. Hence, all MPIO infrastructures are shared among all SCSI transports, including Fiber Channel, SAS, etc. MPIO is the most common usage across all OS vendors. The primary difference between these two is which level the redundancy is maintained. MPIO creates multiple iSCSI sessions with the target storage. Load balance and failover occurs between the multiple sessions. MC/S creates multiple connections within a single iSCSI session to manage load balance and failover. Notice that iSCSI connections and sessions are different than TCP/IP connections and sessions. The above figures describe the difference between MPIO and MC/S.

There are some considerations when user chooses MC/S or MPIO for multi-path.

1. If user uses hardware iSCSI off-load HBA, then MPIO is the only one choice.
2. If user needs to specify different load balance policies for different LUNs, then MPIO should be used.
3. If user installs anyone of Windows XP, Windows Vista or Windows 7, MC/S is the only option since Microsoft MPIO is supported Windows Server editions only.
4. MC/S can provide higher throughput than MPIO in Windows system, but it consumes more CPU resources than MPIO.

Trunking and LACP

Link aggregation is the technique of taking several distinct Ethernet links to let them appear as a single link. It has a larger bandwidth and provides the fault tolerance ability. Beside the advantage

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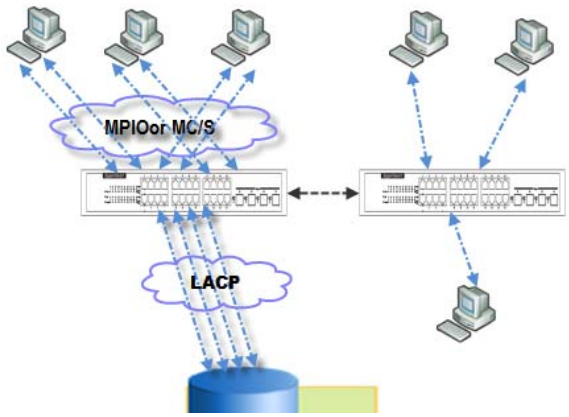
of wide bandwidth, the I/O traffic remains operating until all physical links fail. If any link is restored, it will be added to the link group automatically.

LACP

The Link Aggregation Control Protocol (LACP) is a part of IEEE specification 802.3ad. It allows bundling several physical ports together to form a single logical channel. A network switch negotiates an automatic bundle by sending LACP packets to the peer. Theoretically, LACP port can be defined as active or passive. JetStor controller implements it as active mode which means that LACP port sends LACP protocol packets automatically. Please notice that using the same configurations between JetStor controller and gigabit switch.

The usage occasion of LACP:

- It's necessary to use LACP in a network environment of multiple switches. When adding new devices, LACP will separate the traffic to each path dynamically.



Trunking

Trunking is not a standard protocol. It defines the usage of multiple iSCSI data ports in parallel to increase the link speed beyond the limits of any single port.

The usage occasion of Trunking:

- This is a simple SAN environment. There is only one switch to connect the server and storage. And there is no extra server to be added in the future.
- There is no idea of using LACP or Trunking, uses Trunking first.
- There is a request of monitoring the traffic on a trunk in switch.

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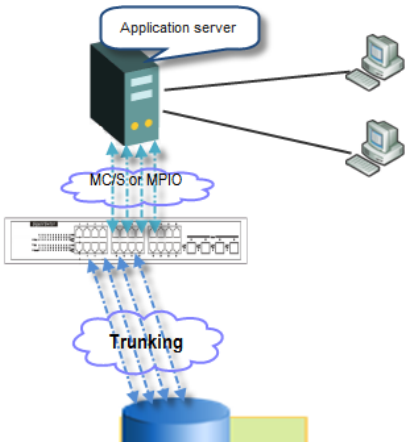

CAUTION:
Before using trunking or LACP, the gigabit switch must support either trunking or LACP. Otherwise, host cannot connect the link with storage device.

Dual Controllers

The JetStor storage system supports dual controllers of the same type for redundancy. Controller 1 (CTRL 1) is the master controller and controller 2 (CTRL 2) is the slave by default.

CAUTION:
- If you try to increase the system memory and running in dual controller mode, please make sure both controllers have the same DIMM on each corresponding memory slot. Failing to do so will result in controller malfunction, which will not be covered by warranty.
- Be aware that when the LED of the Controller Health is in RED, please DO NOT unplug the controller from the system or turn off the power suddenly. This may cause unrecoverable damage, which will not be covered by warranty.

Perform I/O

Please refer to the following topology and have all the connections ready. To perform I/O on dual controllers, server/host should setup MPIO. MPIO policy will keep I/O running and prevent fail connection with single controller failure.

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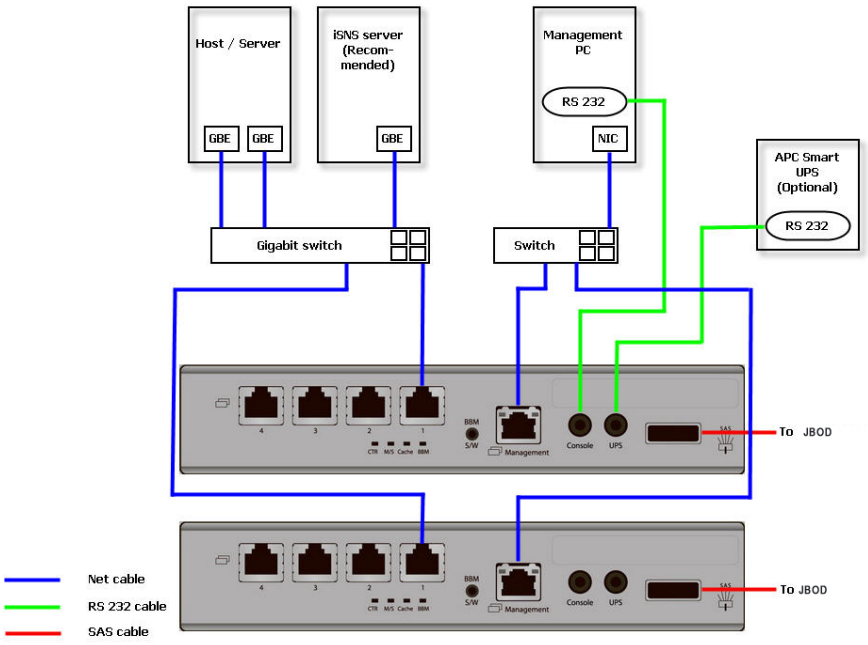
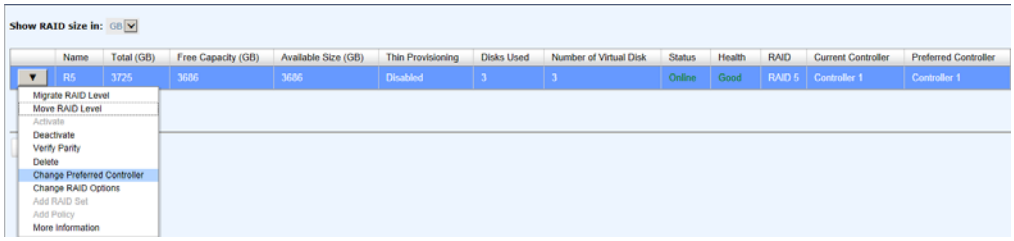


Ownership

When creating a RAID group, it will be assigned with a prefered owner, the default owner is controller 1. To change the ownership of the RAID group, please follow the procedures.

1. In **Volume Configuration -> RAID Group** tab, selects a RAID group. And then click ▼ **-> Change Preferred Controller**.



2. Click **OK** to apply. The ownership of the RG will be switched to the other controller.

Controller Status

There are four statuses in dual controller. It is displayed at **Status** column in **System Maintenance -> System Information**. Describe on the following.

1. **Normal:** Dual controller mode. Both of controllers are functional.
2. **Degraded:** Dual controller mode. When one controller fails or has been plugged out, the system will turn to degraded. In this stage, I/O will force to write through for protecting data

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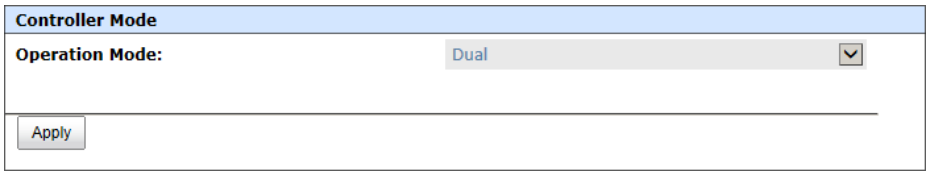
and the ownership of RAID group will switch to good one. For example: if controller 1 which owns the RAID group 1 fails accidently, the ownership of RAID group 1 will be switched to controller 2 automatically. And the system and data can keep working well. After controller 1 is fixed or replaced, The current owner of all RAID groups will be asigned back to their prefered owner.

3. **Lockdown:** Dual controller mode. The firmware of two controllers is different or the size of memory of two controllers is different. In this stage, only master controller can work and I/O will force to write through for protecting data.
4. **Single:** Single controller mode. In the stage, the controller must stay in slot A and MUX boards for SATA drives are not necessary. The differences between single and degraded are described on the following. There is no error message for inserted one controller only. I/O will not force to write through. And there is no ownership of RAID group.

Change Controller Mode

The operation mode can be changed from Single to Dual or vice versa. Please follow the procedures to change the operation mode.

1. In **System Maintenance -> Upgrade** tab, select **Single** or **Dual** in the drop-down list.



2. Click **Apply** button, it will pop up a warning message, click **OK** button to confirm.

Recommend iSNS Server

In addition, iSNS server is recommended. It's important for keeping I/O running smoothly when the ownership of the RAID group is switching or one of the dual controllers fails. For example of without iSNS server, when the controller 1 fails, the running I/O from host to controller 1 may fail because the host switches to new portal is slower at the moment and it may cause I/O time out. With iSNS server, this case would not happen.

TIP:
iSNS server is recommended for dual controller system of iSCSI interfaces.

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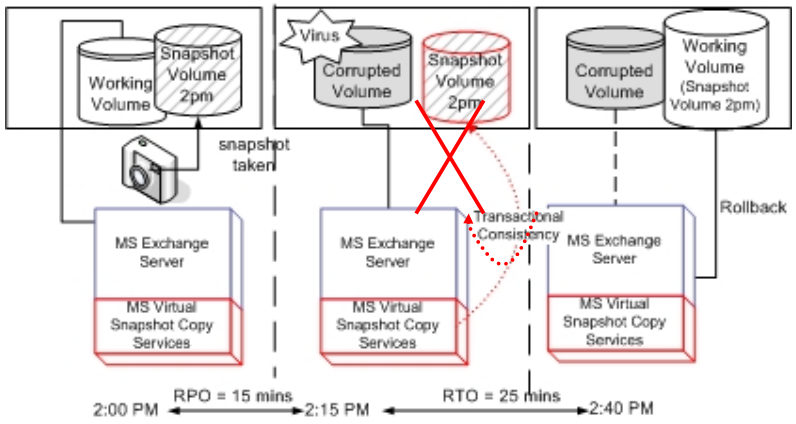
Snapshots

Snapshot-on-the-box captures the instant state of data in the target volume in a logical sense. The underlying logic is Copy-on-Write, moving out the data which would be written to certain location where a write action occurs since the time of data capture. The certain location, named as "Snapshot virtual disk", is essentially a new virtual disk which can be attached to a LUN provisioned to a host as a disk like other ordinary virtual disks in the system.

Rollback restores the data back to the state of any time which was previously captured in case for any unfortunate reason it might be (e.g. virus attack, data corruption, human errors and so on). Snapshot virtual disk is allocated within the same RAID group in which the snapshot is taken, we suggest to reserve 20% of the RAID group size or more for snapshot space. Please refer to the following figure for snapshot concept.



Take a Snapshot

Take an example of taking a snapshot.

1. Before taking a snapshot, it must reserve some storage space for saving variant data. There are two methods to set snapshot space. In **Virtual Disks** tab, selects a virtual disk. And then click ▼ **-> Set Snapshot Space** or in **Snapshots** tab, click **Set Snapshot Space** button.

2. Enter a **Size** which is reserved for the snapshot space, and then click **OK** button. The minimum size is suggested to be 20% of the virtual disk size. Now there are two numbers in

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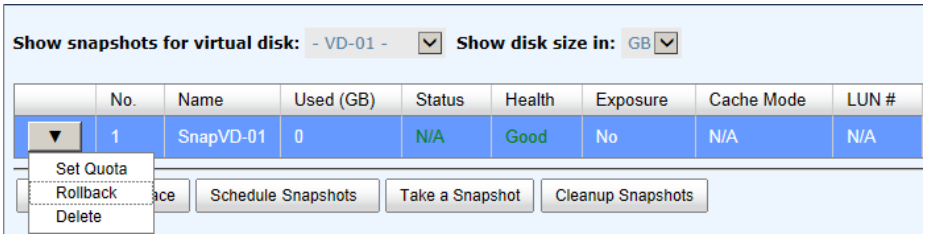
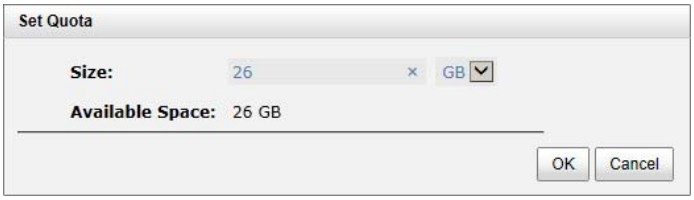
Snapshot Space (GB) column in **Virtual Disks** tab. They mean used snapshot space and total snapshot space.

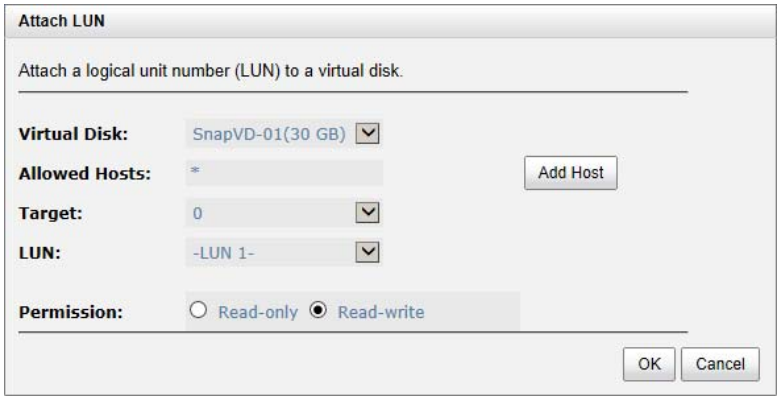
3. There are two methods to take snapshot. In **Virtual Disks** tab, selects a virtual disk. And then click ▼ **-> Take a Snapshot** or in **Snapshots** tab, click **Take a Snapshot** button.
4. Enter a **Snapshot Name**.
5. Click **OK** button. The snapshot is taken.



6. Set quota to expose the snapshot. Click ▼ **-> Set Quota** option.



7. Enter a size which is reserved for the snapshot. If the size is zero, the exposed snapshot will be read only. Otherwise, the exposed snapshot can be read / written, and the size will be the maximum capacity for writing.
8. Attach LUN to the snapshot.



9. Done. The Snapshot can be used.

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Cleanup Snapshots

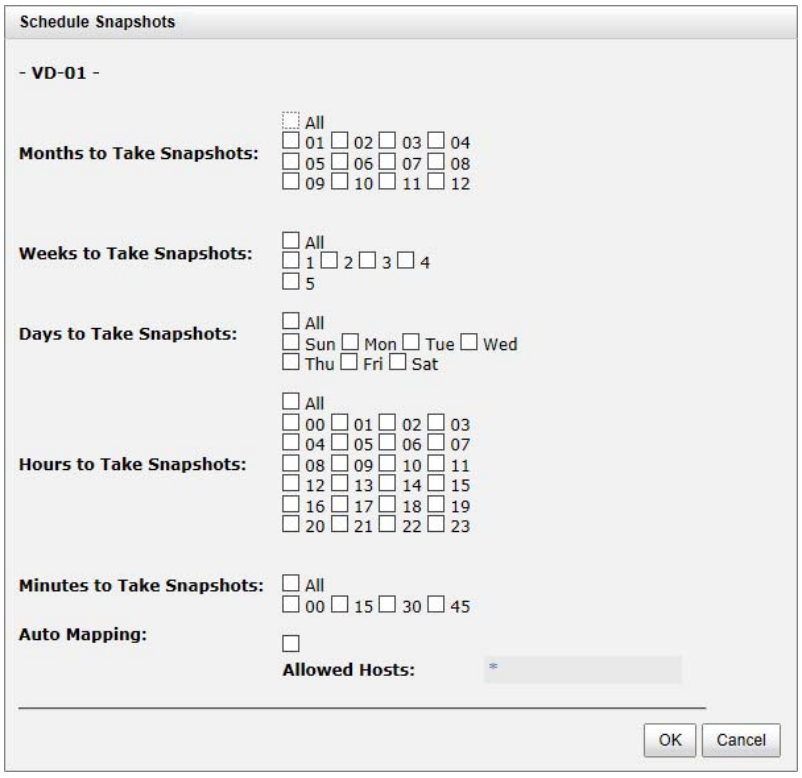
To cleanup all the snapshots, please follow the procedures.

1. There are two methods to cleanup snapshots. In **Virtual Disks** tab, selects a virtual disk. And then click ▼ **-> Cleanup Snapshots** or in **Snapshots** tab, click **Cleanup Snapshots** button.
2. Click **OK** to apply. It will delete all snapshots of the virtual disk and release the snapshot space.

Schedule Snapshots

The snapshots can be taken by schedule such as hourly or daily. Please follow the procedures.

1. There are two methods to set schedule snapshots. In **Virtual Disks** tab, selects a virtual disk. And then click ▼ **-> Schedule Snapshots** or in **Snapshots** tab, click **Schedule Snapshots** button.
2. Check the schedules which you want. They can be set by monthly, weekly, daily, or hourly. Check **Auto Mapping** to attach LUN automatically when the snapshot is taken. And the LUN is allowed to access by **Allowed Hosts**.
3. Click **OK** to apply.



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TIP:
Daily snapshot will be taken at every 00:00. Weekly snapshot will be taken every Sunday 00:00. Monthly snapshot will be taken every first day of month 00:00.

Rollback

The data in snapshot can rollback to the original virtual disk. Please follow the procedures.

1. In **Snapshots** tab, selects a snapshot. And then click ▼ **-> Rollback**.
2. Click **OK** to apply.

CAUTION:
Before executing rollback, it is better that the disk is unmounted on the host computer for flushing data from cache.

Snapshot Constraint

Snapshot function applies Copy-on-Write technique on virtual disk and provides a quick and efficient backup methodology. When taking a snapshot, it does not copy any data at first time until a request of data modification comes in. The snapshot copies the original data to snapshot space and then overwrites the original data with new changes. With this technique, snapshot only copies the changed data instead of copying whole data. It will save a lot of disk space.

- Create a data-consistent snapshot

  Before using snapshot, user has to know why sometimes the data corrupts after rollback of snapshot. Please refer to the following diagram.

  When user modifies the data from host, the data will pass through file system and memory of the host (write caching). Then the host will flush the data from memory to physical disks, no matter the disk is local disk (IDE or SATA), DAS (SCSI or SAS), or SAN (fibre or iSCSI). From the viewpoint of storage device, it cannot control the behavior of host side. This case maybe happens. If a snapshot is taken, some data is still in memory and not flush to disk. Then the snapshot may have an incomplete image of original data. The problem does not belong to the storage device. To avoid this data inconsistent issue between snapshot and original data, user has to make the operating system flush the data from memory of host (write caching) into disk before taking snapshot.

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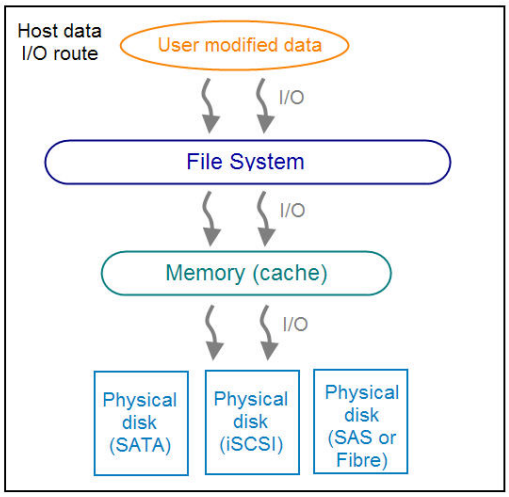

On Linux and UNIX platform, a command named **sync** can be used to make the operating system flush data from write caching into disk. For Windows platform, Microsoft also provides a tool – **sync**, which can do exactly the same thing as the **sync** command in Linux/UNIX. It will tell the OS to flush the data on demand. For more detail about **sync** tool, please refer to http://technet.microsoft.com/en-us/sysinternals/bb897438.aspx

Besides the **sync** tool, Microsoft develops **VSS** (volume shadow copy service) to prevent this issue. VSS is a mechanism for creating consistent point-in-time copies of data known as shadow copies. It is a coordinator between backup software, application (SQL or Exchange…) and storages to make sure the snapshot without the problem of data-inconsistent. For more detail about the VSS, please refer to http://technet.microsoft.com/en-us/library/cc785914.aspx. JetStor storage system can support Microsoft VSS.

- What if the snapshot space is over?

Before using snapshot, a snapshot space is needed from RAID group capacity. After a period of working snapshot, what if the snapshot size over the snapshot space of user defined? There are two different situations:

1. If there are two or more snapshots existed, the system will try to remove the oldest snapshots (to release more space for the latest snapshot) until enough space is released.
2. If there is only one snapshot existed, the snapshot will fail. Because the snapshot space is run out.

For example, there are two or more snapshots existed on a virtual disk and the latest snapshot keeps growing. When it comes to the moment that the snapshot space is run out, the system will try to remove the oldest snapshot to release more space for the latest snapshot usage. As the latest snapshot is growing, the system keeps removing the old snapshots. When it comes that the latest snapshot is the only one in system, there is no more snapshot space which can be released for incoming changes, then snapshot will fail.

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- How many snapshots can be created on a virtual disk?

  There are up to 64 snapshots can be created per virtual disk. What if the 65th snapshot has been taken? There are two different situations:

  1. If the snapshot is configured as schedule snapshot, the latest one (the 65th snapshot) will replace the oldest one (the first snapshot) and so on.
  2. If the snapshot is taken manually, when taking the 65th snapshot will fail and a warning message will be showed on Web UI.

- Rollback and delete snapshot

  When a snapshot has been rolled back, the related snapshots which are earlier than it will also be removed. But the rest snapshots will be kept after rollback. If a snapshot has been deleted, the other snapshots which are earlier than it will also be deleted. The space occupied by these snapshots will be released after deleting.

Clone

Clone function can backup data from the source virtual disk to target. Here is the clone operation. At the beginning, copy all data from the source virtual disk to target. It is also called full copy. Afterwards, use snapshot technology to perform the incremental copy. Please be fully aware that the incremental copy needs to use snapshot to compare the data difference. Therefore, the enough snapshot space for the virtual disk is very important. Of course, clone job can also be set as schedule.

Setup Clone

Take an example of clone the virtual disk.

1. Before cloning, it must prepare backup target virtual disk. In **Virtual Disks** tab, click **Create** button. And then select **Disk Type** to **Backup Target**.

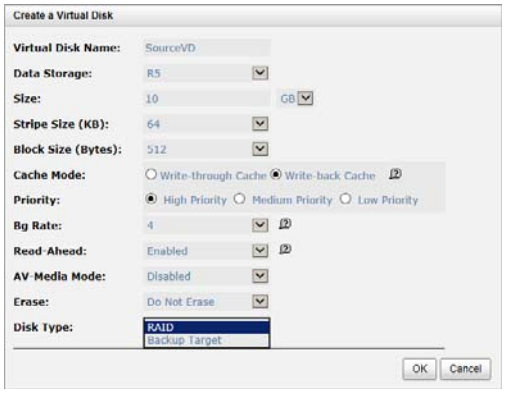

Figure 1: Source side

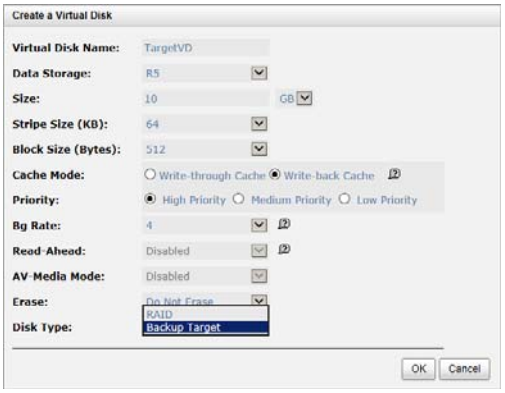

Figure 2: Target side

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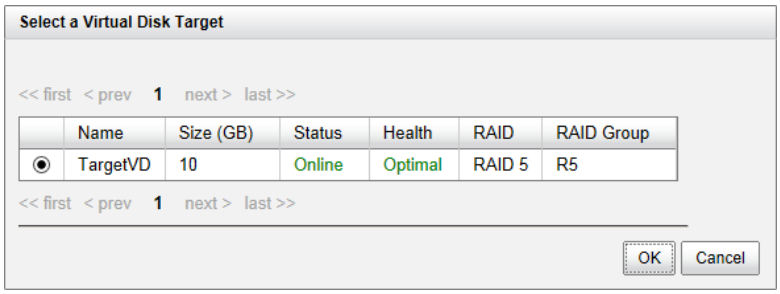
2. Select the source virtual disk, and then click ▼ **-> Set Clone**.
3. Select a target virtual disk, and then click **OK** button.

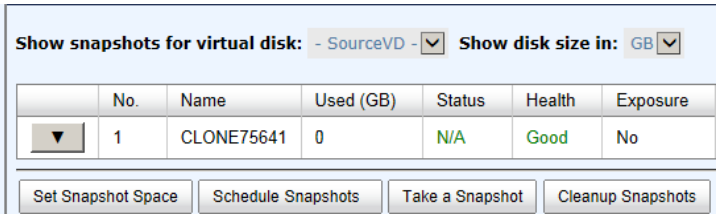


4. At this time, if the source virtual disk has no snapshot space, it will be allocated snapshot space for clone usage automatically. The size will depend on the parameter of **Cloning Options**.

Start and Stop Clone

To start clone, please follow the procedures.

1. Select the source virtual disk, and then click ▼ **-> Start Clone**.
2. Click **OK** button. The source virtual disk will take a snapshot, and then start cloning.



To stop clone, please follow the procedures.

1. Select the source virtual disk, and then click ▼ **-> Stop Clone**.
2. Click **OK** button to stop cloning.

Schedule Clone

The clone job can be set by schedule such as hourly or daily. Please follow the procedures.

1. Select the source virtual disk, and then click ▼ **-> Schedule Clone**.
2. Check the schedules which you want. They can be set by monthly, weekly, daily, or hourly. Click **OK** button to apply.

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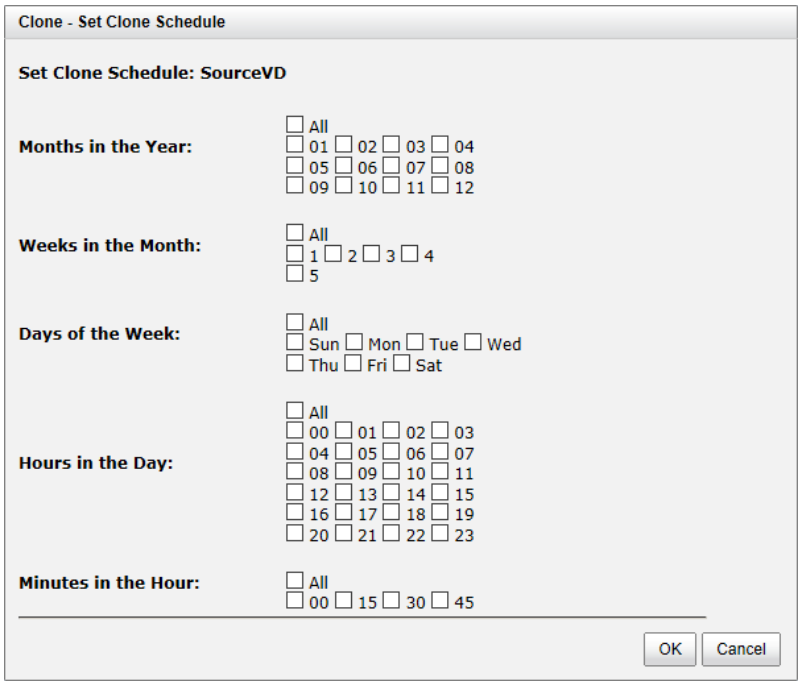
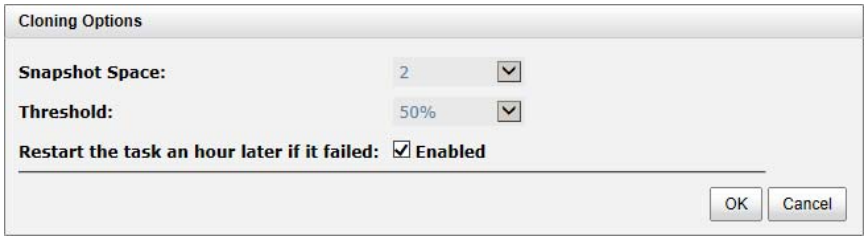


TIP:
Daily clone will be taken at every 00:00. Weekly clone will be taken every Sunday 00:00. Monthly clone will be taken every first day of month 00:00.

Cloning Options

There are three clone options, described on the following.



- **Snapshot Space:** This setting is the ratio of the source virtual disk and snapshot space. If the ratio sets to 2, it means when the clone process is starting, the system will book the free RAID group space to set as the snapshot space which capacity is double the source virtual disk automatically. The options are 0.5 ~ 3.
- **Threshold:** The setting will be effective after enabling schedule clone. The threshold will monitor the usage amount of the snapshot space. When the used snapshot space achieves the threshold, system will take a snapshot and start clone process automatically. The purpose of threshold could prevent the incremental copy failure immediately when running

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out of the snapshot space. For example, the default threshold is 50%. The system will check the snapshot space every hour. When the snapshot space is used over 50%, the system will start clone job automatically. And then continue monitoring the snapshot space. When the rest snapshot space has been used 50%, in other words, the total snapshot space has been used 75%, the system will start clone job again.

- **Restart the task an hour later if failed:** The setting will be effective after enabling schedule clone. When running out of the snapshot space, the virtual disk clone process will be stopped because there is no more available snapshot space. If this option is checked, the system will clear the snapshots of clone in order to release snapshot space automatically, and the clone task will be restarted after an hour. This task will start a full copy.

CAUTION:
The default snapshot space allocated by the system is two times the size of source virtual disk. That is the best value of our suggestion. If user sets snapshot space by manually and lower than the default value, user should take the risk if the snapshot space is not enough and the clone job will fail.

Clear Clone

To clear the clone job, please follow the procedures.

1. Select the source virtual disk, and then click ▼ **-> Clear Clone**.
2. Click **OK** button to clear clone job.

Clone Constraint

While the clone is processing manually, the increment data of the virtual disk is over the snapshot space. The clone will complete the task, but the clone snapshot will fail. At the next time, when trying to start clone, it will get a warning message “This is not enough of snapshot space for the operation”. The user needs to clean up the snapshot space in order to operate the clone process. Each time the clone snapshot failed, it means that the system loses the reference value of incremental data. So it will start a full copy at the next clone process.

When running out of the snapshot space, the flow diagram of the virtual disk clone procedure will be like the following.

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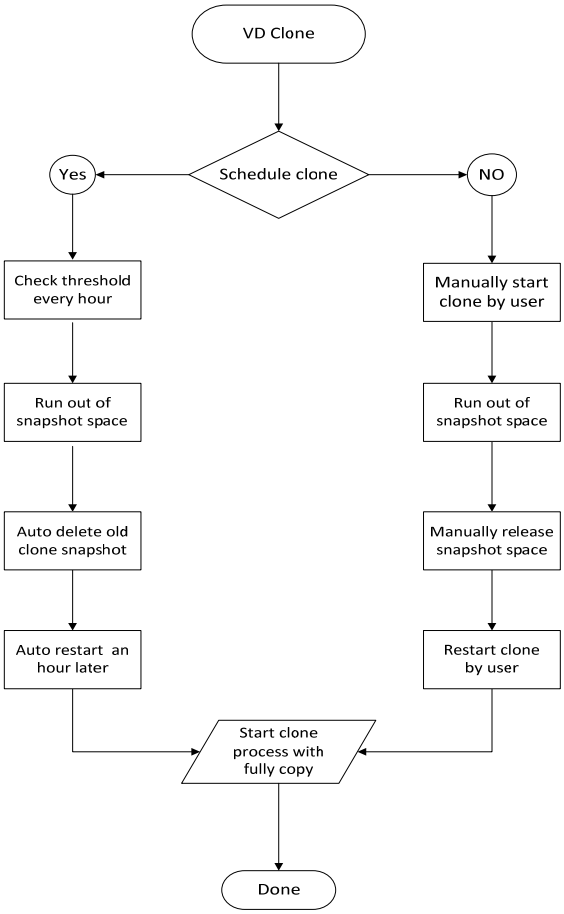

QReplicas

QReplicas function can replicate data easily through LAN or WAN from one system to another. Here is the replication operation. At the beginning, copy all data from the source virtual disk to target. It is also called full copy. Afterwards, use snapshot technology to perform the incremental copy. Please be fully aware that the incremental copy needs to use snapshot to compare the data difference. Therefore, the enough snapshot space for the virtual disk is very important. Of course, replication task can also be set as schedule.

Create QReplica Task

Take an example of creating the QReplica task.

1. Before replication, it must prepare backup target virtual disk. In **Virtual Disks** tab of the target side, click **Create** button. And then select **Disk Type** to **Backup Target**.

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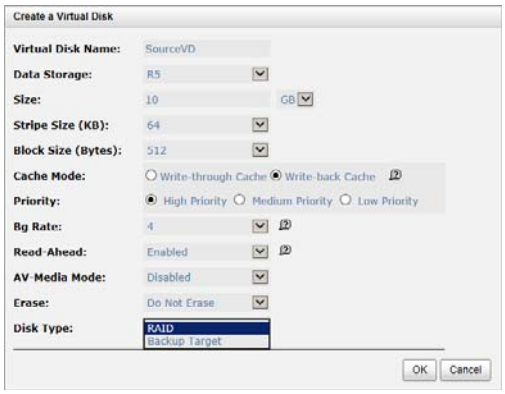


Figure 1: Source Side

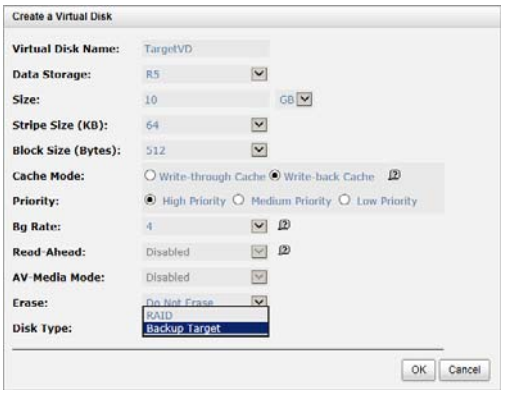


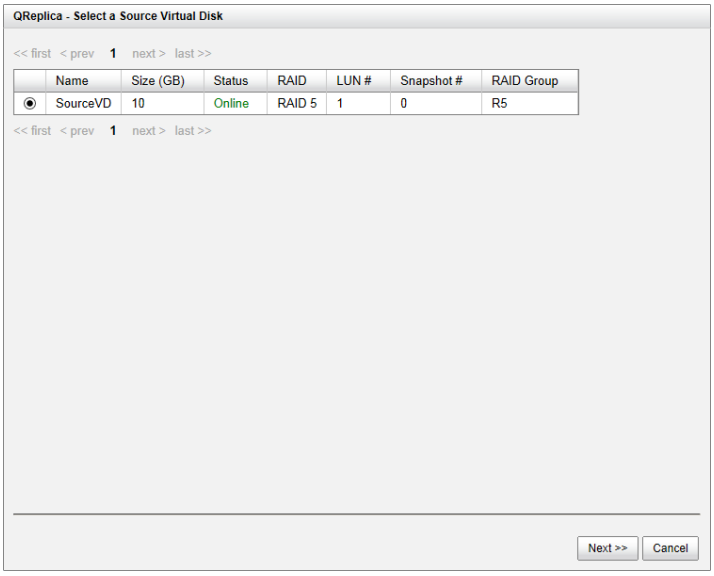
Figure 2: Target Side

2. After creating the target virtual disk, please also setup snapshot space. The snapshot of the source virtual disk can replicate to the target virtual disk. In **Virtual Disks** tab, selects the backup virtual disk. And then click ▼ **-> Set Snapshot Space**.
3. Enter a **Size** which is reserved for the snapshot space, and then click **OK** button.
4. Attach LUN of the source and target virtual disk separately.

Figure 3: Source Side

Figure 4: Target Side

5. In **QReplicas** tab of the source side, click **Create** button.
6. Select a target virtual disk, and then click **Next** button.



7. Select the **Source Port** and input the **Target IP**, and then click **Next** button.

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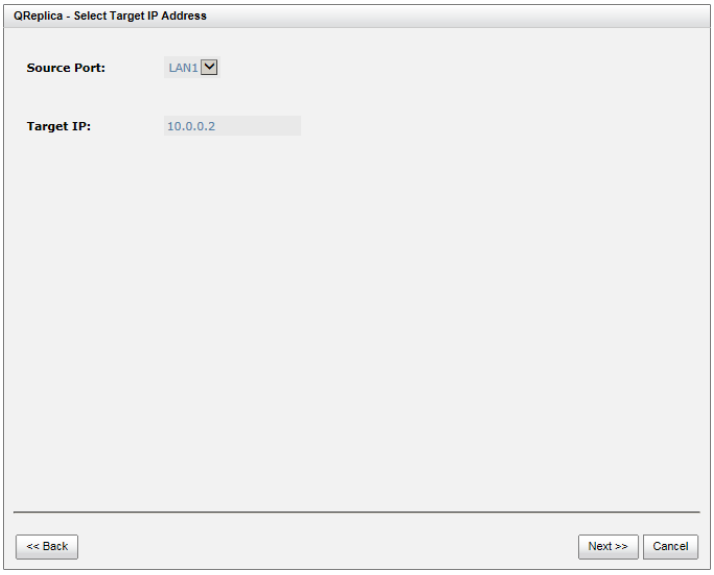

8. Select **Authentication Method** and input the CHAP user if needed. Select a **Target Node**, and then click **Next** button.

9. Select a Target LUN. When a replication job completes, it will take a snapshot on its target virtual disk. Please make sure the snapshot space of the backup virtual disk on the target side is properly configured. Finally, click **Finish** button.

10. The replication task is created.

11. At this time, if the source virtual disk has no snapshot space, it will be allocated snapshot space for replication usage automatically. The size will depend on the parameter of **QReplica Options**.

Start and Stop QReplica Task

To start replication task, please follow the procedures.

1. In **QReplicas** tab of the source side, select the task, and then click ▼ **-> Start**.
2. Click **OK** button. The source and target virtual disks will take snapshots, and then start replication.

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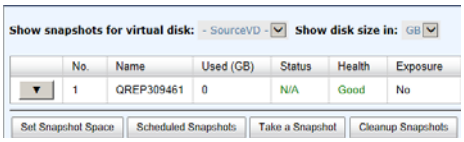


Figure 5: Source side

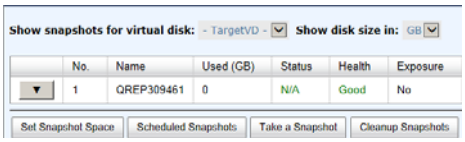


Figure 6: Target side

To stop replication task, please follow the procedures.

1. In **QReplicas** tab of the source side, select the task, and then click ▼ **-> Stop**.
2. Click **OK** button to stop replication.

MPIO

To setup MPIO (Multi Path Input/Ouput) of the replication task, please follow the procedures.

1. In **QReplicas** tab of the source side, select the task, and then click ▼ **-> Add Path**.
2. Next steps are the same as the procedure of creating a new replication task.

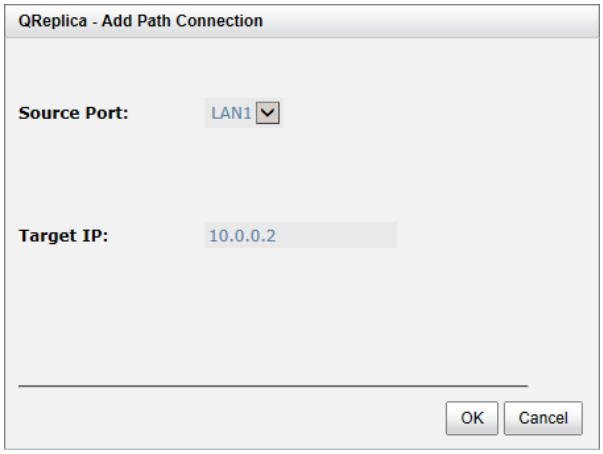
To delete multi path of the replication task, please follow the procedures.

1. In **QReplicas** tab of the source side, select the task, and then click ▼ **-> Delete Path**.
2. Select the path(s) which want to be deleted, and then click **OK** button.
3. The multi path(s) are deleted.

MC/S

To setup MC/S (Multiple Connections per Session) of the replication task path, please follow the procedures.

1. In **QReplicas** tab of the source side, select the task path, and then click ▼ **-> Add Connection**.



2. Select the **Source Port** and input the **Target IP**, and then click **OK** button.

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3. The connection is added.

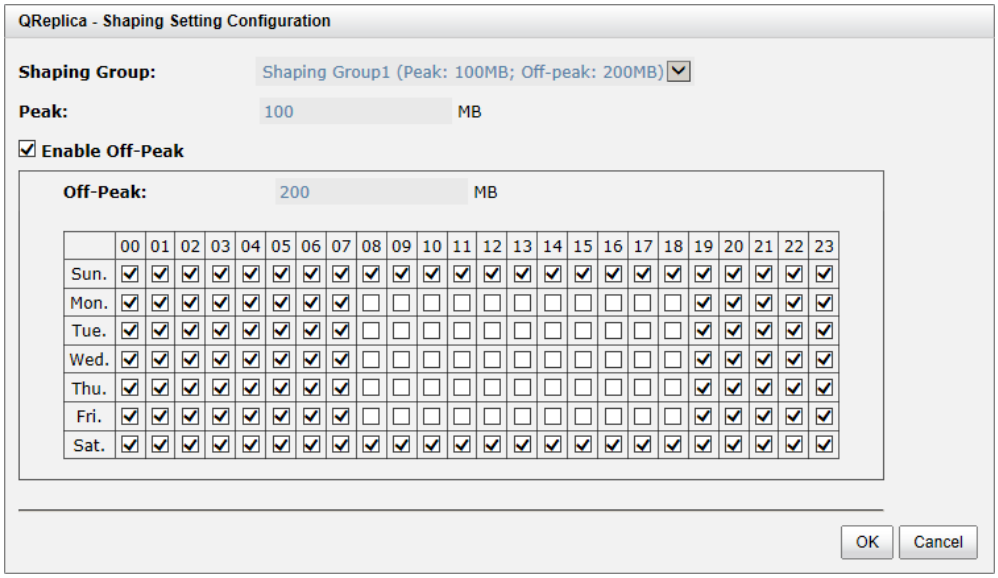
To delete multi connections per session of the replication task path, please follow the procedures.

1. In **QReplicas** tab of the source side, select the task path, and then click ▼ **-> Delete Connection**.
2. Select the connection(s) which want to be deleted, and then click **OK** button.
3. The multi connection(s) are deleted.

Task Shaping

If the replication traffic affects the normal usage, we provide a method to limit it. There are eight shaping groups which can be set. In each shaping group, we also provide peak and off-peak time slot for different bandwidth. The following take an example of setting shaping group.

1. In **QReplicas** tab of the source side, click **Shaping Setting Configuration** button.



2. Select a **Shaping Group** to setup.
3. Input the bandwidth (MB) at the **Peak** time.
4. If needed, check **Enable Off-Peak**, and then input the bandwidth (MB) at **Off-Peak** time. And define the off-peak hour.
5. Click **OK** button.
6. In **QReplicas** tab, select the task, and then click ▼ **-> Set Task Shaping**.

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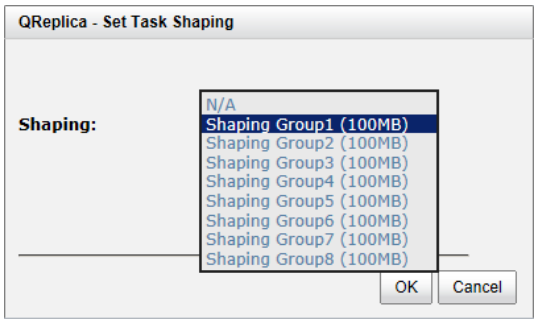
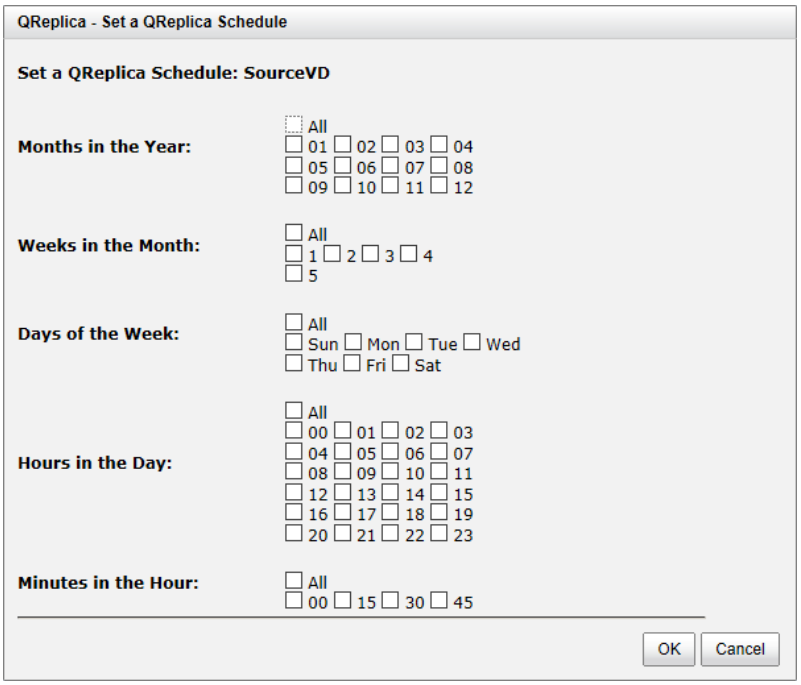


7. Select a Shaping Group from the drop down list. And then click **OK** button.
8. The shaping group is applied to the replication task.

Schedule QReplica Task

The replication task can be set by schedule such as hourly or daily. Please follow the procedures.

1. In **QReplicas** tab, select the task, and then click ▼ **-> Schedule**.
2. Check the schedules which you want. They can be set by monthly, weekly, daily, or hourly. Click **OK** to apply.



TIP:
Daily replication will be taken at every 00:00. Weekly replication will be taken every Sunday 00:00. Monthly replication will be taken every first day of month 00:00.

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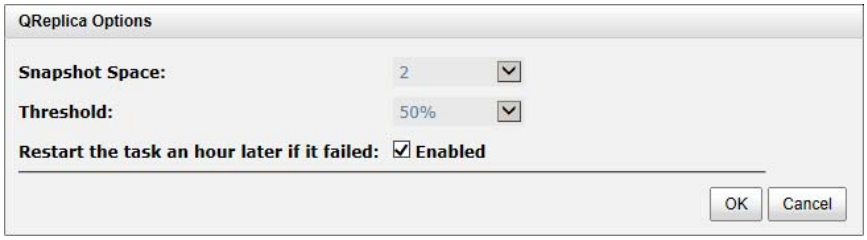
QReplica Options

There are three QReplica options, described on the following.



- **Snapshot Space:** This setting is the ratio of the source virtual disk and snapshot space. If the ratio sets to 2, it means when the replication process is starting, the system will book the free RAID group space to set as the snapshot space which capacity is double the source virtual disk automatically. The options are 0.5 ~ 3.
- **Threshold:** The setting will be effective after enabling schedule replication. The threshold will monitor the usage amount of the snapshot space. When the used snapshot space achieves the threshold, system will take a snapshot and start replication process automatically. The purpose of threshold could prevent the incremental copy failure immediately when running out of the snapshot space. For example, the default threshold is 50%. The system will check the snapshot space every hour. When the snapshot space is used over 50%, the system will start replication job automatically. And then continue monitoring the snapshot space. When the rest snapshot space has been used 50%, in other words, the total snapshot space has been used 75%, the system will start replication task again.
- **Restart the task an hour later if failed:** The setting will be effective after enabling schedule replication. When running out of the snapshot space, the virtual disk replication process will be stopped because there is no more available snapshot space. If this option is checked, the system will clear the snapshots of replication in order to release snapshot space automatically, and the replication task will be restarted after an hour. This task will start a full copy.

CAUTION:
The default snapshot space allocated by the system is two times the size of source virtual disk. That is the best value of our suggestion. If user sets snapshot space by manually and lower than the default value, user should take the risk if the snapshot space is not enough and the replication task will fail.

Delete QReplica Task

To delele the replication task, please follow the procedures.

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1. Select the task in **QReplicas** tab, and then click ▼ **-> Delete**.
2. Click **OK** button to delete the replication task.

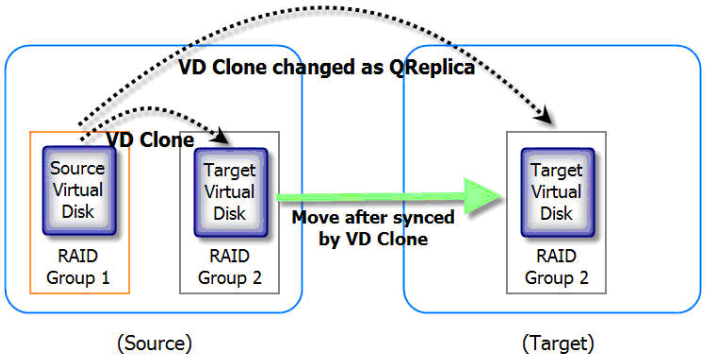
Clone Transfers to QReplica

It is always being a problem that to do full copy over LAN or WAN when the replication task is executed at the first time. It may take days or weeks to replicate data from source to target within limited network bandwidth. We provide two methods to help user shorten the time of executing full copy.

1. One is to skip full copy on a new, clean virtual disk. The term “clean” means that the virtual disk has never been written data since created. For a new created virtual disk which has not been accessed, the system will recognize it and skip full copy automatically when the replication task is created on this virtual disk at the first time.

TIP:
Any I/O access to the new created virtual disk will make it as “not clean”, even though executing “Erase” function when a virtual disk is created. The full copy will take place in such a case.

2. The other way is to use virtual disk clone function, which is a local data copy function between virtual disks to execute full copy at the first time. Then move all the physical drives of the target virtual disk to the target system and then turn the cloning job into replication task with differential copy afterward.



To do that virtual disk clone transfers to QReplica, please follow the procedures.

1. Create a clone job on an existing virtual disk with data stored already.
2. It is better that there is no host connected to the source virtual disk. Then run **Set Clone**, **Start Clone** to synchronize the data between source and target virtual disks.

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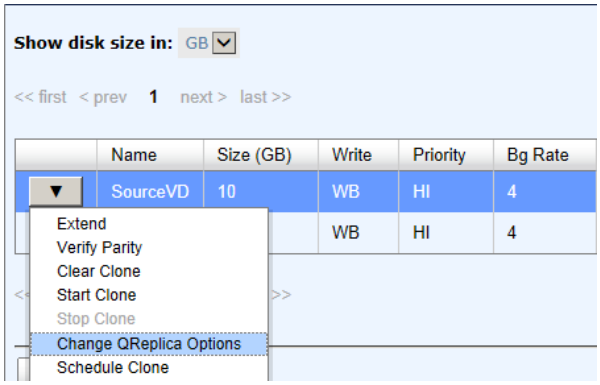
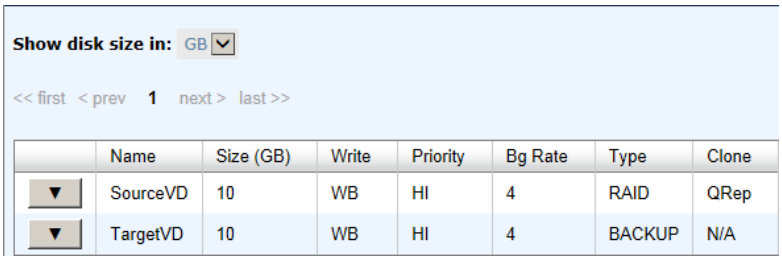
3. After the data is synchronized, change the cloning job to a QReplica task. Select the source virtual disk, and then click ▼ **-> Change QReplica Options**.



4. The **Clone** column of the source virtual disk will be changed from the name of the target virtual disk into **QRep**.



CAUTION:
Changing a cloning job to a replication task is only available when the cloning job has been finished. This change is irreversible.

5. Deactivate the RAID group which the target virtual disk resides in and move all physical disks of the RAID group to the target system. Then activate the RAID group in the target system. Remember to set snapshot space for the target virtual disk. And then attach the target virtual disk to a LUN ID.
6. In **QReplicas** tab of the source side, click **Rebuild** button to rebuild the replication task which is changed from a cloning job formerly.
7. Rebuild the clone relationship, select a source virtual disk.

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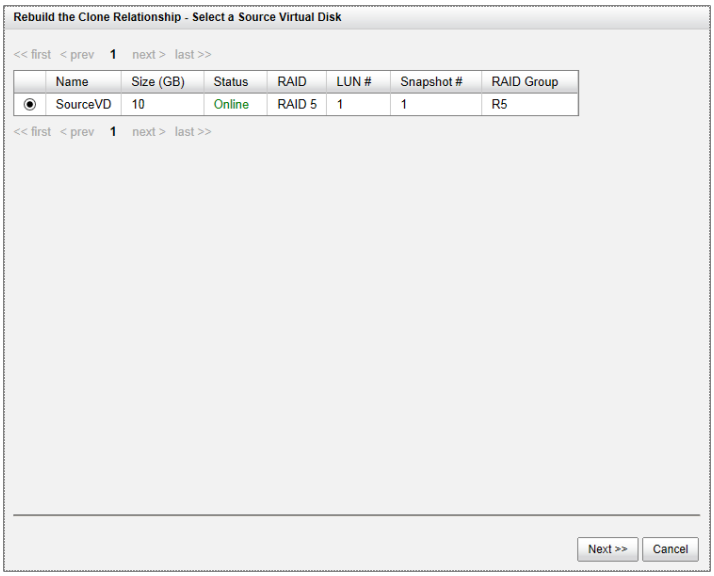

8. Next steps are the same as the procedure of creating a new replication task.
9. If a wrong target virtual disk is selected when rebuilding the replication task, there will be an alert and the system stops the creation.

Fast Rebuild

When executing rebuild, the Fast Rebuild feature skips any partition of the virtual disk where no write changes have occurred, it will focus only on the parts that have changed. This mechanism may reduce the amount of time needed for the rebuild task. It also reduces the risk of RAID failure cause of reducing the time required for the RAID status from degraded mode to healthy. At the same time, it frees up CPU resources more quickly to be available for other I/O and demands.

Solution

Without Fast Rebuild feature, rebuild will start from the beginning partition to the end. It may spend lots of time to complete the task. When enabling Fast Rebuild feature, it will rebuild the partition with the changed only.

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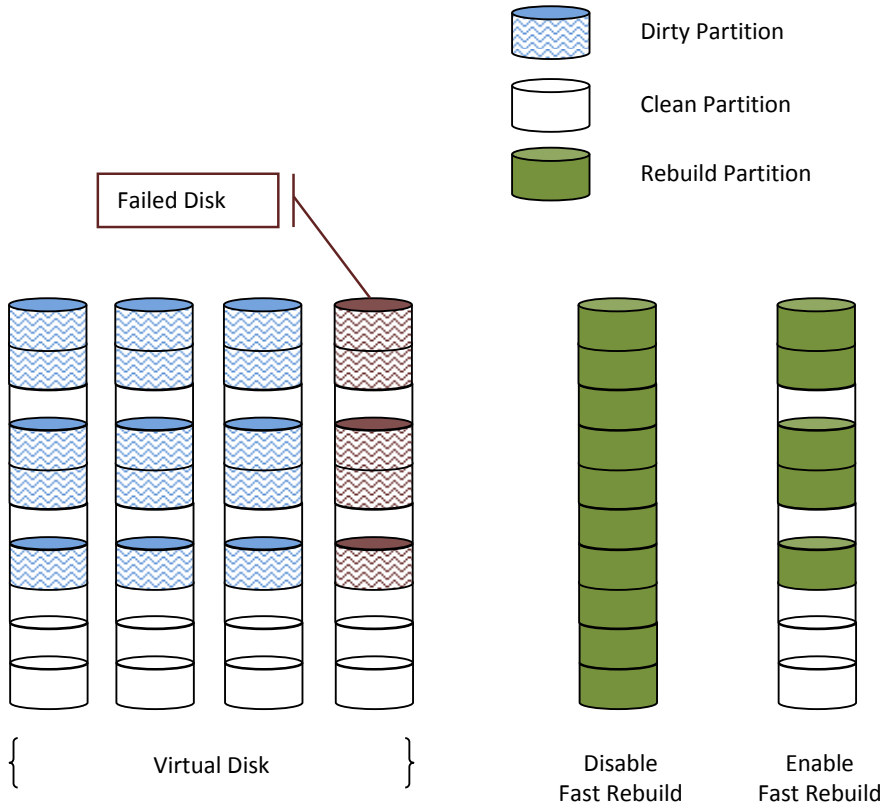

TIP:
With less changed partition, the Fast Rebuild feature may go faster. If the virtual disk is full of changed partition, the rebuild may take the same time without Fast Rebuild feature.

Configuration

When creating a virtual disk, enable the Fast Rebuild. The default is disabled.

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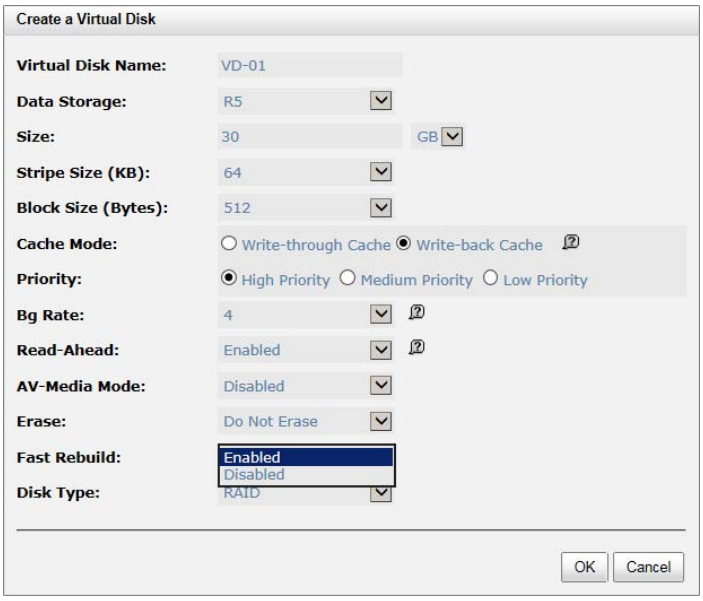

Constraint

Here are some constraints about Fast Rebuild.

- Only thick/fat RAID group supports this feature. Thin provision RAID group already has this feature implement.
- When rebuild happened in a fast rebuild virtual disk, clean partitions are not rebuilt since there are no data saved there. Though clean partitions are never rebuilt, their health status is good.
- If all partitions of the fast rebuild virtual disk are clean, then no rebuild would happen and no event would be sent.
- The RAID stacks could not use optimize algorithm to compute parities of a partition which is not rebuilt. Thus, the performance of random write in a clean partition would be worse.

CAUTION:
The fast rebuild should not be enabled for a virtual disk whose access pattern is random write.

SSD Caching

The traditional storage technology is stored in the HDDs (Hard Disk Drives) and SSDs (Solid-State Drives) are mainly used in mission critical applications where the speed of the storage system needed to be as high as possible. In recent years, the capacity of HDDs has increased; but their random input/output (I/O) has not increased at the same rate. For some applications such as enterprise web with database, cloud, and virtualization which require both high capacity and

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performance, HDDs have the superiority in capacity but lower speed. It means the pure HDD storage is not enough for those applications.

Using the superiority of SSDs, offer exceptionally high speed, SSD caching technology provides the best way to fulfill cost-effectively the performance and capacity requirements of their enterprise applications. Integrated HDDs and SSDs into the storage combine the benefits of both. SSD cache feature enables the system to use SSDs as extended cache, thus increasing the performance of random I/O applications such as databases, file servers, and web servers, etc.

Generally, the SSD caching is useful for the following features:

1. Due to the HDD IOPS, read performance cause the bottleneck.
2. In working space, read I/O is much more than write.
3. The best performance is in the case, the working data size is repeatedly accessed and smaller than the size of SSD cache capacity.

Solution

SSD caching is the secondary cache used to enable better performance. One and more SSDs could be assigned to a single virtual disk to be its SSD caching space. Be attention that the cache volume is not available for regular data storage. Currently, the maximum SSD cache size allowed in a system is 2.4TB.

Methodology

When the read or write I/O performs, this feature copies the data from HDD into SSD. At the next time, any subsequent I/O read of the same logical block addresses can be read directly from SSD. It increases the overall performance with a much lower response time. If the SSDs fail unfortunately, you won't worry the data loss because the data caching in the SSD is a copy of the original which is residing on HDD.

SSD caching is divided into group of sectors of equal sizes. Each group is called a cache block; each block is divided into sub-blocks. The I/O type configured for a virtual disk would affects size of the cache block and size of sub-blocks.

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Populating the Cache

The actions that read data from the HDD and write to the SSD are called populating the cache. It is a background operation that typically immediately follows a host read or write operation. The constraint is that two parameters are used to determine when to start a cache-populate operation:

1. Populate-on-read threshold: The value is great than zero. If it is zero, no action is performed for read cache.
2. Populate-on-write threshold: It's the same action as read.

According to these values, each cache block has associated to its read and write counts. When a host requests the read data located on the cache block, its read count is increment. If a cache hit does not occur, and the read count is greater than or equal to the populate-on-read threshold, then a cache-populate operation is performed with the host read concurrently. If a cache hit occurs, a populate operation is not performed. If the read count is smaller than the threshold, the count continues and a populate operation is not performed neither.

For write cases, it's the same scenario as read. We provide the figures to describe more details on the following.

Read/Write Cache Cases

- Read Data with Cache Miss

  The following figure shows the steps of the controller which handles a host read request when some of the data is not in the SSD cache.

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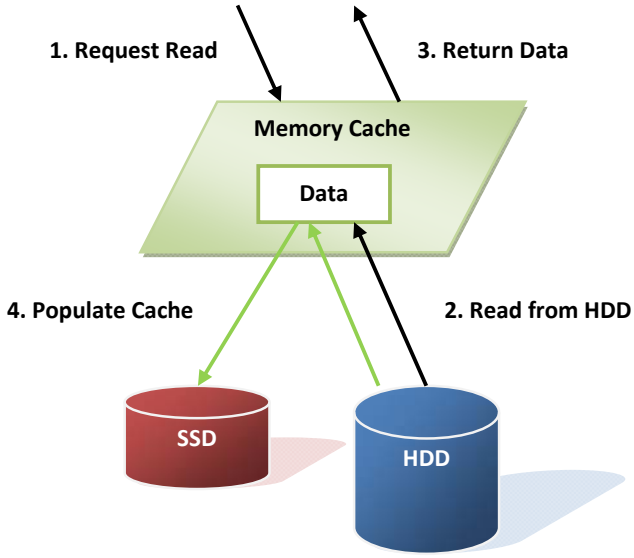
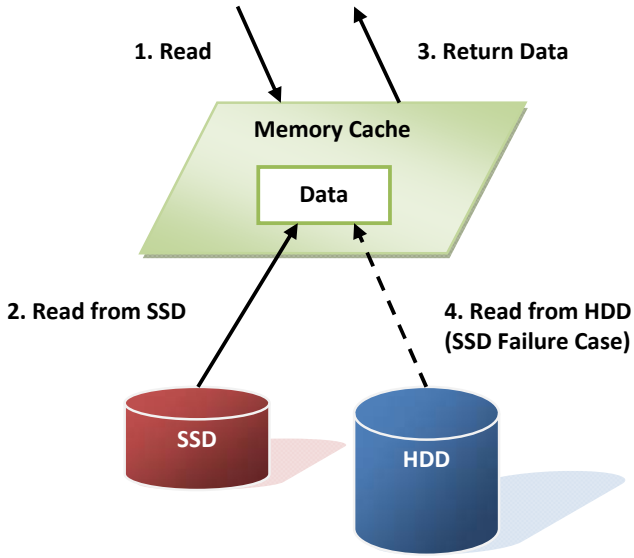


The following steps describe details about a host read with a cache miss:

1. A host requests a read data.
2. Read data from the HDD.
3. Return requested data to the host.
4. Populate the cache to SSD.

- Read Data with Cache Hit

  The following figure shows the steps of the controller which handles a host read request when the data is in the SSD cache.



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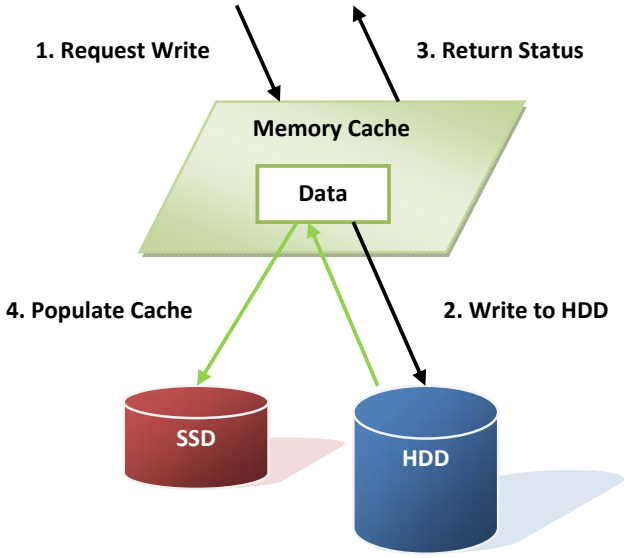
The following steps describe details about a host read with a cache hit:

1. A host requests a read data.
2. Read data from the SSD.
3. Return requested data to the host.
4. If SSD has error, read data from the HDD.

- Write Data

  The following figure shows the steps of the controller which handles a host write request.



The following steps describe details about a host write:

1. A host requests a write data.
2. Write data to the HDD.
3. Return the status to the host.
4. Populate the cache to SSD.

I/O Type

The type of I/O access is a user-selectable SSD cache configuration. The user-selectable I/O type controls the SSD cache internal settings for cache block size, sub-block size, populate-on-read threshold, and populate-on-write threshold. Three pre-defined I/O types are supported; they are database, file system, and web service. The user can select an I/O type to set the SSD cache of a virtual disk. When enabled SSD caching, the user can also change it online. But the cached data would be purged if the I/O type is changed. You may select the suitable I/O types depends on the

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application to get the best performance. If the above three applications are not suitable, the last item is customization which you may set the configurations by yourself.

I/O Type	Block Size (Sectors)	Sub-block Size (Sectors)	Populate-on-Read Threshold	Populate-on-Wrote Threshold
Database	1MB (2,048)	8KB (16)	2	0
File System	2MB (4,096)	16KB (32)	2	2
Web Service	4MB (8,192)	64KB (128)	2	0
Customization	1MB/2MB/4MB	8KB/16KB/64KB	≥ 0	≥ 0

The block size affects the cache use and the warm up time. The cache use shows how much of the allocated cache actually holds the user data. And the warm up time is the process of how long to fill the cache. You can image that the highest cache use is obtained when all of the frequently reread data is located very close to other data that is frequently reread. Using a larger cache block size of I/O type is more useful to performance than a smaller one. Conversely, when frequently reread data is located far from other data that is frequently reread, the lowest cache use is obtained. In this case, the lowest cache block size of I/O type allows the most user data to be cached.

The sub-block size affects the cache warm up time, too. A larger sub-block size causes cache to fill more quickly than a smaller one, but it can also affect the response time of host I/O. Also occupy the system resource, such as CPU utilization, memory bandwidth, or channel utilization. A very high locality of reference can be more useful from a larger sub-block size than from a smaller one, especially if those blocks that are reread frequently reside in the same sub-block. This occurs when one I/O causes the sub-block to be populated and another I/O in the same sub-block gets a cache hit.

These are trade off depend on the applications. Users may set them by experience to get the best performance. Here we provide a formula which can calculate the estimate warm up time.

We define that

- T: Warm up time; seconds required.
- I: Best random IOPS of HDD.
- S: I/O Size.
- D: Number of HDDs.
- C: Total SSD caching capacity.
- P: Populate-on-read or Populate-on-write threshold.

We assume that random read/write from HDD to achieve the capacity of SSD should be

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C * P = I * S *D * T

So we can estimate the warm up time, at least.

T = (C * P) / (I * S * D)

The real case may be longer than the estimate time. Here we take an example on the following.

- I: 250 IOPS (Random IOPS per HDD)
- S: 64KB (Web service)
- D: 16 HDDs
- C: 480GB (1 SSD)
- P: 2 (Populate-on-read threshold)

Warm up time T = (480GB * 2) / (250 * 64KB * 16) = 3932.16 seconds = 65.536 minutes

Configuration

Activate the license key

User needs to obtain a license key and download it to the system to activate the SSD caching function in **System Maintenance -> Upgrade -> SSD Caching License**. Each license key is unique and dedicated to a specific system. To obtain the license key, please contact sales for assistance.

Take an example of enabling SSD caching.

1. After creating a virtual disk, click▼ **-> Set SSD Caching** of the selected virtual disk.
2. Check **Enable** box.
3. Select the policy by drop down menu.
4. Click **Select Disks** button, and then check the SSDs which are provided for SSD caching.
5. Click **OK** button to enable SSD caching.

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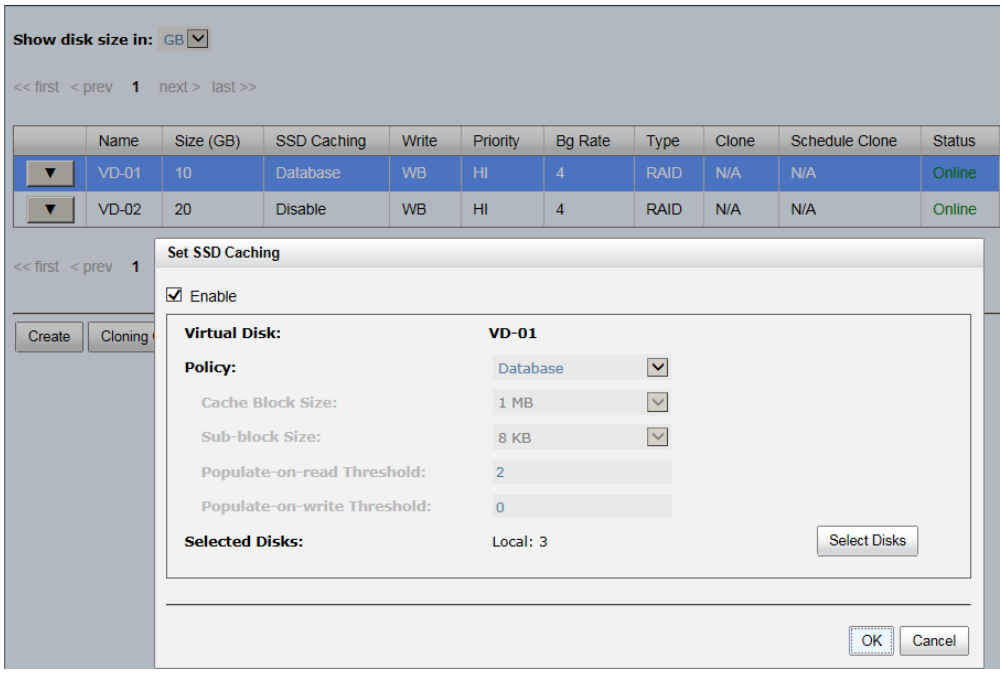

Constraint

Here are some constraints about SSD caching.

- Only SSD could be used SSD caching space of a virtual disk.
- A SSD could be assigned to one and only one virtual disk as its caching space.
- Up to 8 SSDs could be used as SSD cache of a virtual disk.
- Support up to 2.4TB of SSD caching space in one system.

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6 Troubleshooting

System Buzzer

The system buzzer features are listed below:

- The system buzzer alarms 1 second when system boots up successfully.
- The system buzzer alarms continuously when there is error occurred. The alarm will be stopped after error resolved or be muted.
- The alarm will be muted automatically when the error is resolved. E.g., when RAID 5 is degraded and alarm rings immediately, user changes / adds one physical disk for rebuilding. When the rebuilding is done, the alarm will be muted automatically.

Event Notifications

Physical Disk Events

Level	Type	Description
INFO	PD inserted	Disk <slot> is inserted into system
WARNING	PD removed	Disk <slot> is removed from system
ERROR	HDD read error	Disk <slot> read block error
ERROR	HDD write error	Disk <slot> write block error
ERROR	HDD error	Disk <slot> is disabled
ERROR	HDD IO timeout	Disk <slot> gets no response
INFO	PD upgrade started	PD [<string>] starts upgrading firmware process.
INFO	PD upgrade finished	PD [<string>] finished upgrading firmware process.
WARNING	PD upgrade failed	PD [<string>] upgrade firmware failed.
INFO	PD RPS started L2L	Assign PD <slot> to replace PD <slot>.
INFO	PD RPS finished L2L	PD <slot> is replaced by PD <slot>.
ERROR	PD RPS failed L2L	Failed to replace PD <slot> with PD <slot>.

Hardware Events

Level	Type	Description
WARNING	ECC single	Single-bit ECC error is detected at <address>
ERROR	ECC multiple	Multi-bit ECC error is detected at <address>
INFO	ECC dimm	ECC memory is installed
INFO	ECC none	Non-ECC memory is installed

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INFO	SCSI bus reset	Received SCSI Bus Reset event at the SCSI Bus <number>
ERROR	SCSI host error	SCSI Host allocation failed
ERROR	SATA enable device fail	Failed to enable the SATA pci device
ERROR	SATA EDMA mem fail	Failed to allocate memory for SATA EDMA
ERROR	SATA remap mem fail	Failed to remap SATA memory io space
ERROR	SATA PRD mem fail	Failed to init SATA PRD memory manager
ERROR	SATA revision id fail	Failed to get SATA revision id
ERROR	SATA set reg fail	Failed to set SATA register
ERROR	SATA init fail	Core failed to initialize the SATA adapter
ERROR	SATA diag fail	SATA Adapter diagnostics failed
ERROR	Mode ID fail	SATA Mode ID failed
ERROR	SATA chip count error	SATA Chip count error
INFO	SAS port reply error	SAS HBA port <number> reply terminated abnormally
INFO	SAS unknown port reply error	SAS frontend reply terminated abnormally
INFO	FC port reply error	FC HBA port <number> reply terminated abnormally
INFO	FC unknown port reply error	FC frontend reply terminated abnormally
INFO	Port linkup	The Port <number> link status is changed to Up.
INFO	Port linkdown	The Port<number> link status is changed to Down.

EMS Events

Level	Type	Description
INFO	Power install	Power(<string>) is installed
ERROR	Power absent	Power(<string>) is absent
INFO	Power restore	Power(<string>) is restored to work.
ERROR	Power fail	Power(<string>) is not functioning
WARNING	Power detect	PSU signal detection(<string>)
INFO	Fan restore	Fan(<string>) is restored to work.
ERROR	Fan fail	Fan(<string>) is not functioning
INFO	Fan install	Fan(<string>) is installed
ERROR	Fan not present	Fan(<string>) is not present
ERROR	Fan over speed	Fan(<string>) is over speed
WARNING	Thermal level 1	System temperature(<string>) is higher.
ERROR	Thermal level 2	System Overheated(<string>)!!!
ERROR	Thermal level 2 shutdown	System Overheated(<string>)!!! The system will auto-shutdown immediately.
ERROR	Thermal level 2 CTR shutdown	The controller will auto shutdown immediately, reason [Overheated(<string>)].
WARNING	Thermal ignore value	Unable to update thermal value on <string>
WARNING	Voltage level 1	System voltage(<string>) is higher/lower.
ERROR	Voltage level 2	System voltages(<string>) failed!!!
ERROR	Voltage level 2 shutdown	System voltages(<string>) failed!!! The system will auto-shutdown immediately.

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ERROR	Voltage level 2 CTR shutdown	The controller will auto shutdown immediately, reason [Voltage abnormal(<string>)].
INFO	UPS OK	Successfully detect UPS
WARNING	UPS fail	Failed to detect UPS
ERROR	UPS AC loss	AC loss for system is detected
ERROR	UPS power low	UPS Power Low!!! The system will auto-shutdown immediately.
WARNING	SMART T.E.C.	Disk <slot> S.M.A.R.T. Threshold Exceed Condition occurred for attribute <string>
WARNING	SMART fail	Disk <slot>: Failure to get S.M.A.R.T information
WARNING	RedBoot failover	RedBoot failover event occurred
WARNING	Watchdog shutdown	Watchdog timeout shutdown occurred
WARNING	Watchdog reset	Watchdog timeout reset occurred

RMS Events

Level	Type	Description
INFO	Console Login	<username> login from <IP or serial console> via Console UI
INFO	Console Logout	<username> logout from <IP or serial console> via Console UI
INFO	Web Login	<username> login from <IP> via Web UI
INFO	Web Logout	<username> logout from <IP> via Web UI
INFO	Log clear	All event logs are cleared
WARNING	Send mail fail	Failed to send event to <email>.

LVM Events

Level	Type	Description
INFO	RG create OK	RG <name> has been created.
INFO	RG create fail	Failed to create RG <name>.
INFO	RG delete	RG <name> has been deleted.
INFO	RG rename	RG <name> has been renamed as <name>.
INFO	VD create OK	VD <name> has been created.
INFO	VD create fail	Failed to create VD <name>.
INFO	VD delete	VD <name> has been deleted.
INFO	VD rename	Name of VD <name> has been renamed to <name>.
INFO	VD read only	Cache policy of VD <name> has been set as read only.
INFO	VD write back	Cache policy of VD <name> has been set as write-back.
INFO	VD write through	Cache policy of VD <name> has been set as write-through.
INFO	VD extend	Size of VD <name> extends.
INFO	VD attach LUN OK	VD <name> has been LUN-attached.
INFO	VD attach LUN fail	Failed to attach LUN to VD <name>.
INFO	VD detach LUN OK	VD <name> has been detached.
INFO	VD detach LUN fail	Failed to attach LUN from bus <number>, SCSI ID <number>, lun <number>.
INFO	VD init started	VD <name> starts initialization.
INFO	VD init finished	VD <name> completes initialization.
WARNING	VD init failed	Failed to complete initialization of VD <name>.
INFO	VD rebuild started	VD <name> starts rebuilding.
INFO	VD rebuild finished	VD <name> completes rebuilding.

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WARNING	VD rebuild failed	Failed to complete rebuild of VD <name>.
INFO	VD migrate started	VD <name> starts migration.
INFO	VD migrate finished	VD <name> completes migration.
ERROR	VD migrate failed	Failed to complete migration of VD <name>.
INFO	VD scrub started	Parity checking on VD <name> starts.
INFO	VD scrub finished	Parity checking on VD <name> completes with <address> parity/data inconsistency found.
INFO	VD scrub aborted	Parity checking on VD <name> stops with <address> parity/data inconsistency found.
INFO	RG migrate started	RG <name> starts migration.
INFO	RG migrate finished	RG <name> completes migration.
INFO	RG move started	RG <name> starts move.
INFO	RG move finished	RG <name> completes move.
INFO	VD move started	VD <name> starts move.
INFO	VD move finished	VD <name> completes move.
ERROR	VD move failed	Failed to complete move of VD <name>.
INFO	VD attach LUN	LUN <number> is attached to VD <name>.
INFO	VD detach LUN	LUN <number> is detached from VD <name>.
INFO	RG activated	RG <name> has been manually activated.
INFO	RG deactivated	RG <name> has been manually deactivated.
DEBUG	VD rewrite started	Rewrite at LBA <address> of VD <name> starts.
DEBUG	VD rewrite finished	Rewrite at LBA <address> of VD <name> completes.
DEBUG	VD rewrite failed	Rewrite at LBA <address> of VD <name> failed.
WARNING	RG degraded	RG <name> is in degraded mode.
WARNING	VD degraded	VD <name> is in degraded mode.
ERROR	RG failed	RG <name> is failed.
ERROR	VD failed	VD <name> is failed.
ERROR	VD IO fault	I/O failure for stripe number <address> in VD <name>.
DEBUG	Recoverable read error	Recoverable read error occurred at LBA <address>-<address> of VD <name>.
WARNING	Recoverable write error	Recoverable write error occurred at LBA <address>-<address> of VD <name>.
DEBUG	Unrecoverable read error	Unrecoverable read error occurred at LBA <address>-<address> of VD <name>.
ERROR	Unrecoverable write error	Unrecoverable write error occurred at LBA <address>-<address> of VD <name>.
ERROR	Config read fail	Config read failed at LBA <address>-<address> of PD <slot>.
ERROR	Config write fail	Config write failed at LBA <address>-<address> of PD <slot>.
ERROR	CV boot error adjust global	Failed to change size of the global cache.
INFO	CV boot global	The global cache is ok.
ERROR	CV boot error create global	Failed to create the global cache.
INFO	PD dedicated spare	Assign PD <slot> to be the dedicated spare disk of RG <name>.
INFO	PD global spare	Assign PD <slot> to Global Spare Disks.
WARNING	PD read error	Read error occurred at LBA <address>-<address> of PD <slot>.

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WARNING	PD write error	Write error occurred at LBA <address>-<address> of PD <slot>.
WARNING	Scrub wrong parity	The parity/data inconsistency is found at LBA <address>-<address> when checking parity on VD <name>.
WARNING	Scrub data recovered	The data at LBA <address>-<address> is recovered when checking parity on VD <name>.
WARNING	Scrub recovered data	A recoverable read error occurred at LBA <address>-<address> when checking parity on VD <name>.
WARNING	Scrub parity recovered	The parity at LBA <address>-<address> is regenerated when checking parity on VD <name>.
INFO	PD freed	PD <slot> has been freed from RG <name>.
INFO	RG imported	Configuration of RG <name> has been imported.
INFO	RG restored	Configuration of RG <name> has been restored.
INFO	VD restored	Configuration of VD <name> has been restored.
INFO	PD scrub started	PD <slot> starts disk scrubbing process.
INFO	Disk scrub finished	PD <slot> completed disk scrubbing process.
INFO	Large RG created	A large RG <name> with <number> disks included is created
INFO	Weak RG created	A RG <name> made up disks across <number> chassis is created
INFO	RG size shrunk	The total size of RG <name> shrunk
INFO	VD erase finished	VD <name> finished erasing process.
WARNING	VD erase failed	The erasing process of VD <name> failed.
INFO	VD erase started	VD <name> starts erasing process.
WARNING	RG disk missing	RG <name> can not be activated because of missing disks.
ERROR	PD VD read write fault	Read error at LBA <address>-<address> of PD <slot> and rewrite failed at LBA <address>-<address> of VD <name>.
ERROR	PD IO retry fault	Over I/O retry limit in last 10 minutes on PD <slot>, replacing the disk is highly recommended.
ERROR	PD substitute L2L	Over I/O retry limit in last 10 minutes on PD <slot>, the disk is disabled for automatic rebuilding with PD <slot>.

Snapshot Events

Level	Type	Description
WARNING	Snap mem	Failed to allocate snapshot memory for VD <name>.
WARNING	Snap space overflow	Failed to allocate snapshot space for VD <name>.
WARNING	Snap threshold	The snapshot space threshold of VD <name> has been reached.
INFO	Snap delete	The snapshot VD <name> has been deleted.
INFO	Snap auto delete	The oldest snapshot VD <name> has been deleted to obtain extra snapshot space.
INFO	Snap take	A snapshot on VD <name> has been taken.
INFO	Snap set space	Set the snapshot space of VD <name> to <number> MB.
INFO	Snap rollback started	Snapshot rollback of VD <name> has been started.
INFO	Snap rollback finished	Snapshot rollback of VD <name> has been finished.
WARNING	Snap quota reached	The quota assigned to snapshot <name> is reached.
INFO	Snap clear space	The snapshot space of VD <name> is cleared

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iSCSI Events

Level	Type	Description
INFO	iSCSI login accepted	iSCSI login from <IP> succeeds.
INFO	iSCSI login rejected	iSCSI login from <IP> was rejected, reason [<string>]
INFO	iSCSI logout recvd	iSCSI logout from <IP> was received, reason [<string>].

Battery Backup Events

Level	Type	Description
INFO	BBM start syncing	Abnormal shutdown detected, start flushing battery-backed data (<number> KB).
INFO	BBM stop syncing	Abnormal shutdown detected, flushing battery-backed data finished
INFO	BBM installed	Battery backup module is detected
INFO	BBM status good	Battery backup module is good
INFO	BBM status charging	Battery backup module is charging
WARNING	BBM status fail	Battery backup module is failed
INFO	BBM enabled	Battery backup feature is <string>.
INFO	BBM inserted	Battery backup module is inserted
INFO	BBM removed	Battery backup module is removed

JBOD Events

Level	Type	Description
INFO	PD upgrade started	JBOD <name> PD [<string>] starts upgrading firmware process.
INFO	PD upgrade finished	JBOD <name> PD [<string>] finished upgrading firmware process.
WARNING	PD upgrade failed	JBOD <name> PD [<string>] upgrade firmware failed.
INFO	PD freed	JBOD <name> PD <slot> has been freed from RG <name>.
INFO	PD inserted	JBOD <name> disk <slot> is inserted into system.
Warning	PD removed	JBOD <name> disk <slot> is removed from system.
ERROR	HDD read error	JBOD <name> disk <slot> read block error
ERROR	HDD write error	JBOD <name> disk <slot> write block error
ERROR	HDD error	JBOD <name> disk <slot> is disabled.
ERROR	HDD IO timeout	JBOD <name> disk <slot> gets no response
INFO	JBOD inserted	JBOD <name> is inserted into system
WARNING	JBOD removed	JBOD <name> is removed from system
WARNING	JBOD SMART T.E.C	JBOD <name> disk <slot>: S.M.A.R.T. Threshold Exceed Condition occurred for attribute <string>
WARNING	JBOD SMART fail	JBOD <name> disk <slot>: Failure to get S.M.A.R.T information
INFO	JBOD CTR inserted	Controller(<number>) of JBOD <name> is inserted into system
WARNING	JBOD CTR is removed	Controller(<number>) of JBOD <name> is removed from system
WARNING	JBOD degraded	JBOD <name> is in degraded mode.
INFO	PD dedicated spare	Assign JBOD <name> PD <slot> to be the dedicated spare disk of RG <name>.

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INFO	PD global spare	Assign JBOD <name> PD <slot> to Global Spare Disks.
ERROR	Config read fail	Config read error occurred at LBA <address>-<address> of JBOD <name> PD <slot>.
ERROR	Config write fail	Config write error occurred at LBA <address>-<address> of JBOD <name> PD <slot>.
DEBUG	PD read error	Read error occurred at LBA <address>-<address> of JBOD <name> PD <slot>.
WARNING	PD write error	Write error occurred at LBA <address>-<address> of JBOD <name> PD <slot>.
INFO	PD scrub started	JBOD <name> PD <slot> starts disk scrubbing process.
INFO	PD scrub completed	JBOD <name> PD <slot> completed disk scrubbing process.
WARNING	PS fail	Power Supply of <string> in JBOD <name> is FAIL
INFO	PS normal	Power Supply of <string> in JBOD <name> is NORMAL
WARNING	FAN fail	Cooling fan of <string> in JBOD <name> is FAIL
INFO	FAN normal	Cooling fan of <string> in JBOD <name> is NORMAL
WARNING	Volt warn OV	Voltage of <string> read as <string> in JBOD <name> is WARN OVER
WARNING	Volt warn UV	Voltage of <string> read as <string> in JBOD <name> is WARN UNDER
WARNING	Volt crit OV	Voltage of <string> read as <string> in JBOD <name> is CRIT OVER
WARNING	Volt crit UV	Voltage of <item> read as <string> in JBOD <name> is CRIT UNDER
INFO	Volt recovery	Voltage of <string> in JBOD <string> is NORMAL
WARNING	Therm warn OT	Temperature of <string> read as <string> in JBOD <name> is OT WARNING
WARNING	Therm warn UT	Temperature of <string> read as <string> in JBOD <name> is UT WARNING
WARNING	Therm fail OT	Temperature of <string> read as <string> in JBOD <name> is OT FAILURE
WARNING	Therm fail UT	Temperature of <string> read as <string> in JBOD <name> is UT FAILURE
INFO	Therm recovery	Temperature of <string> in JBOD <name> is NORMAL
INFO	JBOD HDD path NG	Path redundancy to JBOD <name> PD <number> is lost
INFO	PD RPS started L2F	Assign JBOD <name> PD <slot> to replace PD <slot>.
INFO	PD RPS started F2L	Assign PD <slot> to replace JBOD <name> PD <slot>.
INFO	PD RPS started F2F	Assign JBOD <name> PD <slot> to replace JBOD <name> PD <slot>.
INFO	PD RPS finished L2F	PD <slot> is replaced by JBOD <name> PD <slot>.
INFO	PD RPS finished F2L	JBOD <name> PD <slot> is replaced by PD <slot>.
INFO	PD RPS finished F2F	JBOD <name> PD <slot> is replaced by JBOD <name> PD <slot>.
ERROR	PD RPS failed L2F	Failed to replace PD <slot> with JBOD %4d PD <slot>.
ERROR	PD RPS failed F2L	Failed to replace JBOD <name> PD <slot> with PD <slot>.
ERROR	PD RPS failed F2F	Failed to replace JBOD <name> PD <slot> with JBOD <name> PD <slot>.
ERROR	PD VD read write fault	Read error at LBA <address>-<address> of JBOD <name> PD <slot> and rewrite failed at LBA <address>-<address> of VD <name>.

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ERROR	PD IO retry fault	Over I/O retry limit in last 10 minutes on JBOD <name> PD <slot>, replacing the disk is highly recommended.
ERROR	PD substitute L2F	Over I/O retry limit in last 10 minutes on PD <slot>, the disk is disabled for automatic rebuilding with JBOD <name> PD <slot>.
ERROR	PD substitute F2L	Over I/O retry limit in last 10 minutes on JBOD <name> PD <slot>, the disk is disabled for automatic rebuilding with PD <slot>.
ERROR	PD substitute F2F	Over I/O retry limit in last 10 minutes on JBOD <name> PD <slot>, the disk is disabled for automatic rebuilding with JBOD <name> PD <slot>.

System Maintenance Events

Level	Type	Description
INFO	System shutdown	System shutdown.
INFO	System reboot	System reboot.
INFO	System console shutdown	System shutdown from <string> via Console UI
INFO	System web shutdown	System shutdown from <string> via Web UI
INFO	System button shutdown	System shutdown via power button
INFO	System LCM shutdown	System shutdown via LCM
INFO	System console reboot	System reboot from <string> via Console UI
INFO	System web reboot	System reboot from <string> via Web UI
INFO	System LCM reboot	System reboot via LCM
INFO	FW upgrade start	System firmware upgrade starts.
INFO	FW upgrade success	System firmware upgrade succeeds.
WARNING	FW upgrade failure	System firmware upgrade is failed.
ERROR	IPC FW upgrade timeout	System firmware upgrade timeout on another controller
INFO	Config imported	<string> config imported

HAC Events

Level	Type	Description
INFO	RG owner changed	The preferred owner of RG <name> has been changed to controller <number>.
INFO	Force CTR write through	Controller <number> forced to adopt write-through mode on failover.
INFO	Restore CTR cache mode	Controller <number> restored to previous caching mode on failback.
INFO	Failover complete	All volumes in controller <number> completed failover process.
INFO	Failback complete	All volumes in controller <number> completed failback process.
INFO	CTR inserted	Controller <number> is inserted into system

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ERROR	CTR removed	Controller <number> is removed from system
ERROR	CTR timeout	Controller <number> gets no response
ERROR	CTR lockdown	Controller <number> is locked down
ERROR	CTR memory NG	Memory size mismatch
ERROR	CTR firmware NG	Firmware version mismatch
ERROR	CTR lowspeed NG	Low speed inter link is down
ERROR	CTR highspeed NG	High speed inter link is down
ERROR	CTR backend NG	SAS expander is down
ERROR	CTR frontend NG	FC IO controller is down
INFO	CTR reboot FW sync	Controller reboot, reason [Firmware synchronization completed]

Clone Events

Level	Type	Description
INFO	VD clone started	VD <name> starts cloning process.
INFO	VD clone finished	VD <name> finished cloning process.
WARNING	VD clone failed	The cloning in VD <name> failed.
INFO	VD clone aborted	The cloning in VD <name> was aborted.
INFO	VD clone set	The clone of VD <name> has been designated.
INFO	VD clone reset	The clone of VD <name> is no longer designated.
WARNING	Auto clone error	Auto clone task: <string>.
WARNING	Auto clone no snap	Auto clone task: Snapshot <name> is not found for VD <name>.

QReplica Events

Level	Type	Description
INFO	Qrep portal enabled	Replication portal is enabled
INFO	Qrep portal disabled	Replication portal is disabled
INFO	VD replicate started	VD <name> starts replication process.
INFO	VD replicate finished	VD <name> finished replication process.
WARNING	VD replicate failed	The replication in VD <name> failed.
INFO	VD replicate aborted	The replication in VD <name> was aborted.
INFO	VD set as replica	VD <name> has been configured as a replica.
INFO	VD set as RAID	VD <name> has been configured as a RAID volume.
INFO	VD replica set	The replica of VD <name> has been designated.
INFO	VD replica reset	The replica of VD <name> is no longer designated.
WARNING	Auto qrep not enable	Auto QReplica task: QReplica is not enabled for VD <name>.
WARNING	Auto qrep error	Auto QReplica task: <string>.
WARNING	Auto qrep no snap	Auto QReplica task: Snapshot <name> is not found for VD <name>.
INFO	Source replicate started	Remote VD <name> starts replicating to VD <name>.
INFO	Source replicate finished	Remote VD <name> finished replication to VD <name>.

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INFO	Source replicate failed	Remote VD <name> failed replication to VD <name>.
INFO	Source replicate aborted	Remote VD <name> aborted replication to VD <name>.

QThin Events

Level	Type	Description
WARNING	RG threshold hit	The used capacity of RG <name> exceeds <number> percent.
INFO	RAID set created	RAID set <number> has been added into RG <name>.
INFO	RAID set deleted	RAID set <number> was deleted from RG <name>.
INFO	VD reclaim started	VD <name> starts space reclamation process.
INFO	VD reclaim completed	VD <name> finished space reclamation process.
WARNING	VD reclaim aborted	The space reclamation in VD <name> was aborted.

- DEBUG level events are displayed in download event log file only.

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Glossary and Acronym List

Common Terminology

Item	Description
RAID	Redundant Array of Independent Disks. There are different RAID levels with different degree of data protection, data availability, and performance to host environment.
PD	The Physical Disk belongs to the member disk of one specific RAID group.
RG	Raid Group. A collection of removable media. One RAID group consists of a set of virtual disks and owns one RAID level attribute.
VD	Virtual Disk. Each RAID group could be divided into several virtual disks. The virtual disks from one RAID group have the same RAID level, but may have different volume capacity.
LUN	Logical Unit Number. A logical unit number (LUN) is a unique identifier which enables it to differentiate among separate devices (each one is a logical unit).
GUI	Graphic User Interface.
RAID cell	When creating a RAID group with a compound RAID level, such as 10, 30, 50 and 60, this field indicates the number of subgroups in the RAID group. For example, 8 disks can be grouped into a RAID group of RAID 10 with 2 cells, 4 cells. In the 2-cell case, PD {0, 1, 2, 3} forms one RAID 1 subgroup and PD {4, 5, 6, 7} forms another RAID 1 subgroup. In the 4-cells, the 4 subgroups are physical disk {0, 1}, physical disk {2, 3}, physical disk {4, 5} and physical disk {6,7}.
WT	Write-Through cache-write policy. A caching technique in which the completion of a write request is not signaled until data is safely stored in non-volatile media. Each data is synchronized in both data cache and accessed physical disks.
WB	Write-Back cache-write policy. A caching technique in which the completion of a write request is signaled as soon as the data is in cache and actual writing to non-volatile media occurs at a later time. It speeds up system write performance but needs to bear the risk where data may be inconsistent between data cache and the physical disks in one short time interval.
RO	Set the volume to be Read-Only.
DS	Dedicated Spare disks. The spare disks are only used by one specific RAID group. Others could not use these dedicated spare disks for any rebuilding purpose.
LS	Local Spare disks. The spare disks are only used by the RAID groups of the local enclosure. Other enclosure could not use these local spare disks for any rebuilding purpose.
GS	Global Spare disks. It is shared for rebuilding purpose. If some RAID groups need to use the global spare disks for rebuilding, they could get the spare disks out from the common spare disks pool for such requirement.
DG	DeGraded mode. Not all of the array's member disks are functioning, but the array is able to respond to application read and write requests to its

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	virtual disks.
SCSI	Small Computer Systems Interface
SAS	Serial Attached SCSI
S.M.A.R.T.	Self-Monitoring Analysis and Reporting Technology
WWN	World Wide Name
HBA	Host Bus Adapter
SES	SCSI Enclosure Services
NIC	Network Interface Card
BBM	Battery Backup Module

FC / iSCSI / SAS Terminology

Item	Description
FC	Fibre Channel
FC-P2P	Point-to-Point
FC-AL	Arbitrated Loop
FC-SW	Switched Fabric
iSCSI	Internet Small Computer Systems Interface
LACP	Link Aggregation Control Protocol
MPIO	Multi-Path Input/Output
MC/S	Multiple Connections per Session
MTU	Maximum Transmission Unit
CHAP	Challenge Handshake Authentication Protocol. An optional security mechanism to control access to an iSCSI storage system over the iSCSI data ports.
iSNS	Internet Storage Name Service
SAS	Serial Attached SCSI

Dual Controller Terminology

Item	Description
SBB	Storage Bridge Bay. The objective of the Storage Bridge Bay Working Group (SBB) is to create a specification that defines mechanical, electrical and low-level enclosure management requirements for an enclosure controller slot that will support a variety of storage controllers from a variety of independent hardware vendors (“IHVs”) and system vendors.
6G MUX	Bridge board is for SATA II disk to support dual controller mode.

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